

Chemtura

An alternative to MbOCA in the context of REACH authorisation

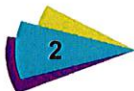
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1. Introduction

1.1 Purpose of this report

This report has been prepared by Amec Foster Wheeler for Chemtura in the context of the EU's REACH Regulation. Chemtura currently import and supply 4, 4'-methylene-bis-ortho-(2-chloroaniline) or MbOCA¹ (CAS No: 101-14-4, EC no.: 202-918-9, 2,2'-dichloro-4,4'-methylenedianiline) and supply this in the EU, as part of an overall polyurethane (PU) system. MbOCA was categorised as a Substance of Very High Concern (SVHC) in November 2011 and entered into Annex XIV of REACH in August 2014². As such, MbOCA will be subject to a requirement for Authorisation under REACH, and had a latest application date of 22 May 2016 and a sunset date of 22 November 2017³.

MbOCA is typically used with either TDI or LFTDI prepolymers as a 2-component system to produce cast polyurethanes. MDI and LFMDI prepolymers also make up a large proportion of the prepolymers used for cast polyurethanes and the PU processor is often able to choose between TDI or MDI based systems. In addition to the prepolymer, a curative is required to produce the PU product; MbOCA is such a curative,

Chemtura has identified the following as a viable alternative 2-component system:

- ▶ Low free monomer MDI (LFMDI) as the prepolymer, in combination with; and
- ▶ HQEE curative (hydroquinone di(beta-hydroxyethyl)ether) (CAS 104-38-1, EC Number: 203-197-3, 2,2'-p-Phenylenedioxydiethanol).

The alternative is therefore an alternative curative (HQEE), but used as part of an overall alternative system. The primary focus of this report is on the LFMDI/HQEE system, which Chemtura believes can meet the most demanding applications for cast polyurethanes in which MbOCA is used. There are other cast polyurethane systems that are available, supplied by Chemtura and others (e.g. DMTDA, which can be used with TDI/LFTDI prepolymers; and also MDI prepolymers with BDO (CAS Number: 110-63-4, EC Number: 203-786-5, 1,4-butanediol)). These other systems can be used for various applications, but are not the primary focus of the present report.

Chemtura has historically been a supplier of MbOCA and has registered the substance under REACH. However, Chemtura is now encouraging customers to switch to alternatives in Europe. Chemtura is not planning to purchase any more MbOCA after June 2017 for use or supply in Europe and to have Chemtura's entire EU supply chain free of MbOCA by the sunset date.

Chemtura does not chemically produce the final polyurethane (PU) elastomer, but rather the prepolymers (including LFMDI, the focus of the current report, but also other prepolymers e.g. based on TDI, LFTDI or MDI). LFMDI prepolymers are produced through reaction of monomers to an intermediate molecular weight state. The prepolymer is then further polymerised to its high molecular weight state by downstream cast polyurethane processors.

This report examines the feasibility of substituting the 2-component MbOCA-based systems with the 2-component LFMDI prepolymer/HQEE system. Both systems are used in the manufacture of cast polyurethane (PU) products which subsequently form part of a large number of components, such as tyres, wheels, recreation and oil and gas/mining applications across the EU.

¹ MbOCA is often abbreviated to "MOCA", however the term MbOCA is used in this report as "MOCA" is a registered trade name of E I Du Pont de Nemours (DuPont Chemical Corporation).

² <http://echa.europa.eu/identification-of-svhc/-/substance-rev/2216/term?searchname=2%2C2%27-dichloro-4%2C4%27-methylenedianiline+%28MOCA%29&searchecnumber=202-918-9>

³ <http://echa.europa.eu/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list/-/substance-rev/76/term?searchname=2%2C2%27-dichloro-4%2C4%27-methylenedianiline+%28MOCA%29&searchecnumber=202-918-9>

The assessment follows the European Chemicals Agency (ECHA's) suggested format for submission of information on alternatives as part of the public consultation on authorisation applications⁴. It has been prepared, taking into account relevant guidance on socio-economic analysis (SEA) under REACH and on assessment of the economic feasibility of alternatives⁵.

This present version of the report has been prepared for review by Chemtura. It has been updated following publication of the application for authorisation in November 2016. Once finalised, it will be submitted to ECHA by Chemtura. Chemtura will need to decide whether it is submitted as is whereupon its contents will be in the public domain, or is submitted confidentially.

1.2 Overview of cast polyurethanes

The following explains in a concise but precise manner the chemical approach related to the manufacture of final PU components / PU articles within the cast PU industry.

Firstly, final components/articles manufactured from cast polyurethane elastomers are derived from reacting a 'prepolymer' with a 'curative'.

Typical isocyanate prepolymers, which account for 90% or more of European prepolymer sales include those based on:

- ▶ Toluene diisocyanate, known as **TDI** (CAS Number: 26471-62-5 (mixed isomer TDI) or 584-84-9 (4-methyl-m-phenylene diisocyanate))
- ▶ Low free toluene diisocyanate, known as **LFTDI** (using the same monomers as conventional TDI prepolymers but with the residual monomer levels reduced to below 0.1%)
- ▶ Methylenediphenyl diisocyanate, known as **MDI** (CAS Number: 101-68-8, 4,4'-Methylenediphenyl diisocyanate)
- ▶ Low free methylenediphenyl diisocyanate, known as **LFMDI** (using the same monomers as conventional MDI prepolymers but with the residual monomer levels reduced to below 1%)

Typical curatives which account for 95% or more of European curative sales include;

- ▶ **MOCA / MBOCA**
- ▶ **DMTDA**, better known as **Ethacure® 300**⁶
- ▶ **1,4-Butanediol**, better known as **BDO**
- ▶ **HQEE**

More specialised curatives include:

- ▶ **M-CDEA** (CAS Number: 106246-33-7, 4,4-methylenebis-3-(chloro-2,6-diethyl)-aniline)
- ▶ **Addolink® 1604 HW**

⁴ http://echa.europa.eu/documents/10162/13555/instructions_third_parties_afa_en.pdf

⁵ Guidance on the preparation of socio-economic analysis as part of the application for Authorisation:
http://echa.europa.eu/documents/10162/13643/sea_authorisation_en.pdf

See also: ECHA's supplementary guidance on 'How the Committee for Socio-Economic Analysis will evaluate economic feasibility in applications for authorisation':

http://echa.europa.eu/documents/10162/13580/seac_authorisations_economic_feasibility_evaluation_en.pdf

⁶ Ethacure® 300 is a registered trademark of Albermarle Corporation.

Secondly, prepolymers are chemically reacted with curatives to form the cast polyurethane. TDI / LFTDI prepolymers are reacted with aromatic diamine curatives whereas MDI / LFMDI / Quasi MDI prepolymers are reacted with diol curatives. In summary:

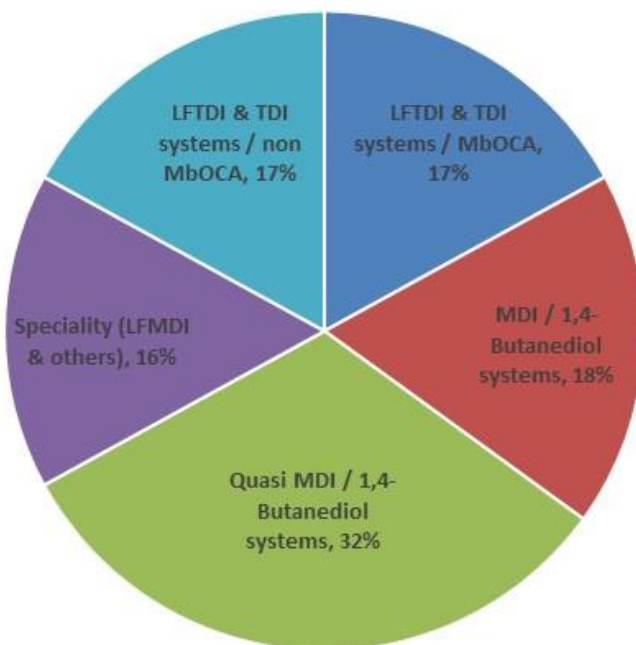
Table 1.1 Prepolymers and curatives in the cast PU industry

Prepolymer	Aromatic diamines	Diols
TDI / LFTDI	MOCA / MbOCA	
	DMTDA	
	M-CDEA	
	Addolink 1604 HW	
MDI / LFMDI / Quasi MDI		1,4-Butanediol
		HQEE

All of the above curatives are utilised within the EEA. They are functional and effective and have been widely used for many years.

The percentage split of the EEA cast PU industry utilising the above prepolymer / curative systems is shown in the pie chart below.

Figure 1.1 European cast PU industry by PU system technology, 2016



Source: Chemtura, 15 November 2016

Thus, the extent of use in the cast PU industry in Europe with respect to the use of various curatives is:

- ▶ DMTDA accounts for approximately 17%.
- ▶ 1,4-Butanediol accounts for approximately 50%.



- ▶ Speciality accounts for approximately 16%.
- ▶ MbOCA accounts for approximately 17%

Chemtura's view is that, in all final applications, MbOCA could be substituted. It is important to note that 83% of the EEA region does not use MbOCA and has been proactive in either not using this curative or successful in transitioning away from this curative.

1.3 Methodology

The study is based on a review of publicly available information on the implications of substituting MbOCA as part of both TDI prepolymer and LFTDI prepolymer cast PU applications. This has been supplemented with interviews with Chemtura technical and commercial staff and interviews with companies who have historically used MbOCA based systems and have successfully adopted the alternative system, as well as extensive internal data available from Chemtura. A wider survey has not been undertaken.

The analysis takes into account the following factors:

- ▶ The technical steps for replacement and their associated timescales and costs (where these are available);
- ▶ The relative prices of MbOCA and LFMDI prepolymer +HQEE systems, including the quantities needed and the extent to which any costs increases are likely to be absorbed along the supply chain or passed on to customers, potentially leading to higher prices paid by the end users⁷;
- ▶ 'Other' costs such as product testing and regulatory approvals, and consequent implications for 'affordability' in the context of REACH socio-economic analysis;
- ▶ The costs of substitution are compared with the numbers of firms involved in the EU cast PU processing industry, to identify costs to the industry as a whole at the point of use; and
- ▶ Anticipated supply and demand for the alternative substance and consequent implications for 'availability' in the context of REACH socio-economic analysis is also assessed.

Separate analyses have been undertaken for those transitioning from MbOCA based TDI and LFTDI prepolymer systems, within the economic feasibility chapter - as the cost implications differ - as far as available evidence allows.

1.4 Contents

Following this introduction:

- ▶ Section 2 identifies the alternative and its properties, based on the 'guidance for identification of substances under REACH and CLP'⁸;
- ▶ The technical feasibility of the LFMDI prepolymer/HQEE system to fulfil the same function as TDI and LFTDI prepolymer/MbOCA based systems in cast PU applications is assessed in section 3;
- ▶ The economic feasibility of the alternative system is examined in section 4;
- ▶ Section 5 evaluates the hazards and risks of the alternative system compared to MbOCA based systems;

⁷ Note that there are other alternatives that will be (and are being) used by the cast polyurethane industry, particularly for less demanding applications (e.g. Ethacure 300 with TDI prepolymers).

⁸ http://www.echa.europa.eu/documents/10162/13643/substance_id_en.pdf



- ▶ Section 6 examines the availability of the alternative system, based on expected supply and demand in the EU. Details of assumptions made are provided; and
- ▶ Study conclusions are provided in section 7.

2. Alternative ID and properties

2.1 Overview

MbOCA is typically used with toluene diisocyanate (TDI) prepolymers as a 2-component system. Besides more commonly known alternatives such as TDI/LFTDI prepolymers with curatives such as DMTDA and others, Chemtura has identified the following as a viable alternative 2-component system:

- ▶ Low free monomer MDI (LFMDI) as the prepolymer, in combination with
- ▶ HQEE curative (hydroquinone di(beta-hydroxyethyl)ether) (CAS 104-38-1).

Chemtura's testing has indicated that this alternative system is able to match the technical performance of MbOCA-based systems in all applications, whereas some of the other potential alternatives cannot.

In practice, LFMDI prepolymers may be used with other curatives, but for simplicity we have concentrated on use of HQEE here as this is considered by Chemtura to represent the most effective alternative system.

Initially Chemtura developed a curative referred to as Vibracure® A260, which contained a high concentration of HQEE with an additive to overcome issues with MDI processing. This was then supplemented with Vibracure® A263 (containing a higher HQEE concentration), though this still required some conversion costs by customers, related to uploading into the plant. More recently, Chemtura has worked with its suppliers to develop Vibracure® 2101, which is the highest concentration of HQEE. Vibracure® 2101 is supplied as granules, which can be used in exactly the same equipment as MbOCA-based systems, avoiding the need for conversion costs by customers.

The alternative is therefore an alternative curative to MbOCA (i.e. HQEE), but used as part of an overall alternative system in which the prepolymer is also changed from TDI or LFTDI to LFMDI.

The following sections outline further information on the alternative, in line with the guidance provided by ECHA on submission of alternatives.

2.2 Identification of the substance

The table below summarises some of the key properties of HQEE taking into account Annex VI of the REACH Regulation. Information on the technical properties of LFMDI prepolymers, using some of the most popular variants as examples, is provided in the technical data sheets included as Appendix A.

Table 2.1 Information on identification of HQEE

	HQEE
Name	2,2'-p-phenylenedioxydiethanol
EC number	203-197-3
CAS number	104-38-1
Molecular formula	C ₁₀ H ₁₄ O ₄
Physical state (20°C)	Solid
Melting point	99°C
Boiling point	194°C
Density	1.264 at 20°C
Vapour pressure	< 0.45 Pa at 45°C
Flammability	Not flammable.

Source: HQEE data based on ECHA dissemination website (accessed 19/03/2015).

2.3 Information on manufacture and uses

Chemtura does not chemically produce the final polyurethane (PU) elastomer, but rather the prepolymer (LFMDI), through reaction of monomers to an intermediate molecular weight state. The prepolymer, via the addition of a curative, is then further polymerised to its high molecular weight state by cast polyurethane processors.

As with MbOCA-based systems, the alternative proposed uses a catalyst. The LFMDI prepolymer/HQEE system allows the use of mercury-free catalysts.

Further details on the quantities of the alternative are provided in the section on 'availability'.

2.4 Classification and labelling

Information on the classification and labelling of HQEE and LFMDI prepolymers under the CLP Regulation are set out below. Note that LFMDI prepolymers, unlike MDI monomer itself, is not classified as a carcinogen, due to the very low concentration of residual monomer.

Table 2.2 Information on classification of LFMDI prepolymers and HQEE

	HQEE	LFMDI prepolymers
Physical hazards	Not classified	Not classified
Health hazards	Not classified ^[Note 1]	Cat 1 respiratory sensitiser (at $\geq 0.1\%$ MDI) ^[Note 2]
Environmental hazards	Not classified	Not classified

Table notes: [1] No harmonised classification. According to the classification provided by companies to ECHA in REACH registrations this substance is harmful to aquatic life with long lasting effects. [2] The concentration of MDI in LFMDI is in the range $\geq 0.1\%$ to 1% . Therefore while MDI is classified as a Category 2 carcinogen, LFMDI is not (free MDI is less than 1% and this classification does not apply as per section 3.6.3.1 of Annex I to the CLP Regulation).

2.5 Guidance on safe use

Safety data sheets for HQEE and LFMDI prepolymers are provided in Appendix A to this document.

3. Technical feasibility

3.1 Uses of MbOCA

One application for authorisation of MbOCA use has been submitted to ECHA and published as part of a consultation process. The application was submitted by REACHLaw Ltd in its legal capacity as Only Representative of Suzhou Xiangyuan Special Fine Chemical Co., Ltd. The applied for use is for "industrial use of MbOCA as a curing agent/chain extender in cast polyurethane elastomer production."

The authorisation application covers the use of MbOCA as a curative in hot cast polyurethane (PU) products, covering activities (uses) undertaken by both the system providers and by PU processors (undertaking moulding activities). The application essentially covers all current use of MbOCA in hot cast polyurethanes.

MbOCA is combined with a prepolymer (plus a catalyst) to produce PU elastomer. Prepolymers used with MbOCA are typically produced from toluene di-isocyanate (TDI) and a polyether or polyester polyol. Polyurethane products are made by filling a mould with the heated liquid resin (prepolymer plus curative), which then hardens to produce the cast polyurethane part. Typical products in which MbOCA-based cast polyurethanes are used in are:

- ▶ Rolls;
- ▶ Wheels;
- ▶ Hydrocyclones;
- ▶ Dynamic bend stiffeners;
- ▶ Power transmission belts;
- ▶ Vibratory bowls for metal finishing;
- ▶ Gaskets;
- ▶ Pump impellers;
- ▶ Pipeline pigs;
- ▶ Belt scrapers;
- ▶ Snow plough blades;
- ▶ Internal pipe liners;
- ▶ Die pads;
- ▶ Railway components; and
- ▶ Bushings.

There are clearly a huge range of different products. In some cases, the final article may be predominantly made from polyurethane (e.g. wheels), or the polyurethane may form only a small part of the end-product produced by polyurethane processors (e.g. pipeline pigs).

3.2 Using Chemtura's alternative for the use in question

Overview

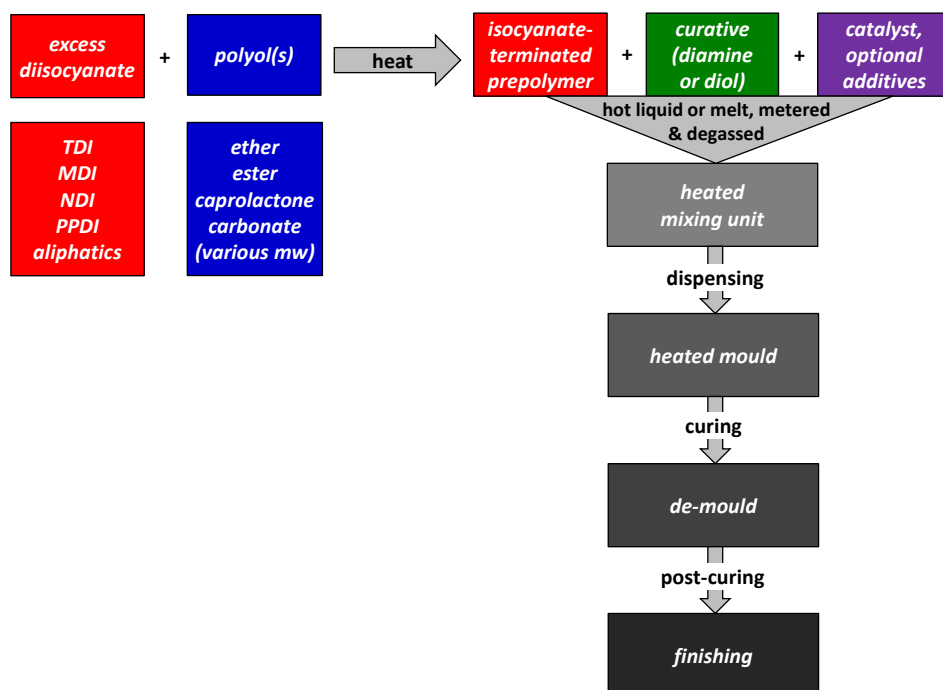
In line with ECHA's guidance, this section describes the functions or tasks performed by the alternative for the use in question. It includes details of the process and the process conditions under which the function is performed. It shows how the alternative meets the functional requirements for replacement of MbOCA and

covers key functional requirements such as critical substance properties related to achieving the desired (equivalent) function, quality criteria, process and performance constraints, and customer requirements for technical acceptability.

MDI prepolymer systems are cured with diol-type curatives, unlike TDI prepolymers which are typically cured with diamines or triols. The system proposed by Chemtura is LFMDI prepolymer cured with the diol HQEE.

The figure below provides a schematic of the steps involved in a typical hot cast PU elastomer processing activity. System providers such as Chemtura supply the raw materials including the prepolymer and the curative and catalyst. PU processors then undertake the processing of these into moulded products.

Figure 3.1 Basic processing steps for hot cast polyurethane elastomers



Source: Chemtura.

Critical substance properties

The main advantages of MbOCA in polyurethane systems are:

- ▶ Long pot-life – giving adequate time to mix, pour and fill the mould;
- ▶ Robust processing – the cast PU product is not affected by small errors in stoichiometry;
- ▶ Reliable processing – there are no significant issues with moisture control and the low viscosity allows ready flow into moulds;
- ▶ Performance – tough, durable elastomers are easily obtained⁹;
- ▶ Catalysis – the ability to catalyse the reaction is important for production efficiency;
- ▶ Multifunctional – it can be used with TDI-ester prepolymer & TDI-ether prepolymer systems;
- ▶ Economical – favourably priced compared with other curatives; and

⁹ As set out in the authorisation application, these include abrasion and cut resistance; humidity, hydrolysis, heat, cut and tear resistance, UV resistance, ozone resistance, and resistance to radiation.

- ▶ Track Record – TDI prepolymer/MbOCA systems have a long history of successful use and customer confidence.

Chemtura believe that all of these properties can be met with the alternative, LFMDI prepolymer/HQEE.

'Critical properties' required of end (cast polyurethane) products include:

- ▶ For ester-based products: wear resistance, load bearing, tear strength, heat resistance, oxidative resistance, radiation stability, weathering resistance, crystallisation rate, and adhesion to substrates; and
- ▶ For ether-based products: hysteresis, resilience, low temperature flexibility and hydrolytic stability.

Different applications will require different combinations of these properties. Alternative PU products without MbOCA will need to be usable within both of these system types, and to provide equivalent properties against each of the properties that are important for a given application (the relative importance of each parameter varies from use to use).

Some MbOCA-based PU systems are for highly technically demanding applications (as highlighted above) and an alternative needs to be equally effective in such applications.

HQEE is used with a range of different ether or ester based LFMDI prepolymers, to give products with a range of different hardness values. Hardness is the primary parameter that is used when choosing a polyurethane system for a particular application. A listing of equivalent prepolymers to common TDI prepolymer/MbOCA systems is provided below:

Ether systems:

- ▶ ADIPRENE® LFM E265 (hardness 80A);
- ▶ ADIPRENE® LFM E295 (hardness 85A);
- ▶ ADIPRENE® LFM E370 (hardness 90A);
- ▶ ADIPRENE® LFM E450 (hardness 93A);
- ▶ ADIPRENE® LFM E500 (hardness 95A);
- ▶ ADIPRENE® LFM E615 (hardness 55D);
- ▶ ADIPRENE® LFM E730 (hardness 60D); and
- ▶ ADIPRENE® LFM E760 (hardness 70D).

Ester systems:

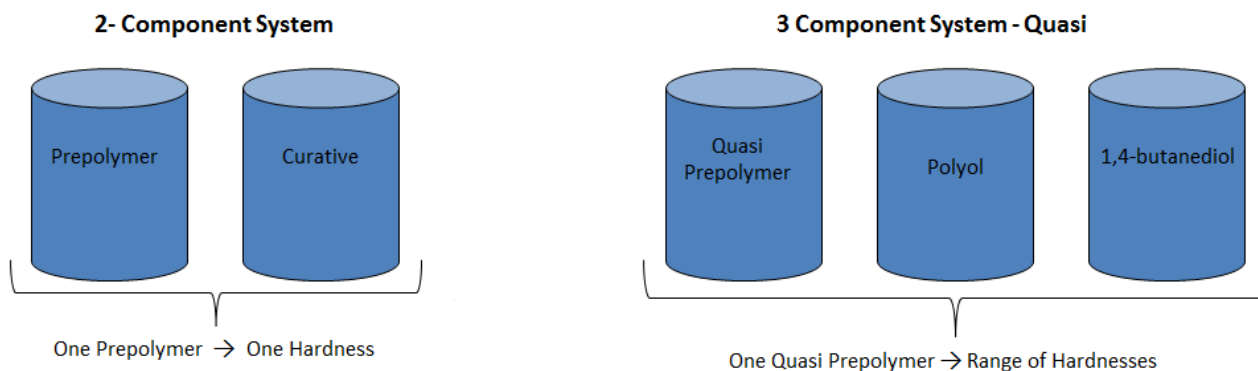
- ▶ ADIPRENE® LFM S345 (hardness 85A); and
- ▶ ADIPRENE® LFM S430 (hardness 90A).

As with TDI prepolymer/MbOCA, the LFMDI prepolymer/HQEE system needs catalysis, which is desirable as it gives the polyurethane processor the ability to control the pot life duration. This catalysis allows the user to rapidly de-mould products (i.e. the process can be quicker-reacting than MbOCA systems, if desired).

Details of process conditions and constraints

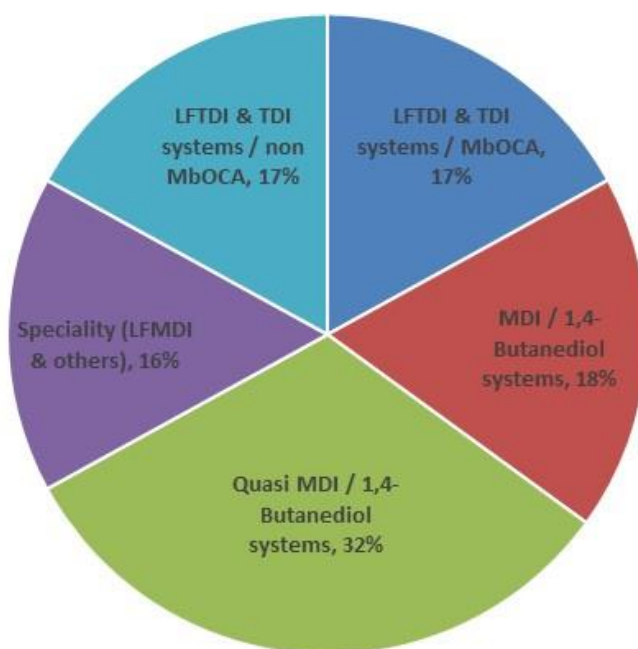
MbOCA is used in production lines that combine the prepolymer and the curative using a meter mix machine. 'Quasi' systems make up a substantial part of cast polyurethanes and are 3 component systems, unlike TDI prepolymer/MbOCA and LFMDI prepolymer/HQEE which are both 2-component systems. The components of 2 and 3 component systems are illustrated below.

Figure 3.2 Illustration of 2 and 3 component cast polyurethane systems



Quasi systems are another form of MbOCA-free chemistry and these make up around a third of cast polyurethanes in Europe, as illustrated in the figure below.

Figure 3.3 European cast polyurethane industry by PU system technology



Source: Chemtura, 15 November 2016.

Most polyurethane producers have capital equipment set up to process TDI prepolymer plus MbOCA as a 2-component system (prepolymer plus curative), with dispensing and metering equipment for each component. The Quasi (3-component) type uses different processing equipment (e.g. requiring 3 meter-mix lines). Unlike Quasi systems, which are offered by some firms as possible alternatives to TDI prepolymer/MbOCA systems, the use of LFMDI prepolymer/HQEE can be done in the same equipment.

3-component Quasi systems are alternatives to MbOCA-based systems for some cast PU products and indeed are being offered as alternatives by some companies. In Europe, Quasi systems already comprise over 30% of cast PU systems, although they are not considered to be technically suitable alternatives for the full range of MbOCA-based systems, as they have only more 'general purpose' properties, and have shorter shelf-lives compared to 2-component systems.

Unlike the rest of the world, the majority of cast PU systems used in Europe are already MbOCA-free.

Chemtura estimates that, of sales of cast polyurethane in Europe of around 33,000 tonnes per year (expressed as prepolymer plus curative), around 80% is already MbOCA-free¹⁰. This compares to global sales where MbOCA remains the most important curing agent for cast PU: it accounts for around 70% of the sales in North America and Australia, and around 85% in Asia. The European cast PU industry had similarly high penetration of MbOCA several decades ago, illustrating the ongoing move away from the use of MbOCA to alternatives such as DMTDA and BDO initially, and more recently to LFMDI prepolymer/HQEE.

In terms of constraints, a key limitation of some potential alternatives to MbOCA-based systems is their pot-life. The pot-life needs to be sufficiently long to allow workability, but sufficiently short to enable efficient production runs. LFMDI prepolymer/HQEE has a comparable pot-life to TDI prepolymer/MbOCA systems, meaning that it can be used in a similar manner during processing.

Requirements for technical acceptability of products

Using a range of different LFMDI prepolymers, Chemtura believe that the LFMDI+HQEE system can achieve comparable technical performance to TDI prepolymer/MbOCA. The table below provides an illustration of some of the key parameters of some LFMDI prepolymer/HQEE systems compared to the most popular (best-selling) TDI prepolymer/MbOCA systems. MbOCA-based systems are in red while the MbOCA free alternatives are in black. Note that VIBRACURE® 2101 is the alternative curative containing HQEE.

Table 3.1 Comparison of physical properties of some TDI prepolymer/MbOCA and LFMDI prepolymer/HQEE systems

DIN Physical Properties						
Property	Unit	DIN	L-100 MbOCA	LF-900A MbOCA	LFM E370 Vibracure 2101	LFM E450 Vibracure 2101
Hardness	Shore A or D	DIN53505	90A	90A	90A	93A
50% Modulus	MPa	DIN 53504-s2	5.10	5.40	5.87	8.45
100% Modulus	MPa	DIN 53504-s2	7.10	6.80	6.93	9.75
200% Modulus	MPa	DIN 53504-s2	9.90	8.90	8.32	10.94
300% Modulus	MPa	DIN 53504-s2	13.90	12.10	10.28	12.93
Stress at Break	N/mm ²	DIN 53504-s2	58.10	47.70	39.56	49.96
Strain at Break	%	DIN 53504-s2	481.50	469.00	500.32	508.07
Tear Strength	kN/m	DIN ISO 34-1 / DIN 53515	84.60	65.00	79.05	80.00
Comp.Set 24hr@ 70 °C	%	DIN ISO 815 / DIN 53517	29.20	29.00	36.50	29.70
Specific gravity	g/cm3	DIN 53479		1.08	1.08	1.12
Abrasion Resistance	mm3	DIN ISO 4649/ DIN 53516 (A)	52.00	80.00	49.80	37.0
Rebound	%	DIN 53512	55	62.00	72.60	62.6

DIN Physical Properties							
Property	Unit	DIN	L-167 MbOCA	LF-950A MbOCA	LFM E500 Vibracure 2101	LFM E615 Vibracure 2101	LFM E730 Vibracure A263
Hardness	Shore A or D	DIN53505	95A	95A	95A	55D	60D
50% Modulus	MPa	DIN 53504-s2	8.10	12.00	9.13	15.87	22.80
100% Modulus	MPa	DIN 53504-s2	10.30	15.00	10.08	17.27	22.71
200% Modulus	MPa	DIN 53504-s2	14.30	21.00	11.02	18.69	23.18
300% Modulus	MPa	DIN 53504-s2	22.70	34.00	12.95	23.10	26.83
Stress at Break	N/mm ²	DIN 53504-s2	66.10	56.00	42.76	66.97	64.01
Strain at Break	%	DIN 53504-s2	441.00	377.00	486.84	505.71	469.08
Tear Strength	kN/m	DIN ISO 34-1 / DIN 53515	89.30	92.00	102.85	123.05	152.38
Comp.Set 24hr@ 70 °C	%	DIN ISO 815 / DIN 53517	34.00	42.00	29.50	33.42	48.00
Specific gravity	g/cm3	DIN 53479		-	1.12	1.15	1.17
Abrasion Resistance	mm3	DIN ISO 4649/ DIN 53516 (A)	50.00	62.00	46.90	38.99	65.40
Rebound	%	DIN 53512	45.00	50.00	58.00	41.50	41.50

Copies of the technical data sheets for the MbOCA-free systems are included in Appendix A.

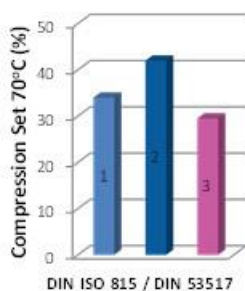
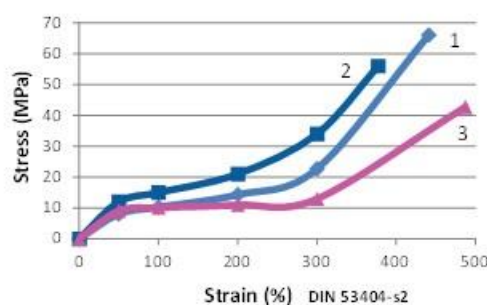
¹⁰ Of the total 33,000t market, around 5000t is "Vulkollan®". Of the remaining 28,000t, Chemtura's estimate (corroborated with suppliers) is that MbOCA constitutes around 500t or less, or 5,500t expressed as the total system (TDI prepolymer/MbOCA) quantity.

In practice, cast PU processors will not make a decision to use the alternative solely on the basis of physical properties such as these. A typical process for testing and eventual replacement of a MbOCA-based system involves the steps described in Section 3.4 below. However, some of the key parameters used in assessing technical suitability are outlined in the figures below, showing how LFMDI prepolymer/HQEE compares to MbOCA-based products.

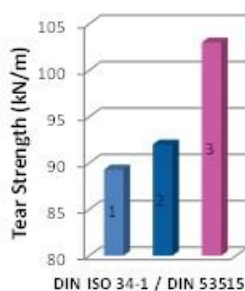
Figure 3.4 Technical performance properties of LFMDI prepolymer/HQEE compared to MbOCA-based systems

Example of Premium Performance: Ether Grade Elastomers, Shore 95A

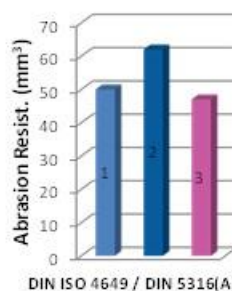
- 1. TDI prepolymer - MbOCA
- 2. LFTDI prepolymer - MbOCA
- 3. LF MDI prepolymer - HQEE



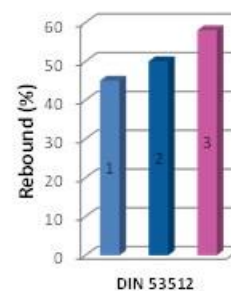
DIN ISO 815 / DIN 53517



DIN ISO 34-1 / DIN 53515



DIN ISO 4649 / DIN 5316(A)



DIN 53512

High Elasticity

Extra Toughness

Improved Wear

Impact Resilience

Source: Chemtura presentation given at UTECH conference, 14 April 2015. Note that in the stress-strain curve, the performance of LFMDI prepolymer/HQEE products is comparable to the MbOCA-based products at % strain levels that are experienced in practice for cast PU products (i.e. cast polyurethane products would not typically be elongated over 50% in actual use).

It is important to note that MbOCA-based systems are sometimes used in more “commodity” type PU products in Europe, but they can also be used in more demanding applications. While other alternatives are suitable for the commodity applications, they may not be suitable for the more demanding applications, whereas LFMDI prepolymer/HQEE is considered to be technically able to match the performance of MbOCA-based systems, and in some cases to exceed its performance.

3.3 Process changes required

Overview

As per ECHA's guidance, this section considers the adaptations or changes in the technology, process and end product necessary to replace MbOCA. It covers issues such as the requirements for equipment, risk management measures, energy, personnel changes and training needs, raw materials and waste.

Changes in processing equipment

A key advantage over other potential alternatives to MbOCA systems is that LFMDI prepolymer/HQEE can be used in the same processing equipment as TDI prepolymer/MbOCA. There is no need to change equipment such as pumps or tanks. Chemtura therefore consider this system (rather than just the curative)

as a true “drop in” replacement. Some of the other alternatives (e.g. MDI prepolymer/BDO) require changes to processing equipment, such as the use of a new pump in meter-mix machines (at a cost of around €400). Note that companies often have several meter-mix machines and, ultimately, all of these would need to be converted to the new system. However having several machines provides an advantage to some companies, as they are able to undertake the validation stage of substitution, and begin producing and marketing PU products using the LFMDI prepolymer/HQEE alternative while continuing to manufacture and sell MbOCA-based products, prior to acceptance of the alternative by their customers. This was done by at least one of the companies interviewed in the course of this study.

A further PU processor interviewed for this study indicates that changes to existing equipment to accommodate the alternative are minimal, involving the replacement of minor spare parts. (It was estimated that this change would take 2 people 1 week to change 1 machine.) Other changes in processing included:

- ▶ Operating equipment at a higher temperature, because the new system has a higher melting point than TDI prepolymer/MbOCA;
- ▶ Familiarisation of staff with the new product and new processing conditions (temperature); and
- ▶ Optimisation of production, to achieve comparable levels of wastage to MbOCA-based systems.

Chemtura started testing and validating the new system with some customers around 3-4 years ago as a proactive response to MbOCA being listed as a SVHC. Several companies have already switched with minimal process changes required and several more have tested and validated the system (without plant modifications) but have not yet switched until they know the outcome of the authorisation process. Chemtura has a plan in place for further switching by customers. Granting authorisation, or a longer review period, would inevitably slow the rate of substitution of MbOCA with the alternative amongst these customers. Further information is provided in Section 3.5.

Changes in risk management measures

Risk management measures needed for MbOCA during processing

As set out by the SCOEL¹¹, MbOCA is a genotoxic carcinogen to which an effect threshold cannot be assigned. Since it is easily absorbed via the skin, biological monitoring is essential. In the UK, in 2009, the Health and Safety Executive (UK HSE) recommended that worker exposure should be as low as reasonably practicable, below an airborne Working Exposure Limit of 0.005 mg/m³ and a Biological Monitoring Guidance Value (based on the 90th percentile of data from workplaces with good control) of 15 µmol MbOCA/mol (35 µg/g) creatinine. Furthermore, this UK figure is noted as needing further reduction.

Based on a survey of workplaces, the UK HSE¹² recommended a wide range of occupational exposure controls including:

- ▶ Risk assessment;
- ▶ General exposure control measures;
- ▶ Personal protective equipment including respiratory protective equipment;
- ▶ Housekeeping and welfare measures (e.g. companies will often undertake swipe testing of equipment/containers to ensure no contamination);
- ▶ Maintenance requirements;

¹¹ Recommendation from the Scientific Committee on Occupational Exposure Limits for 4,4'-Methylene-bis-(2-chloroaniline) [MOCA], European Scientific Committee on Occupational Exposure Limits, SCOEL/SUM/174 June 2010/Annex March 2013.

¹² A survey of occupational exposure to MbOCA in the polyurethane elastomer industry in Great Britain 2005-2006, Health and Safety Executive.

- ▶ Biological monitoring (e.g. typically 3 monthly urine samples);
- ▶ Personal inhalation exposure monitoring;
- ▶ Health surveillance; and
- ▶ Information, instruction and training.

A copy of the risk management measures recommended by the UK HSE is provided in Appendix B.

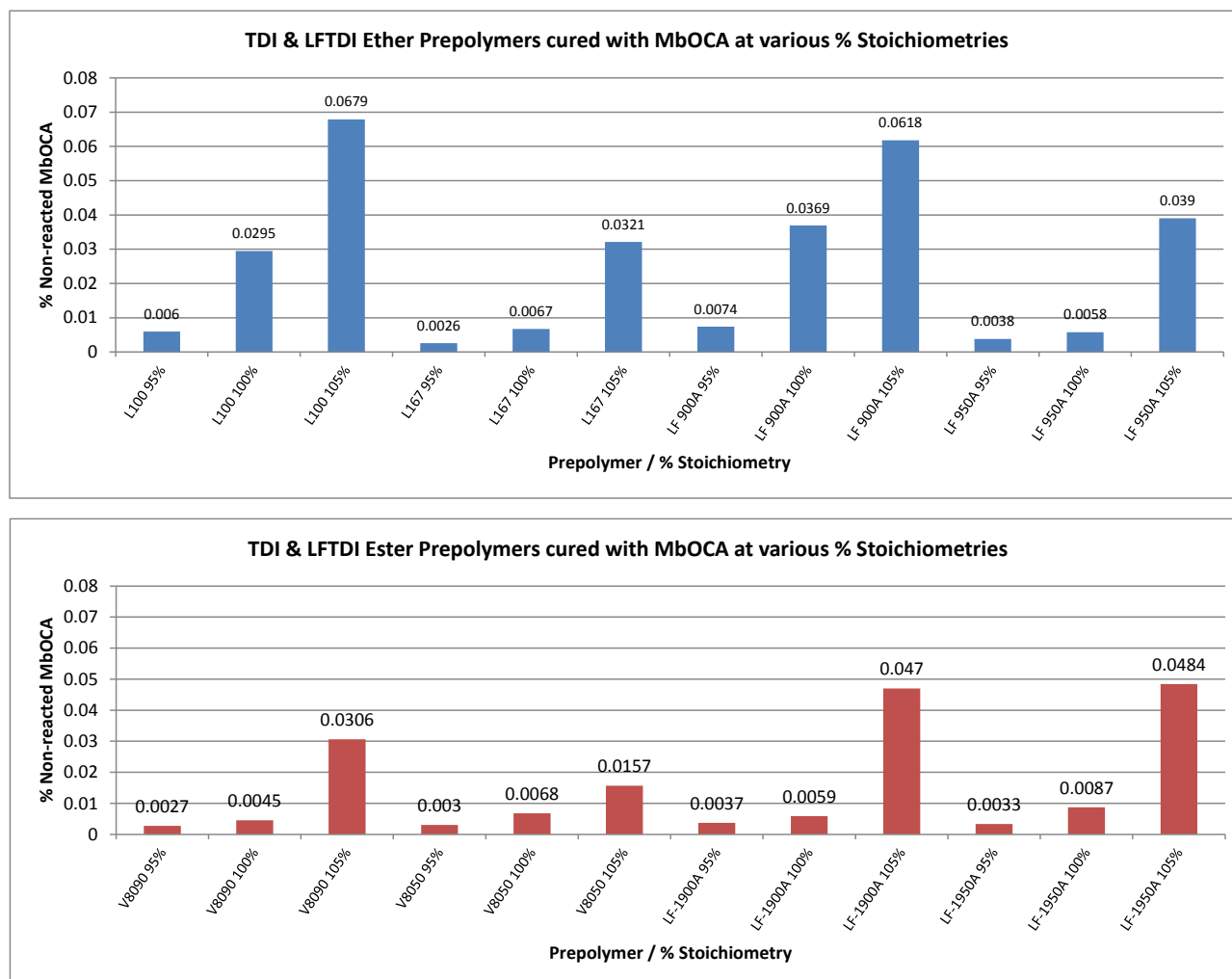
In addition to these measures, Chemtura employs a specialist company to undertake swipe testing of the external areas of all MbOCA kegs that arrive in the EU (they are imported to the port of Antwerp). This measure has been adopted as historically, the UK HSE discovered that the surfaces of the external kegs of the MbOCA delivered to them were contaminated with MbOCA. The MbOCA molecule can permeate various protective surfaces (except e.g. butyl rubber gloves) and hence potential exposure to employees/operatives could arise. If the kegs are discovered to be contaminated they are not accepted into Europe by Chemtura. Contamination has significantly reduced since the adoption of this measure, in combination with Chemtura's specification packaging.

These risk management measures are highly time-consuming and costly, and are not needed when the alternative system (LFMDI prepolymer/HQEE) is used, as neither the prepolymer nor the curative are classified for comparable health effects under the CLP regulation.

Risk management measures needed for MbOCA-based products

Levels of free MbOCA in finished products (articles) should be low. As shown in the figures below, concentrations in typical TDI and LFTDI prepolymer based products are typically below 0.1% w/w.

Figure 3.5 Assessment of non-reacted MbOCA in cured PU elastomers



Source: Chemtura testing. Note that % stoichiometry (or percent theory) relates to the % of MbOCA compared to the amount needed for a full reaction with the prepolymer.

As can be seen from the above, the amount of free MbOCA is well below 0.1% w/w at typically used mixture ratios of 95% theory (used to obtain an excess of isocyanate and minimise free MbOCA), and even at 105% theory, which is higher than would be used in practice. However:

- ▶ The above data is laboratory generated within a highly controlled environment; and
- ▶ The NCO (isocyanate reactive group) content of the prepolymer is reduced during heating (which is typically at 70-80°C) and during re-circulation/ storage.

It cannot be ruled out that, in actual conditions of use (e.g. where processors may leave the product in machines for several hours/days), the amount of MbOCA may be 105% theory or even more, which could lead to concentrations of unreacted MbOCA within cured elastomers to exceed 0.1%.

As ECHA has noted, in response to provision of the above data by Chemtura, where adequate technical measures are in place the content of free MbOCA in the final article is << 0.1%, but if such measures are not in place, the content of free MbOCA rises quickly to amounts in the range of the 0.1% limit¹³.

Such concentrations of an SVHC in finished articles place requirements on processors to (a) notify ECHA of the presence of the substance; and (b) provide information through the supply chain necessary to allow safe

¹³ Responses to Comments Document (RCOM) on ECHA's Draft 4th Recommendation for 2,2'-dichloro-4,4'-methylenedianiline (EC number: 202-918-9), 29 November 2012.

use. Furthermore, if companies wish to ensure that concentrations in their articles are below this figure, they would need to demonstrate this, which may require testing of the articles themselves.

Although the extent to which this is happening in practice is unknown, this is not an abstract notion: downstream clients of Chemtura have sought declarations that the final PU articles are compliant with the 0.1% threshold for SVHC in articles, based on requests from their own customer base.

Personnel changes and training needs

The same personnel can use the LFMDI prepolymer/HQEE alternative as those that use the TDI prepolymer/MBOCA systems. Staff will typically require time to familiarise themselves with the new product and associated documentation, as well as with the modifications to the processing conditions, as described above.

Raw materials

Using the alternative curative to MBOCA (i.e. HQEE) also requires a change to the prepolymer system, as described above. These are the main raw materials used by PU processors. The new system (LFMDI prepolymer/HQEE) also requires the use of a catalyst, as is the case with MBOCA-based systems.

Waste

Based on the interviews undertaken in compiling this report, some companies initially experienced increased levels of wastage using the new system compared to MBOCA-based systems. However, their experience indicates that levels of wastage can be reduced to levels comparable to that with MBOCA-based systems, once staff become familiar with the products and processing techniques. Such increased wastage is common with any such substitution, as companies require time to become accustomed to the new technology. Overall, use of LFMDI prepolymer/HQEE is not considered to lead to increased wastage compared to MBOCA-based systems once this initial familiarisation period is complete.

3.4 Time needed for substitution

Amec Foster Wheeler held interviews with several of Chemtura's customers who have recently replaced TDI prepolymer/MBOCA with LFMDI prepolymer/HQEE, or are in the process of doing so. These include companies with substantial ranges of different products, and cover both large and small companies (with e.g. fewer than 20 people), illustrating that replacement is possible for small companies, as well as large ones.

The typical steps that need to be taken when undertaking the substitution include:

- ▶ Project set-up including definition of requirements and making MBOCA-free material recommendations, for the products in question;
- ▶ Testing the elastomer properties in the laboratory (i.e. casting of samples). This would include optimising processing parameters (e.g. temperature);
- ▶ Agreement to larger-scale testing of final components;
- ▶ Casting the products using moulds previously used for MBOCA-based products (on test lines, or by the material supplier, Chemtura);
- ▶ Fitting the PU products into customers' equipment/final products;
- ▶ Evaluation of performance in the field by the final customer (e.g. for failure, deterioration); and
- ▶ Full scale uploading of LFMDI prepolymer/HQEE into the processor's meter mix systems, replacing TDI prepolymer/MBOCA (i.e. switching of inventories).

The most time-critical step in this process is the evaluation of product performance by the final customer. Chemtura's experience with several companies thus far suggests that this typically takes around 6 months, and that the total substitution process takes around 1-2 years. The most recent experience

suggests that the whole process can be (and has been) undertaken in a period of 6-12 months for companies that produce many different products based on different PU formulations. This includes use of LFMDI prepolymer/HQEE in both small parts (as demonstrated by interviews undertaken for this study), as well as large products (for example use in dynamic bend stiffeners offshore).

Table 3.2 Case study - substitution by a Northern European SME polyurethane processor

The company
<div>[Confidential – Claim #1]</div>
The substitution process
<div>[Confidential – Claim #1]</div>
Technical performance of finished products
<div>[Confidential – Claim #1]</div>
Cost implications
<div>[Confidential – Claim #1]</div>

Chemtura has been a supplier of MbOCA-based systems to the PU processors for many years. This includes many of the largest users of MbOCA in Europe. Chemtura's discussions with these customers suggests that almost all – and certainly all of the largest companies – are indicating that they will move away from use of MbOCA before the sunset date. However, some of these companies are awaiting the outcome of the authorisation process before committing to substitute in the short term.

3.5 Uptake of the alternative by customers

As indicated above, a number of major cast polyurethane companies in the EU have already replaced their MbOCA-based systems with LFMDI prepolymer/HQEE, and several more have already validated the technology and are awaiting the outcome of the authorisation process prior to switching. Chemtura has developed an adoption plan for the new system, working with its customers. [Claim #2]

► [Claim #2]

► [Claim #2]

► [Claim #2]

An illustration of the uptake of the alternative by one of Chemtura's companies is illustrated in a video, available at: <https://www.youtube.com/watch?v=3YYgpXXlsw0>.

This illustrates that substitution of MbOCA, both with LFMDI prepolymer/HQEE and with other alternatives is already underway, driven by the authorisation requirement but also the fact that suitable alternatives are now available.

3.6 Overall conclusions on technical feasibility

Chemtura believes that LFMDI prepolymer cured with HQEE is a technically suitable alternative to TDI prepolymer/MbOCA systems. The system produces high performance elastomers which are capable of being processed on similar (or the same) equipment. They have a suitably long pot life to replace the use of MbOCA systems. Furthermore, they can be catalysed, allowing the product to be rapidly de-moulded as required.

The characteristics in processing are similar to those of MbOCA-based systems, including:

- The ability to use the more common processes for MbOCA-based PU processing, without the need to change equipment¹⁴;
- Pot-life for LFMDI-based systems can equal and exceed those for MbOCA-based systems (typically 10 minutes), meaning that there is sufficient time for them to be used to fill moulds efficiently but effectively; and

¹⁴ A good range of mixing ratio between the prepolymer and curative is required. The usable mixing ratio for LFMDI prepolymer/HQEE is greater than that for TDI prepolymer/MbOCA. The equivalent weight of HQEE is 101 and the equivalent weight of MbOCA is 133.5. The equivalent weight is a reflection upon the accuracy necessary for processing and hence a MDI prepolymer system reacted with HQEE is not difficult to process and can be used in the same equipment as for TDI prepolymer/MbOCA systems.

- ▶ A range of different catalysts are available which can be used to tailor the curing time and other characteristics to the specific products being manufactured¹⁵.

In terms of PU processors, Chemtura's customers include a number of companies that have found processing to be similar, with the product easier to work with than MbOCA due to the reduced need for PPE. Several companies have completely switched from TDI prepolymer/MbOCA to LFMDI prepolymer/HQEE or are in the process of doing so. The switch is partly being driven by the REACH authorisation process, but also by the requirements on SVHC in articles (e.g. many end-users of cast PU products are now requiring demonstration that products are MbOCA-free).

The table below summarises some of the key advantages of MbOCA-based systems and the extent to which these can be achieved with the alternative.

Table 3.3 Performance of LFMDI prepolymer/HQEE against key performance properties of MbOCA systems

Property	Performance of LFMDI+HQEE
Long pot-life	Comparable or longer pot-life. Curing can be accelerated through use of catalyst.
Robust processing – not affected by small changes in stoichiometry	Unlike some alternatives (e.g. BDO), the relative weight needed is not dissimilar to TDI prepolymer/MbOCA, so there are fewer problems with getting the mix right, and with changes due to e.g. reduced NCO content over time while product resides in processing equipment.
Reliable processing – no issues with moisture control	The LFMDI prepolymer/HQEE system has no problems with being hygroscopic. For BDO, which is a popular, inexpensive and non-toxic curative and potential alternative to MbOCA, the substance is hygroscopic which makes it difficult to process if there is any humidity.
Performance – tough, durable elastomers obtained	Customer testing seems positive so far with some customers switched completely. By comparison, the previous most popular alternative curative (DMTDA) has lower physical properties, as well as being Ames-test-positive. LFMDI prepolymer/HQEE can be – and is – used in both very small and very large products.
Multifunctional – used with ether and ester systems	Chemtura are supplying both ether and ester based LFMDI prepolymer systems for use with HQEE curative.
Economical	The alternative is economically feasible, discussed in the next section.
Track record – long history of successful use	Relatively early days but reactions from customers interviewed for this study (and their own customers) are positive thus far.

As indicated above, the alternative system can be used in processors' existing equipment. The lower toxicity of the system also means that processors do not need the same strict workplace exposure controls and monitoring as they do when using MbOCA.

Overall, the information reviewed in preparing this report, including the contacts with PU processors and information from Chemtura, suggests that LFMDI prepolymer/HQEE should be a technically suitable alternative for a wide range of different cast PU applications.

¹⁵ Adiprene Vibrathane Low Free MDI Prepolymer: The substitution of MbOCA – A realistic alternative: LFMDI / Diol cross-linked systems, Chemtura.

4. Economic feasibility

4.1 Overview

The purpose of this section is to evaluate whether the costs associated with transitioning to the alternative are likely to be economically feasible for downstream users (both PU processors and the end-users). As such, the direct and indirect costs incurred by the cast PU industry in transitioning from MbOCA-based systems to the alternative systems are assessed. This is done in four ways.

- ▶ First, direct costs incurred by MbOCA-using PU processors who could transition from MbOCA-based TDI prepolymer and LFTDI prepolymer systems to LFMDI prepolymer/HQEE systems are assessed;
- ▶ Second, costs to individual companies are set out, based on illustrative production volumes of cast PU (considering maximum, minimum and average production volumes);
- ▶ Third, the affordability of the costs identified for business of different sizes are examined. Given that cast polyurethanes are used in a variety of applications, data at sector level is used, cross referenced from various sources. This assessment is based on comparing the additional costs identified with average turnover and margins; and
- ▶ Fourth, potential effects of the additional costs identified on final product prices are considered.

The information in this chapter is based on interviews with companies who have switched from MbOCA systems to LFTDI prepolymer/HQEE systems, alongside data provided by Chemtura and publicly available data on sales characteristics and prices. Various assumptions are set out in the assessment. These are documented and the rationale behind the analysis is provided. The information is not based on a representative survey of the entire market but provides an illustration of the likely costs of substitution.

4.2 Cast PU industry characteristics

MbOCA is no longer manufactured in the EU and all manufacture takes place in Asia (Japan, Taiwan and China)¹⁶. Table 4.1 provides data on cast PU industry characteristics. The EU cast polyurethane sales are estimated at some 33,000 tonnes annually¹⁷. However the volume of cast PU manufactured using MbOCA-based systems is less than this. After consulting with several suppliers and MbOCA-using PU processors, Chemtura estimate the sales opportunity be around 500 tonnes or less per year¹⁸ in terms of MbOCA sales to / use by EU PU processors. For the purposes of this assessment, a higher figure of 1,000 tonnes has also been examined, as this was considered in ECHA's prioritisation of MbOCA for REACH authorisation.

Figure 3.3 earlier in this report illustrates Chemtura's best estimate of the EU industry for cured PU elastomers, indicating the amount that is currently dependent on MbOCA.

The Chemtura estimate of 500 tonnes (or less) was based on research undertaken in 2015 and 2016 and is consistent with the 516 tonnes quoted in the authorisation application (noted to be a 3-year average). This lower figure of 500t may at least partly reflect an element of substitution that has taken place since the formal inclusion of MbOCA on the Candidate List.

¹⁶ Chemtura, 4 November 2014.

¹⁷ Chemtura, 4 November 2014.

¹⁸ Chemtura, 21 June 2016. The figure of 500t corresponds to a total system quantity of around 5,500t, or just under 20% of the total EU market. Note that the total amount imported into the EU was around 700t, but a proportion of this is subsequently re-exported.

Typical prepolymer to curative ratios are 10:1, suggesting overall demand of both prepolymer and curative based on MbOCA of between 5,500 tonnes and 11,000 tonnes. In broad terms, MbOCA-based systems therefore represent around 20% of the EU cast PU sales based on the best estimate of 500t¹⁹. The analysis in this section is based on the implications arising from a transition from MbOCA-based systems – rather than the total market.

There are two main existing MbOCA-based systems, one based on ‘conventional’ TDI prepolymer and another based on LFTDI prepolymer. The cost implications of switching to the alternative system differs between the two. Based on an estimate from Chemtura, the TDI prepolymer market represents some [#2] of MbOCA-using sales opportunities, whilst LFTDI prepolymer represents the remaining [#2]²⁰.

Table 4.1 Industry characteristics, MbOCA usage in EU cast polyurethane (2015)

	Tonnes per year (EU)	Extent of market switching from TDI prepolymer	Extent of market switching from LF TDI prepolymer
Total cast PU sales	33,000		
Low EU Demand for MBOCA (2015)	500		
High EU Demand for MBOCA (2015)	1,000		
Prepolymer to curative ratio	10:1	[#2]	[#2]
EU prepolymer and curative demand, Low (MbOCA users only)	5,500		
EU prepolymer and curative demand, High (MbOCA users only)	11,000		

Source: Total cast PU market estimate, Chemtura, 4 and 12 November 2014. Low end estimate source: Chemtura, 21 June 2016 and is based on market intelligence, having consulted with several suppliers active with the EU. The high end estimate is based on data provided as part of ‘Feedback to annex XV December 2011’ submitted by the largest processors active in France who state that ‘the total amount of MbOCA in the EU is probably around 700 to 800 tonnes and in any case inferior to 1,000t. It is Chemtura’s view that the actual amount of MbOCA on the market is around the low end estimate of 700 tonnes.

4.3 Costs to the PU processing industry

Approach

This section examines the costs likely to be borne by the EU cast PU processing industry that is currently using MbOCA-based systems, in the event that they switch to Chemtura’s alternative LFMDI prepolymer/HQEE. For these companies, the main sources of additional costs are:

- ▶ Additional raw material costs; and
- ▶ Direct/indirect costs of trials / testing.

Substantive additional costs in capital equipment or new plant/ machinery are not necessary (although minor modifications may be required) and substantial costs arising from new regulatory approvals (e.g. safety certificates) are considered unlikely. There are also potential savings through reduced need for such stringent workplace risk management measures.

¹⁹ Low end estimate Chemtura, 21 June 2016 based on assessments of sales opportunities, having consulted with several suppliers active with the EU. The high end estimate is based on data provided as part of ‘Feedback to annex XV December 2011’ submitted by the largest processors active in France who state that ‘the total amount of MbOCA in the EU is probably around 700 to 800 tonnes and in any case inferior to 1,000t.

²⁰ Source: Chemtura, 24 March 2015, based on a review of Chemtura’s EU product range and that of their major competitors.

These issues are discussed further below and draws on interviews with companies that have switched, or are in the process of switching, from MbOCA-based to LFMDI prepolymer/HQEE systems.

Raw material costs

Concerning *raw material* costs, the alternative is more expensive than TDI prepolymer/MbOCA and LFMDI prepolymer/MbOCA. Raw material costs for all companies who need to switch will therefore increase. The price differential for companies that use only LFMDI prepolymer and MbOCA is anticipated to be lower than for those currently using only TDI prepolymer and MbOCA. [Claim #2]. It should be noted, however, that the main supplier of MbOCA to the EU market increased the price of MbOCA by 22% in March 2016, reportedly reflecting increased EHS standards at the site of manufacture in China.

In terms of curative costs, HQEE is currently (2016) approximately [2] times the price of MbOCA on a weight-for-weight basis²¹. However, to provide a stoichiometric mixture with the prepolymer (based on %NCO), only up to 75% of the weight of HQEE is required compared to MbOCA²². The overall impact is therefore an increase in price of curative per unit of final polymer of about [2] times that paid for MbOCA. This is comparable to the price differential of what was previously considered the most promising alternative to MbOCA, DMTDA (Ethacure® 300). For comparison, other curatives for TDI/LFMDI prepolymer systems have relative prices of approximately:

- ▶ DMTDA (Ethacure 300) = 2.08 times the price of MbOCA for equivalent stoichiometric amount;
- ▶ VIBRACURE® A157 / Polacure 740M = 6.7;
- ▶ Lonzacure M-CDEA = 10.9;
- ▶ Addolink® 1604 HM = 5.4²³;
- ▶ Polyol blends or amine curatives and polyols = 3.4; and
- ▶ 1,4-butanediol = 0.30²⁴.

In terms of *overall system costs*, one needs to take into account the relative price of LFMDI prepolymers, since the prepolymer as well as the curative is being changed. At present, the price of LFMDI prepolymers are more than that of TDI prepolymers, but the price is expected to decrease as production capacity increases (including through Chemtura's new plant in Italy, which also will not be subject to the current transportation costs from the USA). Given that the curative represents around 10% of the weight of the system, and the prepolymer around 90% (catalysts, etc. have minimal contribution to the quantities or costs), the overall cost increase for raw materials, in switching from TDI prepolymer and MbOCA to LFMDI prepolymer/HQEE would be a few tens of percent. The price differential between LFMDI prepolymer and LFMDI prepolymer is lower and therefore processors who are currently using a LFMDI prepolymer/MbOCA system will experience a smaller increase in their costs; this is discussed further below.

There are several different specific products that PU processors may use and Table 4.2 provides overall system costs, per tonne of cast polyurethane, for the two most common MbOCA using TDI/LFMDI systems

²¹ [2]

²² Interviews with Company A (confidential) indicates that this may be a conservative (i.e. high) figure and that in their experience 60% HQEE was required compared to MbOCA.

²³ This is also an aromatic diamine and has not historically been used in this application due to the price differential. It is understood, via Chemtura, that some EU processors may be considering this now given the regulatory focus on MbOCA. It is understood there is currently no supply within the EU at present.

²⁴ Source, Chemtura, ADIPRENE® VIBRATHANE® Low Free MDI Prepolymer. The substitution of MbOCA – a realistic alternative Low Free Monomer MDI (LFMDI prepolymer) / Diol Cross-linked Systems. The above is based on Table 10, which takes into account both the cost ratio and curative amount required. It is noted that these figures are from 2014 and do not take into account the recent price increase for MbOCA.

on the market, for both TDI and LFTDI. [REDACTED]

[REDACTED] System costs are shown for existing MbOCA systems and the comparative LFMDI prepolymer/HQEE based system in each case. The price increase is higher for a transition from TDI prepolymer than from LFTDI prepolymer, which will affect the overall costs to the market as a whole – and to individual firms. The figures below are current price estimates, as production of LFMDI prepolymers and HQEE increases, the price differential is expected to reduce.

The assessment in the remainder of this section draws on average prices for the two most common ‘old’ and ‘new’ systems, rather than an assessment for every product²⁵. Further details are provided in Appendix C.

Table 4.2 Comparative systems cost, per tonne of cast polyurethanes (2016)

‘Old’ MbOCA System	System Cost ‘€ per tonne’	‘New’ LFMDI/HQEE System	System Cost ‘€ per tonne’
TDI versus LF MDI			
ADIPRENE® L 167/MbOCA	[REDACTED]	ADIPRENE® LFM E500/HQEE	[REDACTED]
ADIPRENE® L 100/MbOCA	[REDACTED]	ADIPRENE® LFM E370/HQEE	[REDACTED]
LF TDI versus LF MDI			
‘Old’ MbOCA System	System Cost ‘€ per tonne’	New’ LFMDI/HQEE System	System Cost ‘€ per tonne’
ADIPRENE® LF950A/MbOCA	[REDACTED]	ADIPRENE® LFM E500/HQEE	[REDACTED]
ADIPRENE® LF900A/MbOCA	[REDACTED]	ADIPRENE® LFM E500/HQEE	[REDACTED]

Source: Chemtura, 23 June 2016, based on comparative costs assessment that takes into account material, production costs, curative costs, freight and duty costs and gross profit margin. The prices were provided to the consultants in Euro and have been rounded to 2 significant figures.

Based on an average of the two most common system prices for both TDI prepolymers and LF TDI prepolymers and the extent of MbOCA demand in Europe today, an estimate of the total change in raw material cost is shown below. These costs would be borne by the EU PU processing market as a whole, not individual firms. Table 4.3 shows individual costs for both TDI and LFTDI systems as well as the costs combined. Note that this assumes the total EU market converts to this particular alternative, which in practice is not expected. The figures also takes not account of the savings that would arise from reduced costs associated with risk management when using the alternative system, this is discussed later.

This suggests that total existing raw material costs arising from MbOCA-based TDI prepolymer and LFTDI prepolymer systems are [REDACTED] assuming current EU use of MbOCA of 500 tonnes per year. The new HQEE-based systems would result in raw material costs of around [REDACTED], an increase of [REDACTED] per year – or around [REDACTED] before savings have been taken into account²⁶.

Table 4.3 Best estimate of EU raw material costs (transition from TDI/LF TDI prepolymer + MbOCA to LFMDI prepolymer/HQEE, € per year)

Transition from ...	TDI prepolymer/MbOCA	LFTDI prepolymer/MbOCA	Total
Share of EU market	[REDACTED]	[REDACTED]	100%

²⁵ I.e. the price differential for TDI prepolymer to LFMDI prepolymer is based on comparing the average difference between ADIPRENE® L 167 and ADIPRENE® L100/MbOCA and ADIPRENE® E500 and ADIPRENE® E370/HQEE.

²⁶ The underlying calculations are described in the Appendix to this report. If the actual use of MbOCA were higher i.e. at 1,000 tonnes per year, the current raw material cost would be [REDACTED] and costs of the new system would be [REDACTED], an increase of [REDACTED] per year. However, Chemtura believes that the sales are much closer to 500 tonnes MbOCA than 1000 tonnes.

Transition from ...	TDI prepolymer/MbOCA	LFTDI prepolymer/MbOCA	Total
Current raw material cost (MbOCA-system)	[#4]	[#4]	[#4]
New raw material cost (LFMDI prepolymer/HQEE)	[#4]	[#4]	[#4]
Cost increase	[#4]	[#4]	[#4]

Source: Amec Foster Wheeler, based on price data provided by Chemtura, 23 June 2016. Comparative costs assessment takes into account material, production costs, curative costs, freight and duty costs and gross profit margin... These prices have been multiplied by 5,500 as the best estimate of the current market for MbOCA-based systems (tonnes of prepolymer + curative), as well as taking into account the extent of the market estimated to be switching from TDI prepolymer and LFTDI prepolymer systems respectively (Table 4.1). The figures in the above table are based on averaging the price differentials of the two most common MbOCA based and HQEE based products, respectively. Cost data for the specific products covered are shown in Appendix C. Note numbers have been rounded. Note these are gross costs before savings associated with alternative are included. They also assume 100% conversion to LFMDI prepolymer/HQEE.

Processing equipment, testing and regulatory approvals

The alternative system has been designed so that it can be used without the need for processors to invest in new capital equipment as set out in Section 3. HQEE can be provided in granule format, like MbOCA, and it is a 2-component system with similar processing characteristics to TDI prepolymer/MbOCA systems, which means that PU processors can use their existing (TDI prepolymer/MbOCA-using) equipment.

As noted in Table 4.1 the majority – approximately 80% – of the EU cast polyurethane market does not use MbOCA.²⁷ Other MbOCA free systems are available on the market and are widely used (and have been for many years). However, these are mainly Quasi systems which, as discussed earlier, are 3-component systems as opposed to a 2-component system (such as TDI prepolymer/MbOCA or LFMDI prepolymer/HQEE). Their use would involve investment in new capital equipment if processors only have 2-component machines, rather than the 3-component machines required for Quasi systems²⁸.

A typical MbOCA-using PU processor uses ‘meter-mix’ equipment and a typical firm will have several but usually fewer than 10 such machines, while the largest will have many more (e.g. over 20). Each machine is estimated to cost between €180,000 and €300,000. Whilst the existing alternatives could, theoretically, replace MbOCA-based systems many of these are used within 3-component or ‘quasi’ systems (see earlier Figure 3.2). These use the quasi prepolymer, polyol and 1,4-butanediol. Quasi-based system provide good all-round performance, but are not typically used in specialist applications where the end products require particular performance characteristics (for instance in demanding mining applications where durability is a key requirement). Other curatives are also used and marketed as alternatives to MbOCA, such as those listed in the previous subsection.

Despite this, consultation with MbOCA-using PU processors that have switched to the LFMDI prepolymer/HQEE alternative indicates that some indirect costs have been incurred. Whilst the specifics differ somewhat amongst companies there are some common themes, discussed below:

- ▶ Companies typically provide test moulds to Chemtura who create sample PU products at their plant. This is provided at no cost to the processors. Chemtura also do not charge for technical support time and provide the use of their own laboratory to avoid initial production disruptions for the PU processors;
- ▶ Processors then evaluate the products, including field tests and evaluate effects on the final products. This has incurred some staff and testing costs, but these were not considered significant by those interviewed;
- ▶ As with all technical innovations, some technical challenges were initially encountered:

²⁷ Source Chemtura, 12 November 2014.

²⁸ Note that some MbOCA users will already be using 3-component machines.

- ▶ First, one company experienced some loss of productivity because the viscosity of the alternative system was different and took longer at the moulding stage. This also required changes to the injection and moulding equipment. This was estimated as costing some €100,000 although it should be noted that this was associated with changes to several MbOCA-based production lines alongside a second (unrelated) processing change undertaken at the same time²⁹; and
- ▶ Second, two companies reported that the temperature at which processing needs to be undertaken is higher (and more precise), resulting in some indirect processing costs. Companies also reported initial challenges in replicating some characteristics (i.e. smooth surface texture), but these were resolved. These were not deemed to be significant by the companies interviewed.
- ▶ Companies then started pilot production (for example on one of several production lines), and carried out further evaluation of the PU products;
- ▶ Once satisfied, production was increased to all production lines. This required existing machines to be cleaned and re-programmed (a minor task); and
- ▶ All companies consulted indicated that costs associated with relevant regulatory approvals (i.e. product-specific approvals for use of the product in the EU, and/or within specific Member States) or safety testing were either not incurred or were not significant. However, these are typically incurred by the customers of the PU processors, who have not been interviewed for the current study.

The three companies consulted were not able to provide a quantitative estimate of the indirect costs associated with the transition, however each has successfully switched to the alternative system. Moreover the companies consulted produce large numbers of different articles for use in many applications (one company estimated that they had manufactured 10,000 unique articles in the last 10 years). There is not a 'standard recipe' for these products either with MbOCA or with the alternative system, hence there is an ongoing process of product testing and optimisation with both systems.

In addition, two of the companies consulted chose to undertake the transition from MbOCA to the alternative either alongside other process changes, or alongside a planned renewal of the meter mix machinery which had come to the end of its designed operational life. This enabled existing orders to be met, whilst testing the LFMDI prepolymer/HQEE alternative. Overall, those consulted indicated that the major source of additional cost was due to the difference in the raw material price.

Volumes required

Consultation with downstream users has identified that the same volumes of the LFMDI prepolymer are needed to achieve the same technical function. Rather less HQEE is required compared to MbOCA, typically around 75% of the quantity of MbOCA³⁰. The system unit costs used in the analysis takes this into account.

Other costs and savings

Due to the lower risks associated with LFMDI prepolymers and HQEE, compared to MbOCA-based systems, there are cost savings associated with avoiding the need for additional worker and other protection measures. These measures include:

- ▶ Regular biological monitoring of employees and analysis of samples. A company applying good practice would typically undertake this four times a year (once every quarter) and this would

²⁹ Interview with 'Company B' (Confidential), 27 February 2015.

³⁰ Interviews with Company A (Confidential) indicates that this may be a conservative (i.e. high) figure and that in their experience 60% HQEE was required compared to MbOCA. The higher figure has been used for the purposes of the analysis.

involve an occupational health practitioner spending time on site along with laboratory analysis of samples. The unit cost for this is estimated at €100 per employee for each test (i.e. €400 per year, per employee)³¹. It should also be noted that in Chemtura's experience this process also incurs a psychological cost, given the health implications of exposure, as employees wait for test results, for example. This has not been taken into account in the financial analysis;

- ▶ Extraction systems and personal protective equipment (PPE) required as a result of REACH and also the Carcinogens and Mutagens Directive (2004/37/EC). A 2011 report prepared by the Institute of Occupational Medicine (IOM), Entec and Imperial College London³² estimated that the costs associated with PPE (cost of purchasing, cleaning the equipment and instructing staff on their use) would be between €1000 and €2000 per company;
- ▶ Ventilation/extraction systems, including scrubbers/filters, and their associated maintenance and replacement costs. The above IOM report estimated that total annualised costs for a stationary local exhaust ventilation system (LEV) were in the region of €5,700 to €25,000 per year. This included the following components:
 - ▶ Capital Cost (€42,000 to €252,000);
 - ▶ Annual Maintenance (€1,000);
 - ▶ Annual Testing (€1,000 to €5,000); and
 - ▶ Filter Change (every five years €5,000)³³
- ▶ Costs of disposing of MbOCA containers and linings as hazardous waste (these are incinerated); and costs of monitoring and ensuring compliance with concentration-limits for MbOCA in articles, and associated supply chain assurance costs. Costs of incineration alone are estimated by Chemtura to be substantial – around €450 per drum³⁴.

These costs can be very substantial and one of the companies interviewed suggested that the administrative and other savings associated with not using MbOCA could outweigh the additional cost of raw materials.

4.4 Cost to individual companies

This section considers the additional costs, per company taking account of additional raw materials costs and savings associated with avoided Risk Management Measures (RMMs).

Production volumes are based on an estimate from Chemtura. In turn this is based on extensive discussions within Chemtura to identify 'all known businesses' in the EU. This identified a total of around 50 MbOCA processors who collectively use some 350 tonnes of MbOCA per year³⁵. The estimate included details of MbOCA usage of each company alongside the EU Member State where the company was located. This data indicates an average use of 7 tonnes of MbOCA per company per year. The same data showed that the maximum MbOCA usage within these 50 companies was around 50 tonnes per year and the smallest amount used was 1 tonne.

³¹ Source: Chemtura estimate based on costs incurred for both occupational health practitioner and analysis of results.

³² Source: Cherrie et al (May 2011) Health, socio-economic and environmental aspects of possible amendments to the EU Directive on the protection of workers from the risks related to carcinogens and mutagens at work (report on MbOCA). Data from page 937.

³³ Total annualised costs are based on an assumed 20 year lifetime and were calculated in the original report using a discount rate of 4% per year. The costs estimated in the original IOM et al research are based on consultation with LEV suppliers.

³⁴ Source, Chemtura, 31 March 2015.

³⁵ Source, Chemtura, June 2016. This compares to the estimate in the authorisation application of 89 processors using 516 tonnes (noting that the tonnage figure is a 3-year average value).

Given that the overall estimate of MbOCA use across Europe is between 500 and 1,000 tonnes, this suggests that between some 70 (i.e. 500/7) and 140 (i.e. 1,000/7) MbOCA-using processors could be active in the EU, somewhat higher than Chemtura's estimate (and in Chemtura's view is likely to overstate the actual number). It is used here to estimate an upper-bound, based on the simple calculations noted above.

Chemtura have also provided an estimate regarding the number of employees working for MbOCA-using PU processors. This indicated that the largest producers employ some 60 staff; the smallest around 5 and the average company employs 12 people³⁶.

Table 4.4 estimates costs that would be incurred by per MbOCA processing company. Based on the data above, MbOCA-using PU processing companies are estimated to use an average of 7 tonnes of MbOCA per year. The corresponding MbOCA uses for small and large production volumes are 1 and 50 tonnes respectively. As above the assessment assumes the TDI prepolymer market represents approximately 50% and the LFTDI prepolymer market the remaining (approximately) 50%. As noted earlier, the analysis is focussed only on the part of the market using MbOCA (c. 20% of the European PU market).

The precise number of companies that manufacture their product using TDI prepolymer and LFTDI prepolymer systems, or a combination of the two, is not known. It is assumed that at least some companies will use both. Therefore costs are shown for a company assuming: 100% of production is based on TDI prepolymer; 100% based on LFTDI prepolymer; and assuming production of both TDI prepolymer and LFTDI prepolymer using the overall EU average split between the two noted earlier.

In terms of raw material costs for companies transiting from TDI prepolymer to LFMDI prepolymer only, companies with average production volumes are estimated to incur additional costs of some [£4,000] per year. For small producers the costs are estimated at around [£4,000] per year. The largest producers are estimated to incur around [£4,000] in raw material costs, per year. This would be offset to an extent by a saving for each company associated with avoided risk management measures. For an average company, this could equate to a saving of around €22,000, per year. For the largest firms this equates to a saving of some €41,000 per year and for the smallest this equates to some €19,000 per year³⁷. It is important to note this figure does not take into account savings from avoided hazardous waste treatment, which are in the order of €450 per drum. The overall net cost for companies transitioning from TDI prepolymer/MbOCA to LFMDI prepolymer/HQEE equates to some [£4,000] for an average company (and between [£4,000] and some [£4,000] for the smallest and largest processors, respectively).

Those transitioning from LFTDI prepolymer to LFMDI prepolymer only experience lower additional costs. For companies with average production volumes, the cost is estimated at around [£4,000] per year. For small producers the costs are estimated at some [£4,000] per year and for larger producers the costs are estimated at some [£4,000] per year. As above, after taking into account the expected savings, the net annual costs to these firms equate to some [£4,000] for the average firm. Importantly, the smallest firms are estimated to realise a small saving of some [£4,000] per year. The largest firms are expected to incur a net cost of a little under [£4,000], per year.

For those companies that process both TDI prepolymer and LFTDI prepolymer, assuming the EU average proportion between the two, suggests costs for an average sized producer would be some [£4,000], and between some [£4,000] and a little over [£4,000] for smallest and largest, respectively. Taking into account savings as above, the net cost is estimated to be some [£4,000] per year. For the smallest processors this equates to a net cost of only [£4,000]; and a net cost of a little over [£4,000] for the largest.

³⁶ Source, Chemtura, 18 February 2015

³⁷ The savings are based in the text in the 'other costs and savings' section above. For further information refer to the tables in Appendix C.

Table 4.4 Estimating average costs and savings per company, based on production volumes (€, per year, per company)

Costs per company (Summary)	Average (Prod Vol)	Small (Prod Vol)	Large (Prod Vol)
100% TDI prepolymer processor [1]			
Costs	[#4]	[#4]	[#4]
Savings	€ 22,000	€ 19,000	€ 41,000
Net Costs	[#4]	[#4]	[#4]
100% LFTDI processor [1]			
Costs	[#4]	[#4]	[#4]
Savings	€ 22,000	€ 19,000	€ 41,000
Net Costs (Saving)	[#4]	[#4]	[#4]
TDI and LFTDI processor, based on EU average [2]			
Costs	[#4]	[#4]	[#4]
Savings	€ 22,000	€ 19,000	€ 41,000
Net Costs	[#4]	[#4]	[#4]

Source: Amec Foster Wheeler, based on price data provided by Chemtura, 23 June 2016. Based on calculation of the total number of MbOCA processors active in the EU provided by Chemtura, 18 February 2015 (c.50, using c.350 tonnes of MbOCA). This indicates average MbOCA usage of 7 tonnes per company.

Table Notes:

[1]: Costs are based on the average costs from the two most common systems (see Appendix C for further details)

[2]: Costs are based on average costs from TDI prepolymer and LFTDI prepolymer processors combined (see Appendix C for further details). The assessment assumes [#2] of the market is currently using TDI prepolymers and the remanding [#2] LFTDI prepolymers. Note that numbers have been rounded.

4.5 Affordability

This section compares costs identified to be incurred per company with average company turnover and margins within the sector. The purpose is to evaluate whether the scale of cost increases are such that the costs would have to be passed on in the form of higher prices to the final consumer, or whether they could be absorbed within existing profit margins. It is our current understanding that margins for some downstream users are healthy, and could absorb some additional costs; however this is likely to differ across geographies/sectors and over time³⁸.

Importantly, the articles manufactured using cast PU are numerous and differ substantially. Many form part of much larger systems/products. On this basis, it is not possible to carry out a product by product assessment. (By way of example, one modest sized company interviewed for this study had produced over 10,000 unique articles over the last 10 years.)

Table 4.5 provides a sector level assessment, based on average turnover statistics derived from three publicly available data sources (further detail is provided in the table notes). It should be noted that data from 2011 – as would any data – reflect prevailing economic conditions³⁹.

³⁸ Chemtura, 12 November 2015.

³⁹ Whilst data is provided for different years, historical turnover rates have not been updated to current prices as turnover reflects various factors, not least wider economic conditions, not prevailing inflation rates.

- ▶ First, 2011 Eurostat data on the 'Manufacture of Rubber and Plastics Products' across the EU. This indicates average turnover per company to be some €4.6 million;
- ▶ Second data from the British Plastics Federation indicated that, in 2011, average turnover amongst UK firms in the 'plastics sector, to be somewhat lower around £2.5 million (or €2.9 million)⁴⁰; and
- ▶ Third, data taken from the UK Office of National Statistics (ONS) is based on the 'manufacturing' sector in 2014. This indicated average turnover in the UK manufacturing sector was £2.1 million (€2.5 million)⁴¹.

Recognising that none of these broad sectors precisely match PU processors (where data was not available and Chemtura are not privy to this information), the analysis is carried out using all three figures.

As previously, three results are shown. First, the net costs assuming the company uses 100% TDI prepolymer systems. Second net costs assuming 100% LFTDI prepolymer systems and third, the net costs assuming the mix between the two is in line with the EU average. Given that only average turnover for the sector as whole is available, this is compared to the costs identified to be incurred by 'average' MbOCA-using PU processors [redacted].

As a proportion of turnover, the costs identified are small; between 2% and 6% depending on the data source and the processing systems used. This suggests the scale of the cost increases are likely to be affordable.

However, a more accurate approach is to compare the costs as a proportion of net margin (i.e. profit). Publicly available data suggests that EBITDA in the Speciality Chemicals) sector as follows:

- ▶ Average (between 12% and 20%). This assessment assumes the median rate of 16%⁴².

Clearly margins will differ between geographies, sectors and products/applications and from firm to firm. The approach is illustrative, used to place the scale of the cost increases in context. [redacted].

Overall, the figure of 16% appears in reasonable agreement with this data.

Overall the analysis suggests that average costs would represent from [redacted] of margins for companies transitioning only from LFTDI prepolymer systems. This suggests in at least some applications, of the costs could be absorbed but for others some or all of the additional cost increases would need to be passed on in the form of higher product prices.

Similarly, for those transitioning only from TDI prepolymers, the costs represent from [redacted] up to [redacted]. This suggests again that, whilst some companies could absorb at least some of the costs, the additional costs would have to be passed on to downstream users in the form of higher prices.

For companies that utilise both TDI prepolymer and LFTDI prepolymer systems – assuming the EU average split between the two – suggests the costs would represent from a little over [redacted], up to some [redacted] of typical margins. This is likely to be affordable for some applications but for others some or all of the costs may need to be passed on to downstream/end users. This is discussed in the next section.

⁴⁰ Based on exchange rates as of March 2011 of 1.152352 <http://www.x-rates.com/average/?from=GBP&to=EUR&year=2011>

⁴¹ Based on exchange rates as of March 2014 of 1.202721 <http://www.x-rates.com/average/?from=GBP&to=EUR&amount=1.00&year=2014>

⁴² Source: Standard and Poor Ratings Service Key Credit Factors for the Specialty Chemicals, December 31st 2013:

Table 4.5 Estimating affordability per company, based on average production volumes, turnover and margins

	Average (Prod Vol), Eurostat [1]		Average (Prod Vol), BPF [2]		Average (Prod Vol), ONS [3]	
	% of turnover	% of margin [4]	% of turnover	% of margin [4]	% of turnover	% of margin [4]
100% TDI prepolymer processor	[#4]	[#4]	[#4]	[#4]	[#4]	[#4]
100% LF TDI prepolymer processor	[#4]	[#4]	[#4]	[#4]	[#4]	[#4]
TDI and LFTDI prepolymer processor, based on EU average	[#4]	[#4]	[#4]	[#4]	[#4]	[#4]

Source: Amec Foster Wheeler, based on average turnover data taken from three sources.

[1] Annual enterprise statistics for special aggregates of activities (NACE Rev. 2) [sbs_na_sca_r2], from Eurostat. This indicates that there were some 65,107 enterprises active in the 'Manufacture of Rubber and Plastics Products' sector across the EU 28. The data relates to 2011. This is compared to the total 'Turnover or gross premiums written' for that sector across the EU 28 in 2011, which was €300 bn. This indicates average turnover was €4.6 million. This figure was then compared to the costs identified (based on average production volumes). Note that the latest data available is for 2014, with 2013 and 2012 data also available. However these data contain numerous gaps, with an EU total not available, hence 2011 data is used, cross referenced to two other sources. See: <http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>

[2] Data taken from the British Plastics Federation indicated that in 2011, The UK plastics Industry generated turnover of £19 billion, from 7,500 companies, giving average turnover of £2.5 million (£2.9 million). <http://www.bpf.co.uk/Industry/Default.aspx>

[3] Data taken from the UK Office of National Statistics (ONS) from the manufacturing sector in 2014, which divided turnover in the UK manufacturing sector, by the number of enterprises, indicating average turnover was some £2.1 million (£2.4 million). <https://www.gov.uk/government/statistics/business-population-estimates-2014>

[4] Based on the median of reported 'average' EBITDA (of between 12% and 20%) in the speciality Chemicals sector. Source: [Standard and Poor Ratings Service Key Credit Factors for the Specialty Chemicals, December 31st 2013](#).

4.6 Effects on final product prices

There is no standard threshold at which it can be concluded costs would be unaffordable for the PU processors. However the preceding high level assessment suggests that the costs could potentially be absorbed in certain sectors/applications, but for others the costs may not be affordable.

In these cases, MbOCA processors have a combination of three options. First they could absorb the costs, either temporarily or permanently, with an associated reduction in their profit margin. Second they could pass the additional costs on to downstream users where these are likely to be acceptable (i.e. in some specialist applications with demanding functionality and/or where the parts form part of much larger systems). Third, the customers of the PU processors could import MbOCA-based PU from outside the EU, in cases where the concentration of MbOCA in articles is below 0.1%, and hence not subject to the REACH SVHC substances in articles provisions, if this is technically feasible (and affordable).

Changes to the PU costs will have different effects across the various applications, Consultation with Chemtura indicates that whilst the importance of PU in the final product price differs substantially there are three broad categories:

- ▶ Relatively simple geometries with the part manufactured from 100% PU. These parts are heavily dependent on PU price as it could represent 70% of the part cost.
- ▶ More complex geometries which are a combination of metal & PU for which the impact of PU cost is around 30-35% of the part cost.
- ▶ Specialised high tech parts for which PU impact is less than 10% of total part cost⁴³.

Figure 4.1 illustrates some of the end user applications that may be affected. These fall into four categories: tyres and wheels; recreation and consumer applications (e.g. golf balls); industrial applications (e.g. power

⁴³ Chemtura, 10 March 2015.

transmission belts, internal pipe liners; and mining, oil and gas applications (e.g. pipeline pigs, mining screens).

In the majority of cases the PU components themselves form part of much larger systems, suggesting any price increase, would be further diluted before the final end use.

Figure 4.1 Cast PU: Example Applications



Source: Chemtura, 5 November 2014. The example products may or may not be manufactured with MbOCA-based systems.

Moreover, consultation with three companies who have successfully switched to LFMDI prepolymer/HQEE, indicates that the costs incurred by those who have undertaken the transition has not affected the final product price as follows:

- ▶ Company B: The final product was not more expensive i.e. costs were not passed on as the company was able to absorb the price increase;
- ▶ Company C: Given price sensitivity of European customers at present and competition from global suppliers, the additional costs were not passed on;
- ▶ Company A: So far the company have not passed any of the additional costs on to their customers. Their raw material costs represent c.25% of their costs, however each product is different, certain products will require large amounts of testing, and others are relatively simple. The costs of raw materials, in relative terms, tends to be greater for products that contain greater quantities of PU. If they were to do so, the company estimate the implication of the additional raw material costs would be between a 1% up to a maximum of 10% increase, depending on the specific application. It should be noted that, since the interview was undertaken, the price differential has reduced, so the increase would be less than this:
- ▶ However, the company reported that the additional raw material costs were offset by cost savings in three ways. First, the company reported some efficiency savings associated with PPE that was required when using MbOCA. Second, the company have experienced a significant reduction in administrative costs (arising from administrative liaison, arising from purchase and storage of MbOCA, costs of disposing MbOCA waste which is designated as hazardous); and

- The company estimated that when these savings were taken into account the net costs were close to zero.

In terms of impacts on final product prices, taking the above into account we expect to see relatively small price increases in some applications and an ability of PU processors to pass the increased costs onto their customers in some circumstances, given the specialised nature of many applications and that the PU components themselves tend to form part of larger final products or systems.

No adverse effects on product durability are expected - indeed some product types may be more durable with LFMDI prepolymer/HQEE - so no increase in costs is expected through the need for more frequent replacement of end products.

4.7 Effects on employment

Chemtura's data on employment amongst EU cast polyurethane processors indicates that there are at least 600 employees of PU processors using MbOCA (i.e. higher than that assumed in the authorisation application).

The processability of LFMDI prepolymer/HQEE systems is such that the existing employees of PU processors would be able to use the expertise of their existing employees (using MbOCA) to produce equivalent cast PU products, using the same equipment. Assuming replacement of TDI prepolymer/MbOCA with LFMDI prepolymer/HQEE is not therefore expected to entail any change in the type/nature of employment amongst PU processors.

Similarly, the economic implications of implementing LFMDI prepolymer/HQEE are not expected to lead to significant increases in product prices, and product quality is expected to be at least as good. Hence competition from any suppliers of finished PU products from outside the EU is not likely to increase as a result of moving away from MbOCA based systems. While the additional raw material costs for PU processors may not be insignificant, if all companies move away from the use of MbOCA, there is not expected to be any adverse effect on competitiveness of the EU, and hence no direct effect on employment. It is recognised that some PU processors will switch to other alternatives, such as TDI prepolymer/DMTDA systems. Likewise here the economic impacts are not expected to lead to any adverse effects on employment.

Indeed, a switch to the alternative(s), with the EU taking a lead in pushing to progressively replace MbOCA use, could lead to an increase in employment in the EU, for example through investment in new plant and technology related to the alternatives (such as Chemtura's recent construction of a plant to manufacture LFMDI prepolymers in Italy⁴⁴) and through the ability to 'export' this technology to other parts of the world, given we may expect them to follow the EU's lead in requiring replacement of MbOCA.

⁴⁴ "Chemtura announces new MDI plant for Italy", UTECH Polyurethane, <http://utech-polyurethane.com/news/chemtura-announces-new-mdi-plant-for-italy/>.

5. Hazards and risks of the alternative

5.1 Concerns with MbOCA

MbOCA is classified as a Category 1B carcinogen. The potential for exposure in the workplace of suppliers (such as Chemtura), as well as PU processors necessitates a range of strict exposure controls to be adopted. As noted earlier in Chemtura's case, this includes swipe testing undertaken at the port of Antwerp, and by the supplier of MbOCA in Asia.

In terms of risks associated with handing finished PU products, laboratory testing by Chemtura has illustrated that, even with high quantities of MbOCA e.g. at 105% theory (95% is considered optimal), concentrations in cured polyurethane articles were a maximum of 680 ppm⁴⁵. In practice in the workplace, there is the possibility for higher concentrations, particularly if the prepolymer is retained in equipment/pipework for any time, where the amount of NCO in the prepolymer decreases, meaning less to react with the curative, and hence more residual curative. This could potentially lead to concentrations of MbOCA in articles above the 0.1% threshold which would necessitate notification to ECHA and provision of information to allow safe use through the supply chain.

Customers continuing to use MbOCA in the event of a granted authorisation would be required to notify their use to ECHA (with consequent likely inspections as part of national enforcement activities). Chemtura understands that this would be a further deterrent to continued use by some of its customers, even if continued use is authorised.

Furthermore, ECHA has recently highlighted to Chemtura that MbOCA is suspected to have PBT properties based on experimental data, modelling predictions, external databases, and/or harmonized/self-classification for toxicity⁴⁶.

5.2 Reduction in hazards and risks with the alternative

Whilst also a supplier of MbOCA, Chemtura has recognised the need for an alternative system, given the expected regulatory controls, and given the inherent hazards of the substance. A substance without the need for such stringent exposure controls would be preferable.

MDI is classified under the CLP Regulation as a Category 2 carcinogen. However, LFMFI prepolymer is not classified as such because the concentration of residual MDI monomer is below 1%, thus reducing the potential exposure of workers. LFMFI prepolymers are however still classified as a Category 1 respiratory sensitiser at between 0.1 and 1% MDI.

HQEE does not have harmonised classification under the CLP Regulation. According to the classification provided by companies to ECHA in REACH registrations this substance is harmful to aquatic life with long lasting effects.

The safety data sheets for LFMFI prepolymers and HQEE are attached as Appendix A.

⁴⁵ Chemtura Analytical Report, 31 August 2012. This information was submitted to the public consultation on prioritisation of MbOCA for inclusion on Annex XIV of REACH.

⁴⁶ Letter from ECHA to Chemtura of 26 January 2016.

6. Availability

6.1 Introduction

MbOCA is not produced in Europe or North America. Instead it is imported primarily from Asia, before being placed on the EU market. There are several suppliers of MbOCA to the EU market. Any alternative would need to have comparable availability within a reasonable timeframe, taking into account the sunset date.

This section examines whether the alternative system is likely to be available in sufficient quantities to meet European demand, assuming MbOCA based systems are either unavailable or demand decreases. The assessment is based on discussions undertaken with Chemtura and the companies noted earlier. It is important to consider both the availability of HQEE as a curative and also of LFMDI prepolymers, in terms of their ability to replace the market currently occupied by MbOCA-based systems.

6.2 Demand

The EU cast polyurethanes market is estimated to amount to around 33,000 tonnes per year (of cured cast polyurethanes). MbOCA-based products are estimated to represent around 5,500t of this amount. MbOCA is typically used at a ratio of 1 part MbOCA to 10 parts prepolymer, and EU sales of MbOCA are estimated at 500 tonnes or less (and up to a maximum of 1,000t per year was assumed in the analysis for sensitivity testing purposes). As noted earlier, extensive research by Chemtura has indicated that the current market is at most 500 tonnes, and is likely be less. The 'high' scenario below assumes 1,000 tonnes and is shown for illustration.

Around 75% of the mass of HQEE is required per unit mass of PU compared to MbOCA. Additional supply of HQEE to the EU market would therefore need to be around 375 tonnes and up to a maximum of 750 tonnes, per year. Demand for LFMDI prepolymers (in the event of a complete switch for all MbOCA-using applications) is expected to be in line with that of TDI/LFTDI prepolymers and remain at some 5,000 tonnes, per year. Demand for the alternative system will increase in line with decreases in demand for the MbOCA-based system. The demand assumption is for a total replacement of MbOCA-based systems in Europe by the sunset date of November 2017⁴⁷.

Table 6.1 Maximum EU demand for LFMDI and HQEE, tonnes per year

	Central	High
MbOCA Demand (2015)	500	1,000
Prepolymer to curative ratio	10:1	10:1
Implied TDI/LFTDI prepolymer demand (2015)	5,000	10,000
Total System demand (2015)	5,500	11,000
HQEE / MbOCA replacement ratio [1]	75%	75%
Implied HQEE demand (Maximum, Nov 2017)	375	750
Implied LFMDI prepolymer demand (Maximum, Nov, 2017)	5,000	10,000
Total System demand (Maximum, Nov, 2017)	5,375	10,750

Source, Based on data provided by Chemtura, 4 November 2014 and 21 June 2016...

⁴⁷ <http://echa.europa.eu/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list/-/substance-rev/76/term?searchname=2%2C2%27-dichloro-4%2C4%27-methylenedianiline+%28MOCA%29&searchecnumber=202-918-9>

Table Notes [1]: Interviews with Company A (Confidential) indicates that this may be a conservative (i.e. high) figure and that in their experience 60% HQEE was required compared to MbOCA. The higher figure has been used for the purposes of the analysis.

6.3 Supply

[#2]

]. Market research reports indicate there are several more HQEE manufacturers. A total of four additional European based companies, a further nine Asian based companies and a further 5 North American were identified in a 2013 report⁴⁸. However, it is of note that some of the EU suppliers may be purchasing HQEE from non-EU firms, for supply to the EU market.

On this basis, the existing HQEE supply is likely to be significantly greater than set out below.

Overall, this suggests that existing HQEE capacity is over [#4], which is clearly sufficient to meet the maximum potential future demand, after making allowance for limited HQEE demand for other applications⁴⁹. It is noted that there has been a significant increase in HQEE capacity in the last 1-2 years, assumed to be in response to the expected need to replace MbOCA.

Table 6.2 HQEE output capability, tonnes per year (2015/2016)

	Current Capacity	Future Capacity	Notes
[#2]	[#2]	[#2]	[#2]
[#2]	[#2]	[#2]	[#2]
[#2]	[#2]	[#2]	[#2]
[#2]	[#2]	[#2]	[#2]
[#2]	[#2]	[#2]	[#2]
[#2]	[#2]	[#2]	[#2]
Total	[#2]	[#2]	

Source: [#2]

In terms of the availability of LFMDI prepolymers, Chemtura is one of the known producers of LFMDI prepolymers. Chemtura's first production plant was based in the USA and the company has recently completed construction of a new plant at Latina in Italy, in order to meet expected demand for LFMDI prepolymers to replace MbOCA-based TDI prepolymer systems. Production at Latina – to supplement that in the USA – began in September 2016, with full capacity expected to be reached by the end of Q1 of 2017. At this point, Chemtura expects to have a capacity of some [#2]. This volume would be

⁴⁸ HQEE (CAS 104-38-1), Market Research Report, 2013. Business Analytics Centre

⁴⁹ The available evidence suggests this is limited. For instance Xiangyaun indicate the 'main use of HQEE is in PU applications' <http://www.chinamboca.com/en/download/HQEE-L.pdf> and Rhein Chemie suggest that main uses are in PU and TPE resins <http://www.tri-iso.com/hein-chemie-addolink-30-10.html>

sufficient to meet demand, even if the current MbOCA market was 1,000, rather than 500 tonnes, given that some companies will use alternative systems (based on the other curatives mentioned previously). Chemtura currently expects [REDACTED] of its customers to move to the LFMDI prepolymer/HQEE system, with the remainder expected to adopt other alternatives.

In addition to Chemtura, it is understood that the company Coim will substantially increase its capacity to produce LFMDI prepolymers (in the USA)⁵⁰, which will further assure the availability of sufficient quantities to meet demand as MbOCA-based systems are replaced.

In practice, not all MbOCA-based systems would be replaced by LFMDI prepolymer/HQEE and Chemtura currently estimates that customers accounting for a large part of their sales would switch to this system, and the others % would switch to other systems (e.g. DMTDA + TDI prepolymer). Because not all PU processors would switch to the LFMDI prepolymer/HQEE alternative, this further confirms that no lack of availability of HQEE on the market would be expected.

Chemtura can provide both ether-based and ester-based LFMDI prepolymers, in a range of different hardness types. The full range of LFMDI ether and ester products have undergone internal validation and are available on the market for evaluation by processors.

⁵⁰ Press release: COIM USA announces the expansion of its Low Free Polyurethane Prepolymers production capacity in New Jersey, USA, <http://www.coimgroup.com/locator.cfm?SectionID=54&PageID=2017>.

7. Conclusion on suitability and availability of the alternative

7.1 Scope of the study

This study has examined the feasibility of substituting MbOCA used with either TDI prepolymers or LFTDI prepolymers in the manufacture of cast polyurethane (PU) products with an alternative 2-component system manufactured by Chemtura. The alternative consists of low free monomer MDI (LFMDI) as the prepolymer, in combination with HQEE as the curative. The alternative is therefore an alternative curative (HQEE), used as part of an alternative system.

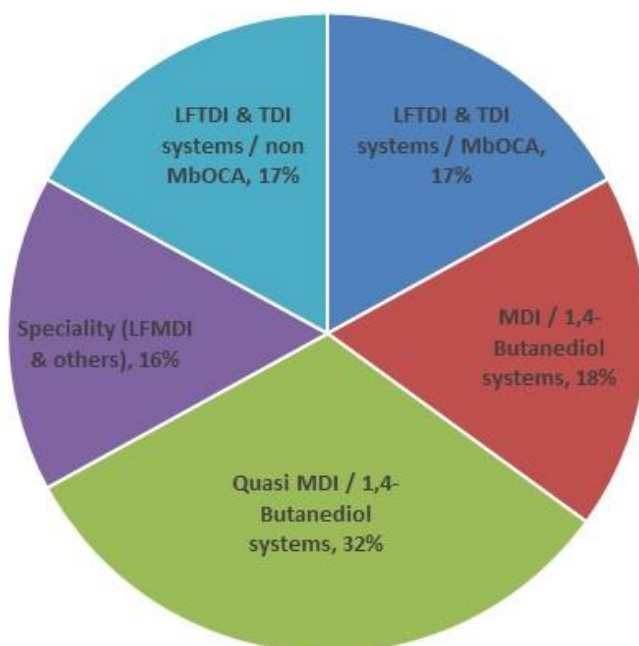
The analysis contained in this report follows the advice of ECHA for the format of submissions of information on alternatives, as part of the public consultation on authorisation applications. As such, the report considers the alternative's properties, its technical and economic feasibility, comparative hazards and risks and whether the alternative is likely to be available in sufficient quantities by the sunset date.

7.2 Hazards and risks of the alternative

Hazards and risks associated with the alternative system are lower. MbOCA is classified as a category 1B carcinogen whereas the alternative has no such classification. LFMDI prepolymers are not classified as a carcinogen because the concentration of free MDI monomer is less than 1%, although it is classified as a category 1 respiratory sensitiser at concentrations between 0.1 and 1% MDI monomer. HQEE does not have harmonised classification under the CLP regulation, and according to the classification provided by companies to ECHA in REACH registrations this substance is classed as harmful to aquatic life with long lasting effects.

7.3 Technical feasibility of substitution

Cast polyurethanes using MbOCA represent less than a quarter of the total EU cast polyurethane market, with different prepolymer/curative systems used by the majority of the market, as shown below – based on a Chemtura estimate of the EU market for cured PU elastomers.



MbOCA-based cast polyurethanes are used in a variety of products, including rolls, wheels, hydrocyclones, dynamic bend stiffeners, power transmission belts, vibratory bowls for metal finishing, gaskets, pump impellers, pipeline pigs, belt scrapers, snow plough blades, internal pipe liners, die pads, railway components and bushings. In some cases the final article may largely comprise polyurethane, while in others it may form only a small part of the end product. Key technical requirements of the alternative in polyurethane systems include long pot-life, giving adequate time to mix pour and fill the mould; robust and reliable processing (i.e. no significant issues with moisture control or errors in stoichiometry); and flexibility of use with either TDI ester or ether systems. Interviews with Chemtura, alongside customers who have switched to the alternative, indicate that these properties can be met with the alternative LFMDI prepolymer and HQEE without adversely affecting the properties of the cast polyurethane.

In terms of processing equipment, most polyurethane processors have capital equipment set up to process TDI prepolymer plus MbOCA as part of a 2-component system, with metering and dispensing equipment for each component (called meter mixes). Quasi systems, marketed by some companies as possible alternatives to TDI prepolymer and MbOCA, use three components (and hence require different meter mix machines). LFMDI prepolymer and HQEE can be used using the same equipment, hence new capital machinery (estimated to cost approximately €180,000 to €300,000 per machine), does not need to be purchased by polyurethane processors. Given that MbOCA is a genotoxic carcinogen, various risk management measures, and including personal protective equipment (PPE) would no longer be required when using LFMDI prepolymer and HQEE, which represents a cost saving for PU processors. These savings have been estimated at around €22,000 on average and up to €41,000 for each company and are based on the avoided costs of biological monitoring for employees and associated personal protective equipment (PPE); ventilation and extraction systems and waste disposal.

Interviews with downstream users – both large and small – who have successfully switched to the alternative indicate that other processing changes include the need to operate moulds at higher (and more precise) temperatures; optimisation of production to minimise waste; alongside familiarisation of staff with these changes.

The most time-critical step in the substitution process is the evaluation of product performance by the final customer. Chemtura's experience with several companies thus far suggests that this typically takes around 6 months, and that the total substitution process takes around 1-2 years, although recent experience indicates that it can often be done more quickly (e.g. within 6-12 months). Overall, the evidence suggests that the alternative system is technically feasible for a wide range of cast PU applications.

7.4 Economic feasibility of substitution

In terms of economic feasibility, major investments in new capital equipment are not expected to be required. Indirect costs associated with testing and evaluation have not been significant. However, raw material costs from the alternative are greater than for MbOCA-based systems, based on greater unit costs for both LFMDI prepolymers (compared to TDI prepolymers or LFTDI prepolymers) as well as for HQEE. Overall system costs, on a per tonne basis, are therefore expected to increase, however the price differential for companies switching from LFTDI prepolymers and MbOCA are lower than for those companies using TDI prepolymers and MbOCA. These costs would be offset to an extent by savings associated with reduced need for risk management measures. These savings have been factored into the analysis below which are based on net costs for an average company. They exclude, however, the costs currently associated with dealing with MbOCA-containing hazardous waste.

Overall assuming the EU MbOCA market is somewhere between 500 tonnes and 1,000 tonnes and based on typical MbOCA usage of 7 tonnes per year (smallest 1 tonne, largest 50 tonnes) average net costs per company would be in the region of [REDACTED] for those switching from TDI prepolymer/MbOCA to LFMDI+HQEE and around [REDACTED] for those switching from LFTDI prepolymer/MbOCA to LFMDI prepolymer/HQEE. For those that currently use both systems, the costs are expected to be around [REDACTED].

When compared to average turnover from within the sector, these costs are small, representing between 2% and up to 6% of turnover. [REDACTED]

For companies that utilise both systems – assuming the EU average split between the two – the costs would be somewhere in the middle, representing between a little over [REDACTED], up to around [REDACTED] of typical margins, depending on the economic data used.

However, anecdotal evidence suggests that margins in some sectors and applications are healthy, and empirical evidence from interviews with companies suggests that some processors are able to absorb the price differential. The price change will be less significant for those companies formerly using LFMDI prepolymer/MbOCA, where there may be less need for the costs to be passed on in the form of higher product prices to their customers. The specialist nature of many applications, as well as the fact that affected articles tend to form part of larger systems, would mitigate the effects. On balance, whilst PU articles in some applications may well increase, the evidence suggests the alternative system is economically feasible for a range of cast PU applications.

7.5 Availability of the alternative

Any alternative would need to have comparable availability within a reasonable timeframe, taking into account the sunset date. Based on estimates of existing EU demand for MbOCA, demand for HQEE is expected to be at maximum between [REDACTED] and [REDACTED] tonnes per year (assuming a complete switch to this alternative) and demand for LFMDI prepolymers is expected to be between 5,000 and 10,000 tonnes. This assumes complete cessation of MbOCA usage and that all companies use the Chemtura alternative, which probably overstates actual demand. Current disclosed supply capacity of HQEE is over [REDACTED] tonnes. Making allowance for limited HQEE demand from other applications, these volumes appear more than sufficient.

In terms of LFMDI prepolymer availability, the prepolymers are currently manufactured by Chemtura in the United States and Europe, with combined production capacity of [REDACTED] tonnes of LFMDI prepolymers expected by Q1 of 2017, some 8 months in advance of the sunset date.

The recent (mid-2016) completion of construction of the new LFMDI prepolymer plant at Chemtura's site in Italy is considered to be a positive example of REACH encouraging innovation in the European chemicals industry.

7.6 Overall conclusion

Given the above, and that downstream user experience indicates substitution need not be a lengthy process, this suggests limited need for a REACH authorisation for MbOCA. Substitution of MbOCA is clearly already ongoing, both with the alternative considered in this report (LFMDI prepolymer/HQEE), as well as other alternative curatives such as DMTDA and BDO. A long authorisation period would curtail this existing process of substitution, as well as disadvantaging those companies that are already replacing MbOCA with safer alternatives, in line with the aim of authorisation.



Appendix A

Example technical data sheets and SDS for LFMDI prepolymer and HQEE

This appendix provides copies of technical data sheets and safety data sheets for some of the most common LFMDI prepolymer based systems produced by Chemtura.

ADIPRENE® LFM E265

Low Free MDI-Terminated Polyether Prepolymer

ADIPRENE® Low Free MDI prepolymers are available in polyether, polyester and polycaprolactone compositions. In comparison to conventional MDI prepolymers, the level of Free MDI is less than 1%.

Benefits of ADIPRENE® LF MDI Prepolymers:

- Unsurpassed Health & Safety
- Excellent Performance
- Superior Processing & High Productivity

Unsurpassed Health & Safety

ADIPRENE® Low Free MDI prepolymers have low free MDI content (1%) for improved health and safety during handling and processing. The ADIPRENE® LF technology enables Chemtura to create a range of complete LF MDI-based systems, including the prepolymer, curative, and catalyst, with a “non-toxic” classification.

Excellent Performance

These systems are often selected as an alternative for TDI and LF TDI-based prepolymers cured with MbOCA. They are especially suited for applications requiring higher end performance, including rollers, mining, oil & gas, and tires & wheels.

Superior Processing & High Productivity

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives offer exceptionally low viscosity and extended pot life up to 8 minutes without a catalyst, enabling the casting of very large and complex parts. With a catalyst, these systems result in shorter demold times which offer the processor the ability to achieve very high productivity. They can be processed using meter-mix machines without the need for retrofitting.

VIBRACURE® Curative Properties	Unit	VIBRACURE® 2101	VIBRACURE® A260
Equivalent Weight		101	93.6
Appearance at Room Temperature		White pellet	White solid
% Theory	%	95	95
Melting Point	°C (°F)	107-110 (225-230)	107 - 100 (225 - 230)
Processing Temperature	°C (°F)	120 (248)	120 (248)

Curative Processing

VIBRACURE® curatives used with ADIPRENE® LF MDI must be processed above their melting temperatures (>120°C) to ensure that process lines, pumps and valves do not block. They can be dried by melting and placing under vacuum. VIBRACURE® A260 is a blend and must be mixed to ensure homogeneity. Mixing can be done prior to uploading to the meter-mix machine tank or within the curative tank via recirculating pump.

Formulation Stoichiometry

When reacting ADIPRENE® Low Free MDI prepolymers with VIBRACURE® curatives, a value of 95% theory is typically used to achieve an optimal balance of physical properties of the cured polyurethane elastomer. Varying the formulation stoichiometry will enable maximization of specific properties and characteristics.

Prepolymer Meltdown Procedure

ADIPRENE® Low Free MDI prepolymers must be pre-heated to 80-85°C for processing. Devices such as melting ovens, thermostatically controlled warming blankets or drum heaters can be used to pre-heat these prepolymers. Approximate pre-heat times at 70°C are:

20.4 Kgs / 1 pail for 10-12 hours
204 Kgs / 1 drum for 16-24 hours

Prepolymer exposed to temperatures lower than 24°C during shipment and/or storage may require longer meltdown times.

Note: Do not loosen the pail or drum to relieve the pressure. This will allow moisture into the prepolymer which can damage the material.

Heat Stability

The NCO content of ADIPRENE® Low Free MDI prepolymers decreases with time upon exposure to heat. Prolonged heat exposure will result in lower than expected final hardness of the cured elastomer and longer demold times. Maximum recommended heating times as a function of temperature are shown below.

Temperature	Duration
70°C	2 Days
85°C	36 Hours

Catalysts

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives require catalysis. Chemtura offers VIBRACAT® catalysts. Depending on the demolding time required, the most appropriate grade will be recommended by the Chemtura Technical Service team.

Meter-Mix Machine Turbine Speed

Due to the very low viscosity of these ADIPRENE® LF MDI systems, the turbine speed for meter-mix machines should be within the region of 1500-2000 rpm to avoid the creation of micro-bubbles within the mixing chamber.

The design of the mixing turbine and the flow output of the machine should be considered when deciding on mixing turbine speed.

Mold Temperatures & Cure Profile

Factors such as final component size, material flow path length & complexity, and required productivity will influence the mold temperature decision.

Typical mold and post cure temperatures are 100-120°C. Typical post cure conditions are 16 hours at 100-120°C.

Demold Time

Demolding times are depending on part thickness and material formulation, including use of catalysts.

Industrial Hygiene

For detailed industrial hygiene information for all ADIPRENE® Low Free MDI prepolymers and VIBRACURE® curatives included in this document, please refer to the relevant Safety Data Sheet (SDS).

For more detailed information on the use of DURACURE® curatives or VIBRACAT® catalysts, please refer to the appropriate technical data sheets.

Prepolymer Properties		Unit	Typical Value
NCO Range		%	2.5 - 2.8
Amine Equivalent			1500 - 1681
Free MDI Content		%	<1.0
Brookfield Viscosity @ 50°C		Centipoise	3900
Brookfield Viscosity @ 70°C		Centipoise	1450
Brookfield Viscosity @ 100°C		Centipoise	540
Density @ 70°C		g/cm ³	1.01
Appearance @ 25°C			White solid
Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	DIN 53505	Shore A or D	80A
50% Modulus	DIN 53504-s2	MPa	4.0
100% Modulus	DIN 53504-s2	MPa	5.1
200% Modulus	DIN 53504-s2	MPa	6.4
300% Modulus	DIN 53504-s2	MPa	7.8
Stress at Break	DIN 53504-s2	MPa	31.5
Strain at Break	DIN 53504-s2	%	763
Tear Strength	DIN 53515 / ISO 34-1	kN/m	62.1
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	94
Rebound Resilience	DIN 53512	%	79
Specific Gravity	DIN 53479		1.06
Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	DIN 53505	Shore A or D	78A
50% Modulus	DIN 53504-s2	MPa	3.5
100% Modulus	DIN 53504-s2	MPa	4.5
200% Modulus	DIN 53504-s2	MPa	5.8
300% Modulus	DIN 53504-s2	MPa	7.2
Stress at Break	DIN 53504-s2	MPa	31.2
Strain at Break	DIN 53504-s2	%	707
Tear Strength	DIN 53515 / ISO 34-1	kN/m	53.8
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	92
Rebound Resilience	DIN 53512	%	76
Specific Gravity	DIN 53479		1.06

The physical properties listed are represented as "Typical". Information contained herein is considered accurate to the best of our knowledge. It is offered for your consideration and investigation, and is not to be construed as a representation or warranty expressed or implied. The "Typical" properties may vary slightly; and the fabricator or end user is responsible for insuring the suitability of our products for their specific application or end use. Refer to the Safety Data Sheet for this product for additional important information relating to the product and its use. The Technical Data Sheet is not intended to be, and should not be relied upon as, a substitute for the detailed health and safety information contained on the Safety Data Sheet. NO PART OF THIS TECHNICAL DATA SHEET CONSTITUTES AN EXPRESS OR IMPLIED REPRESENTATION REGARDING THE CHARACTERISTICS, USE, QUALITY, SAFETY, MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCT. ALL SUCH WARRANTIES ARE EXCLUDED EVEREST, ANDEROL, ROYCO, and PQ and their corresponding logos are characteristics of Chemtura Corporation or its affiliates. Copyright © 2016 Chemtura Corporation. All rights reserved.

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ADIPRENE® LFM E295

Low Free MDI-Terminated Polyether Prepolymer

ADIPRENE® Low Free MDI prepolymers are available in polyether, polyester and polycaprolactone compositions. In comparison to conventional MDI prepolymers, the level of Free MDI is less than 1%.

Benefits of ADIPRENE® LF MDI Prepolymers:

- Unsurpassed Health & Safety
- Excellent Performance
- Superior Processing & High Productivity

Unsurpassed Health & Safety

ADIPRENE® Low Free MDI prepolymers have the low free MDI content (1%) for improved health and safety during handling and processing. The ADIPRENE LF® technology enables Chemtura to create a range of complete LF MDI-based systems, including the prepolymer, curative, and catalyst, with a “non-toxic” classification.

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These systems are often selected as an alternative for TDI and LF TDI-based prepolymers cured with MbOCA. They are especially suited for applications requiring higher end performance, including rollers, mining, oil & gas, and tires & wheels.

Superior Processing & High Productivity

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives offer exceptionally low viscosity and extended pot life up to 8 minutes without a catalyst, enabling the casting of very large and complex parts. With a catalyst, these systems result in shorter demold times which offer the processor the ability to achieve very high productivity. They can be processed using meter-mix machines without the need for retrofitting.

VIBRACURE® Curative Properties	Unit	VIBRACURE® 2101	VIBRACURE® A260
Equivalent Weight		101	93.6
Appearance at Room Temperature		White pellet	White solid
% Theory	%	95	95
Melting Point	°C (°F)	107-110 (225-230)	107 - 100 (225 - 230)
Processing Temperature	°C (°F)	120 (248)	120 (248)

Curative Processing

VIBRACURE® curatives used with ADIPRENE® LF MDI must be processed above their melting temperatures (>120°C) to ensure that process lines, pumps and valves do not block. They can be dried by melting and placing under vacuum. VIBRACURE® A260 is a blend and must be mixed to ensure homogeneity. Mixing can be done prior to uploading to the meter-mix machine tank or within the curative tank via recirculating pump.

Formulation Stoichiometry

When reacting ADIPRENE® Low Free MDI prepolymers with VIBRACURE® curatives, a value of 95% theory is typically used to achieve an optimal balance of physical properties of the cured polyurethane elastomer. Varying the formulation stoichiometry will enable maximization of specific properties and characteristics.

Prepolymer Meltdown Procedure

ADIPRENE® Low Free MDI prepolymers must be pre-heated to 80-85°C for processing. Devices such as melting ovens, thermostatically controlled warming blankets or drum heaters can be used to pre-heat these prepolymers. Approximate pre-heat times at 70°C are:

20.4 Kgs / 1 pail for 10-12 hours
204 Kgs / 1 drum for 16-24 hours

Prepolymer exposed to temperatures lower than 24°C during shipment and/or storage may require longer meltdown times.

Note: Do not loosen the pail or drum to relieve the pressure. This will allow moisture into the prepolymer which can damage the material.

Heat Stability

The NCO content of ADIPRENE® Low Free MDI prepolymers decreases with time upon exposure to heat. Prolonged heat exposure will result in lower than expected final hardness of the cured elastomer and longer demold times. Maximum recommended heating times as a function of temperature are shown below.

Temperature	Duration
70°C	2 Days
85°C	36 Hours

Catalysts

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives require catalysis. Chemtura offers VIBRACAT® catalysts. Depending on the demolding time required, the most appropriate grade will be recommended by the Chemtura Technical Service team.

Meter-Mix Machine Turbine Speed

Due to the very low viscosity of these ADIPRENE® LF MDI systems, the turbine speed for meter-mix machines should be within the region of 1500-2000 rpm to avoid the creation of micro-bubbles within the mixing chamber.

The design of the mixing turbine and the flow output of the machine should be considered when deciding on mixing turbine speed.

Mold Temperatures & Cure Profile

Factors such as final component size, material flow path length & complexity, and required productivity will influence the mold temperature decision. Typical mold and post cure temperatures are 100-120°C. Typical post cure conditions are 16 hours at 100-120°C.

Demold Time

Demolding times are depending on part thickness and material formulation, including use of catalysts.

Industrial Hygiene

For detailed industrial hygiene information for all ADIPRENE® Low Free MDI prepolymers and VIBRACURE® curatives included in this document, please refer to the relevant Safety Data Sheet (SDS).

For more detailed information on the use of DURACURE® curatives or VIBRACAT® catalysts, please refer to the appropriate technical data sheets.

Prepolymer Properties		Unit	Typical Value
NCO Range		%	2.8-3.1
Amine Equivalent			1356-1501
Free MDI Content		%	< 1.0
Brookfield Viscosity @ 50°C		Centipoise	3,900
Brookfield Viscosity @ 70°C		Centipoise	1,500
Brookfield Viscosity @ 100°C		Centipoise	530
Density @ 70°C		g/cm ³	1.008
Appearance @ 25°C			White solid

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	DIN 53505	Shore A or D	86A
50% Modulus	DIN 53504-s2	MPa	4.0
100% Modulus	DIN 53504-s2	MPa	5.0
200% Modulus	DIN 53504-s2	MPa	6.2
300% Modulus	DIN 53504-s2	MPa	7.5
Stress at Break	DIN 53504-s2	MPa	40.6
Strain at Break	DIN 53504-s2	%	733
Tear Strength	DIN 53515 / ISO 34-1	kN/m	75.8
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	93
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	41
Specific Gravity	DIN 53479		1.06

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	DIN 53505	Shore A or D	80A
50% Modulus	DIN 53504-s2	MPa	3.3
100% Modulus	DIN 53504-s2	MPa	4.4
200% Modulus	DIN 53504-s2	MPa	5.5
300% Modulus	DIN 53504-s2	MPa	7.1
Stress at Break	DIN 53504-s2	MPa	36.3
Strain at Break	DIN 53504-s2	%	655
Tear Strength	DIN 53515 / ISO 34-1	kN/m	62.3
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	81
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	35
Specific Gravity	DIN 53479		1.06

The physical properties listed are represented as "Typical". Information contained herein is considered accurate to the best of our knowledge. It is offered for your consideration and investigation, and is not to be construed as a representation or warranty expressed or implied. The "Typical" properties may vary slightly; and the fabricator or end user is responsible for insuring the suitability of our products for their specific application or end use. Refer to the Safety Data Sheet for this product for additional important information relating to the product and its use. The Technical Data Sheet is not intended to be, and should not be relied upon as, a substitute for the detailed health and safety information contained on the Safety Data Sheet. NO PART OF THIS TECHNICAL DATA SHEET CONSTITUTES AN EXPRESS OR IMPLIED REPRESENTATION REGARDING THE CHARACTERISTICS, USE, QUALITY, SAFETY, MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCT. ALL SUCH WARRANTIES ARE EXCLUDED EVEREST, ANDEROL, ROYCO, and PQ and their corresponding logos are characteristics of Chemtura Corporation or its affiliates. Copyright © 2016 Chemtura Corporation. All rights reserved.

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ADIPRENE® LFM E370

Low Free MDI-Terminated Polyether Prepolymer

ADIPRENE® Low Free MDI prepolymers are available in polyether, polyester and polycaprolactone compositions. In comparison to conventional MDI prepolymers, the level of Free MDI is less than 1%.

Benefits of ADIPRENE® LF MDI Prepolymers:

- Unsurpassed Health & Safety
- Excellent Performance
- Superior Processing & High Productivity

Unsurpassed Health & Safety

ADIPRENE® Low Free MDI prepolymers have low free MDI content (1%) for improved health and safety during handling and processing. The ADIPRENE® LF technology enables Chemtura to create a range of complete LF MDI-based systems, including the prepolymer, curative, and catalyst, with a “non-toxic” classification.

Excellent Performance

These systems are often selected as an alternative for TDI and LF TDI-based prepolymers cured with MbOCA. They are especially suited for applications requiring higher end performance, including rollers, mining, oil & gas, and tires & wheels.

Superior Processing & High Productivity

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives offer exceptionally low viscosity and extended pot life up to 8 minutes without a catalyst, enabling the casting of very large and complex parts. With a catalyst, these systems result in shorter demold times which offer the processor the ability to achieve very high productivity. They can be processed using meter-mix machines without the need for retrofitting.

VIBRACURE® Curative Properties	Unit	VIBRACURE® 2101	VIBRACURE® A260
Equivalent Weight		101	93.6
Appearance at Room Temperature		White pellet	White solid
% Theory	%	95	95
Melting Point	°C (°F)	107-110 (225-230)	107 - 100 (225 - 230)
Processing Temperature	°C (°F)	120 (248)	120 (248)

Curative Processing

VIBRACURE® curatives used with ADIPRENE® LF MDI must be processed above their melting temperatures (>120°C) to ensure that process lines, pumps and valves do not block. They can be dried by melting and placing under vacuum. VIBRACURE® A260 is a blend and must be mixed to ensure homogeneity. Mixing can be done prior to uploading to the meter-mix machine tank or within the curative tank via recirculating pump.

Formulation Stoichiometry

When reacting ADIPRENE® Low Free MDI prepolymers with VIBRACURE® curatives, a value of 95% theory is typically used to achieve an optimal balance of physical properties of the cured polyurethane elastomer. Varying the formulation stoichiometry will enable maximization of specific properties and characteristics.

Prepolymer Meltdown Procedure

ADIPRENE® Low Free MDI prepolymers must be pre-heated to 80-85°C for processing. Devices such as melting ovens, thermostatically controlled warming blankets or drum heaters can be used to pre-heat these prepolymers. Approximate pre-heat times at 70°C are:

20.4 Kgs / 1 pail for 10-12 hours
204 Kgs / 1 drum for 16-24 hours

Prepolymer exposed to temperatures lower than 24°C during shipment and/or storage may require longer meltdown times.

Note: Do not loosen the pail or drum to relieve the pressure. This will allow moisture into the prepolymer which can damage the material.

Heat Stability

The NCO content of ADIPRENE® Low Free MDI prepolymers decreases with time upon exposure to heat. Prolonged heat exposure will result in lower than expected final hardness of the cured elastomer and longer demold times. Maximum recommended heating times as a function of temperature are shown below.

Temperature	Duration
70°C	2 Days
85°C	36 Hours

Catalysts

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives require catalysis. Chemtura offers VIBRACAT® catalysts. Depending on the demolding time required, the most appropriate grade will be recommended by the Chemtura Technical Service team.

Meter-Mix Machine Turbine Speed

Due to the very low viscosity of these ADIPRENE® LF MDI systems, the turbine speed for meter-mix machines should be within the region of 1500-2000 rpm to avoid the creation of micro-bubbles within the mixing chamber.

The design of the mixing turbine and the flow output of the machine should be considered when deciding on mixing turbine speed.

Mold Temperatures & Cure Profile

Factors such as final component size, material flow path length & complexity, and required productivity will influence the mold temperature decision.

Typical mold and post cure temperatures are 100-120°C. Typical post cure conditions are 16 hours at 100-120°C.

Demold Time

Demolding times are depending on part thickness and material formulation, including use of catalysts.

Industrial Hygiene

For detailed industrial hygiene information for all ADIPRENE® Low Free MDI prepolymers and VIBRACURE® curatives included in this document, please refer to the relevant Safety Data Sheet (SDS).

For more detailed information on the use of DURACURE® curatives or VIBRACAT® catalysts, please refer to the appropriate technical data sheets.

Prepolymer Properties		Unit	Typical Value
NCO Range		%	3.5-3.9
Amine Equivalent			1077-1201
Free MDI Content		%	< 1.0
Brookfield Viscosity @ 50°C		Centipoise	4890
Brookfield Viscosity @ 70°C		Centipoise	1925
Brookfield Viscosity @ 100°C		Centipoise	700
Density @ 70°C		g/cm ³	1.01
Appearance @ 25°C			White solid

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	DIN 53505	Shore A or D	90A
50% Modulus	DIN 53504-s2	MPa	5.9
100% Modulus	DIN 53504-s2	MPa	6.9
200% Modulus	DIN 53504-s2	MPa	8.3
300% Modulus	DIN 53504-s2	MPa	10.3
Stress at Break	DIN 53504-s2	MPa	39.6
Strain at Break	DIN 53504-s2	%	500
Tear Strength	DIN 53515 / ISO 34-1	kN/m	79.1
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	49.8
Rebound Resilience	DIN 53512	%	72.6
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	36
Specific Gravity	DIN 53479		1.08

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	DIN 53505	Shore A or D	85A
50% Modulus	DIN 53504-s2	MPa	4.4
100% Modulus	DIN 53504-s2	MPa	5.7
200% Modulus	DIN 53504-s2	MPa	7.4
300% Modulus	DIN 53504-s2	MPa	9.4
Stress at Break	DIN 53504-s2	MPa	37.1
Strain at Break	DIN 53504-s2	%	493
Tear Strength	DIN 53515 / ISO 34-1	kN/m	64.7
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	49.5
Rebound Resilience	DIN 53512	%	68.3
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	25
Specific Gravity	DIN 53479		1.08

Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	ASTM D2240	Shore A or D	90A
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	5.9
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	7.2
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	8.5
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	10.1
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	24.0
Strain at Break	ASTM D412 Die C / ISO 037 II	%	517
Tear Strength	ASTM D624 Die C	kN/m	82.1
Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	ASTM D2240	Shore A or D	85A
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	4.5
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	5.9
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	7.6
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	9.6
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	23.7
Strain at Break	ASTM D412 Die C / ISO 037 II	%	478
Tear Strength	ASTM D624 Die C	kN/m	69.3

Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Твердость	DIN 53505A	ед. Шор A(D)	90A
Модуль при 50% растяжении	GOST 270-75 Type II	мПа	5.2
Модуль при 100% растяжении	GOST 270-75 Type II	мПа	6.5
Модуль при 200% растяжении	GOST 270-75 Type II	мПа	7.7
Модуль при 300% растяжении	GOST 270-75 Type II	мПа	9.2
Предел прочности на разрыв	GOST 270-75 Type II	мПа	32.0
Относительное удлинение при разрыве	GOST 270-75 Type II	%	558
Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Твердость	DIN 53505A	ед. Шор A(D)	85A
Модуль при 50% растяжении	GOST 270-75 Type II	мПа	4.2
Модуль при 100% растяжении	GOST 270-75 Type II	мПа	5.5
Модуль при 200% растяжении	GOST 270-75 Type II	мПа	7.1
Модуль при 300% растяжении	GOST 270-75 Type II	мПа	9.0
Предел прочности на разрыв	GOST 270-75 Type II	мПа	28.9
Относительное удлинение при разрыве	GOST 270-75 Type II	%	502

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ADIPRENE® LFM E450

Low Free MDI-Terminated Polyether Prepolymer

ADIPRENE® Low Free MDI prepolymers are available in polyether, polyester and polycaprolactone compositions. In comparison to conventional MDI prepolymers, the level of Free MDI is less than 1%.

Benefits of ADIPRENE® LF MDI Prepolymers:

- Unsurpassed Health & Safety
- Excellent Performance
- Superior Processing & High Productivity

Unsurpassed Health & Safety

ADIPRENE® Low Free MDI prepolymers have low free MDI content (1%) for improved health and safety during handling and processing. The ADIPRENE® LF technology enables Chemtura to create a range of complete LF MDI-based systems, including the prepolymer, curative, and catalyst, with a “non-toxic” classification.

Excellent Performance

These systems are often selected as an alternative for TDI and LF TDI-based prepolymers cured with MbOCA. They are especially suited for applications requiring higher end performance, including rollers, mining, oil & gas, and tires & wheels.

Superior Processing & High Productivity

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives offer exceptionally low viscosity and extended pot life up to 8 minutes without a catalyst, enabling the casting of very large and complex parts. With a catalyst, these systems result in shorter demold times which offer the processor the ability to achieve very high productivity. They can be processed using meter-mix machines without the need for retrofitting.

VIBRACURE® Curative Properties	Unit	VIBRACURE® 2101	VIBRACURE® A260
Equivalent Weight		101	93.6
Appearance at Room Temperature		White pellet	White solid
% Theory	%	95	95
Melting Point	°C (°F)	107-110 (225-230)	107 - 100 (225 - 230)
Processing Temperature	°C (°F)	120 (248)	120 (248)

Curative Processing

VIBRACURE® curatives used with ADIPRENE® LF MDI must be processed above their melting temperatures (>120°C) to ensure that process lines, pumps and valves do not block. They can be dried by melting and placing under vacuum. VIBRACURE® A260 is a blend and must be mixed to ensure homogeneity. Mixing can be done prior to uploading to the meter-mix machine tank or within the curative tank via recirculating pump.

Formulation Stoichiometry

When reacting ADIPRENE® Low Free MDI prepolymers with VIBRACURE® curatives, a value of 95% theory is typically used to achieve an optimal balance of physical properties of the cured polyurethane elastomer. Varying the formulation stoichiometry will enable maximization of specific properties and characteristics.

Prepolymer Meltdown Procedure

ADIPRENE® Low Free MDI prepolymers must be pre-heated to 80-85°C for processing. Devices such as melting ovens, thermostatically controlled warming blankets or drum heaters can be used to pre-heat these prepolymers. Approximate pre-heat times at 70°C are:

20.4 Kgs / 1 pail for 10-12 hours
204 Kgs / 1 drum for 16-24 hours

Prepolymer exposed to temperatures lower than 24°C during shipment and/or storage may require longer meltdown times.

Note: Do not loosen the pail or drum to relieve the pressure. This will allow moisture into the prepolymer which can damage the material.

Heat Stability

The NCO content of ADIPRENE® Low Free MDI prepolymers decreases with time upon exposure to heat. Prolonged heat exposure will result in lower than expected final hardness of the cured elastomer and longer demold times. Maximum recommended heating times as a function of temperature are shown below.

Temperature	Duration
70°C	2 Days
85°C	36 Hours

Catalysts

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives require catalysis. Chemtura offers VIBRACAT® catalysts. Depending on the demolding time required, the most appropriate grade will be recommended by the Chemtura Technical Service team.

Meter-Mix Machine Turbine Speed

Due to the very low viscosity of these ADIPRENE® LF MDI systems, the turbine speed for meter-mix machines should be within the region of 1500-2000 rpm to avoid the creation of micro-bubbles within the mixing chamber.

The design of the mixing turbine and the flow output of the machine should be considered when deciding on mixing turbine speed.

Mold Temperatures & Cure Profile

Factors such as final component size, material flow path length & complexity, and required productivity will influence the mold temperature decision.

Typical mold and post cure temperatures are 100-120°C. Typical post cure conditions are 16 hours at 100-120°C.

Demold Time

Demolding times are depending on part thickness and material formulation, including use of catalysts.

Industrial Hygiene

For detailed industrial hygiene information for all ADIPRENE® Low Free MDI prepolymers and VIBRACURE® curatives included in this document, please refer to the relevant Safety Data Sheet (SDS).

For more detailed information on the use of DURACURE® curatives or VIBRACAT® catalysts, please refer to the appropriate technical data sheets.

Prepolymer Properties		Unit	Typical Value
NCO Range		%	4.3-4.7
Amine Equivalent			894-977
Free MDI Content		%	< 1.0
Brookfield Viscosity @ 50°C		Centipoise	4225
Brookfield Viscosity @ 70°C		Centipoise	1480
Brookfield Viscosity @ 100°C		Centipoise	460
Density @ 70°C		g/cm ³	1.04
Appearance @ 25°C			White solid

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	DIN 53505	Shore A or D	93A
50% Modulus	DIN 53504-s2	MPa	8.5
100% Modulus	DIN 53504-s2	MPa	9.8
200% Modulus	DIN 53504-s2	MPa	10.9
300% Modulus	DIN 53504-s2	MPa	12.9
Stress at Break	DIN 53504-s2	MPa	50.0
Strain at Break	DIN 53504-s2	%	508
Tear Strength	DIN 53515 / ISO 34-1	kN/m	80.0
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	37.0
Rebound Resilience	DIN 53512	%	62.6
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	29.7
Specific Gravity	DIN 53479		1.12

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	DIN 53505	Shore A or D	91A
50% Modulus	DIN 53504-s2	MPa	6.5
100% Modulus	DIN 53504-s2	MPa	8.0
200% Modulus	DIN 53504-s2	MPa	9.5
300% Modulus	DIN 53504-s2	MPa	11.1
Stress at Break	DIN 53504-s2	MPa	32.3
Strain at Break	DIN 53504-s2	%	547
Tear Strength	DIN 53515 / ISO 34-1	kN/m	71.0
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	39.4
Rebound Resilience	DIN 53512	%	60.4
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	29.2
Specific Gravity	DIN 53479		1.10

Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	ASTM D2240	Shore A or D	93A
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	10.0
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	11.3
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	12.4
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	14.5
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	38.2
Strain at Break	ASTM D412 Die C / ISO 037 II	%	487
Tear Strength	ASTM D624 Die C	kN/m	99
Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	ASTM D2240	Shore A or D	91A
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	8.1
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	9.8
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	11.5
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	14.7
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	29.3
Strain at Break	ASTM D412 Die C / ISO 037 II	%	402
Tear Strength	ASTM D624 Die C	kN/m	81

Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Твердость	DIN 53505A	ед. Шор A(D)	93A
Модуль при 50% растяжении	GOST 270-75 Type II	мПа	8.5
Модуль при 100% растяжении	GOST 270-75 Type II	мПа	9.9
Модуль при 200% растяжении	GOST 270-75 Type II	мПа	10.9
Модуль при 300% растяжении	GOST 270-75 Type II	мПа	12.5
Предел прочности на разрыв	GOST 270-75 Type II	мПа	41.7
Относительное удлинение при разрыве	GOST 270-75 Type II	%	542
Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Твердость	DIN 53505A	ед. Шор A(D)	91A
Модуль при 50% растяжении	GOST 270-75 Type II	мПа	6.3
Модуль при 100% растяжении	GOST 270-75 Type II	мПа	8.0
Модуль при 200% растяжении	GOST 270-75 Type II	мПа	9.7
Модуль при 300% растяжении	GOST 270-75 Type II	мПа	11.8
Предел прочности на разрыв	GOST 270-75 Type II	мПа	32.7
Относительное удлинение при разрыве	GOST 270-75 Type II	%	493

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ADIPRENE® LFM E500

Low Free MDI-Terminated Polyether Prepolymer

ADIPRENE® Low Free MDI prepolymers are available in polyether, polyester and polycaprolactone compositions. In comparison to conventional MDI prepolymers, the level of Free MDI is less than 1%.

Benefits of ADIPRENE® LF MDI Prepolymers:

- Unsurpassed Health & Safety
- Excellent Performance
- Superior Processing & High Productivity

Unsurpassed Health & Safety

ADIPRENE® Low Free MDI prepolymers have low free MDI content (1%) for improved health and safety during handling and processing. The ADIPRENE® LF technology enables Chemtura to create a range of complete LF MDI-based systems, including the prepolymer, curative, and catalyst, with a “non-toxic” classification.

Excellent Performance

These systems are often selected as an alternative for TDI and LF TDI-based prepolymers cured with MbOCA. They are especially suited for applications requiring higher end performance, including rollers, mining, oil & gas, and tires & wheels.

Superior Processing & High Productivity

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives offer exceptionally low viscosity and extended pot life up to 8 minutes without a catalyst, enabling the casting of very large and complex parts. With a catalyst, these systems result in shorter demold times which offer the processor the ability to achieve very high productivity. They can be processed using meter-mix machines without the need for retrofitting.

VIBRACURE® Curative Properties	Unit	VIBRACURE® 2101	VIBRACURE® A260
Equivalent Weight		101	93.6
Appearance at Room Temperature		White pellet	White solid
% Theory	%	95	95
Melting Point	°C (°F)	107-110 (225-230)	107 - 100 (225 - 230)
Processing Temperature	°C (°F)	120 (248)	120 (248)

Curative Processing

VIBRACURE® curatives used with ADIPRENE® LF MDI must be processed above their melting temperatures (>120°C) to ensure that process lines, pumps and valves do not block. They can be dried by melting and placing under vacuum. VIBRACURE® A260 is a blend and must be mixed to ensure homogeneity. Mixing can be done prior to uploading to the meter-mix machine tank or within the curative tank via recirculating pump.

Formulation Stoichiometry

When reacting ADIPRENE® Low Free MDI prepolymers with VIBRACURE® curatives, a value of 95% theory is typically used to achieve an optimal balance of physical properties of the cured polyurethane elastomer. Varying the formulation stoichiometry will enable maximization of specific properties and characteristics.

Prepolymer Meltdown Procedure

ADIPRENE® Low Free MDI prepolymers must be pre-heated to 80-85°C for processing. Devices such as melting ovens, thermostatically controlled warming blankets or drum heaters can be used to pre-heat these prepolymers. Approximate pre-heat times at 70°C are:

20.4 Kgs / 1 pail for 10-12 hours
204 Kgs / 1 drum for 16-24 hours

Prepolymer exposed to temperatures lower than 24°C during shipment and/or storage may require longer meltdown times.

Note: Do not loosen the pail or drum to relieve the pressure. This will allow moisture into the prepolymer which can damage the material.

Heat Stability

The NCO content of ADIPRENE® Low Free MDI prepolymers decreases with time upon exposure to heat. Prolonged heat exposure will result in lower than expected final hardness of the cured elastomer and longer demold times. Maximum recommended heating times as a function of temperature are shown below.

Temperature	Duration
70°C	2 Days
85°C	36 Hours

Catalysts

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives require catalysis. Chemtura offers VIBRACAT® catalysts. Depending on the demolding time required, the most appropriate grade will be recommended by the Chemtura Technical Service team.

Meter-Mix Machine Turbine Speed

Due to the very low viscosity of these ADIPRENE® LF MDI systems, the turbine speed for meter-mix machines should be within the region of 1500-2000 rpm to avoid the creation of micro-bubbles within the mixing chamber.

The design of the mixing turbine and the flow output of the machine should be considered when deciding on mixing turbine speed.

Mold Temperatures & Cure Profile

Factors such as final component size, material flow path length & complexity, and required productivity will influence the mold temperature decision.

Typical mold and post cure temperatures are 100-120°C. Typical post cure conditions are 16 hours at 100-120°C.

Demold Time

Demolding times are depending on part thickness and material formulation, including use of catalysts.

Industrial Hygiene

For detailed industrial hygiene information for all ADIPRENE® Low Free MDI prepolymers and VIBRACURE® curatives included in this document, please refer to the relevant Safety Data Sheet (SDS).

For more detailed information on the use of DURACURE® curatives or VIBRACAT® catalysts, please refer to the appropriate technical data sheets.

Prepolymer Properties		Unit	Typical Value
NCO Range		%	4.8-5.2
Amine Equivalent			808-875
Free MDI Content		%	< 1.0
Brookfield Viscosity @ 50°C		Centipoise	3090
Brookfield Viscosity @ 70°C		Centipoise	1100
Brookfield Viscosity @ 100°C		Centipoise	332
Density @ 70°C		g/cm ³	1.08
Appearance @ 25°C			White solid

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	DIN 53505	Shore A or D	95A
50% Modulus	DIN 53504-s2	MPa	9.1
100% Modulus	DIN 53504-s2	MPa	10.1
200% Modulus	DIN 53504-s2	MPa	11.0
300% Modulus	DIN 53504-s2	MPa	13.0
Stress at Break	DIN 53504-s2	MPa	42.8
Strain at Break	DIN 53504-s2	%	487
Tear Strength	DIN 53515 / ISO 34-1	kN/m	102.9
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	46.9
Rebound Resilience	DIN 53512	%	58.0
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	29.5
Specific Gravity	DIN 53479		1.12

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	DIN 53505	Shore A or D	92A
50% Modulus	DIN 53504-s2	MPa	6.7
100% Modulus	DIN 53504-s2	MPa	8.1
200% Modulus	DIN 53504-s2	MPa	9.6
300% Modulus	DIN 53504-s2	MPa	12.1
Stress at Break	DIN 53504-s2	MPa	42.2
Strain at Break	DIN 53504-s2	%	458
Tear Strength	DIN 53515 / ISO 34-1	kN/m	88.3
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	45.6
Rebound Resilience	DIN 53512	%	52.0
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	27.9
Specific Gravity	DIN 53479		1.11

Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	ASTM D2240	Shore A or D	95A
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	10.1
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	11.0
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	11.7
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	13.2
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	29.9
Strain at Break	ASTM D412 Die C / ISO 037 II	%	486
Tear Strength	ASTM D624 Die C	kN/m	107
Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	ASTM D2240	Shore A or D	92A
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	7.6
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	9.1
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	10.4
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	12.2
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	28.5
Strain at Break	ASTM D412 Die C / ISO 037 II	%	485
Tear Strength	ASTM D624 Die C	kN/m	100

Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Твердость	DIN 53505A	ед. Шор A(D)	95A
Модуль при 50% растяжении	GOST 270-75 Type II	мПа	9.1
Модуль при 100% растяжении	GOST 270-75 Type II	мПа	10.2
Модуль при 200% растяжении	GOST 270-75 Type II	мПа	10.9
Модуль при 300% растяжении	GOST 270-75 Type II	мПа	12.4
Предел прочности на разрыв	GOST 270-75 Type II	мПа	33.8
Относительное удлинение при разрыве	GOST 270-75 Type II	%	501
Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Твердость	DIN 53505A	ед. Шор A(D)	92A
Модуль при 50% растяжении	GOST 270-75 Type II	мПа	6.8
Модуль при 100% растяжении	GOST 270-75 Type II	мПа	8.3
Модуль при 200% растяжении	GOST 270-75 Type II	мПа	9.7
Модуль при 300% растяжении	GOST 270-75 Type II	мПа	11.7
Предел прочности на разрыв	GOST 270-75 Type II	мПа	29.2
Относительное удлинение при разрыве	GOST 270-75 Type II	%	465

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ADIPRENE® LFM E615

Low Free MDI-Terminated Polyether Prepolymer

ADIPRENE® Low Free MDI prepolymers are available in polyether, polyester and polycaprolactone compositions. In comparison to conventional MDI prepolymers, the level of Free MDI is less than 1%.

Benefits of ADIPRENE® LF MDI Prepolymers:

- Unsurpassed Health & Safety
- Excellent Performance
- Superior Processing & High Productivity

Unsurpassed Health & Safety

ADIPRENE® Low Free MDI prepolymers have low free MDI content (1%) for improved health and safety during handling and processing. The ADIPRENE® LF technology enables Chemtura to create a range of complete LF MDI-based systems, including the prepolymer, curative, and catalyst, with a “non-toxic” classification.

Excellent Performance

These systems are often selected as an alternative for TDI and LF TDI-based prepolymers cured with MbOCA. They are especially suited for applications requiring higher end performance, including rollers, mining, oil & gas, and tires & wheels.

Superior Processing & High Productivity

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives offer exceptionally low viscosity and extended pot life up to 8 minutes without a catalyst, enabling the casting of very large and complex parts. With a catalyst, these systems result in shorter demold times which offer the processor the ability to achieve very high productivity. They can be processed using meter-mix machines without the need for retrofitting.

VIBRACURE® Curative Properties	Unit	VIBRACURE® 2101	VIBRACURE® A260
Equivalent Weight		101	93.6
Appearance at Room Temperature		White pellet	White solid
% Theory	%	95	95
Melting Point	°C (°F)	107-110 (225-230)	107 - 100 (225 - 230)
Processing Temperature	°C (°F)	120 (248)	120 (248)

Curative Processing

VIBRACURE® curatives used with ADIPRENE® LF MDI must be processed above their melting temperatures (>120°C) to ensure that process lines, pumps and valves do not block. They can be dried by melting and placing under vacuum. VIBRACURE® A260 is a blend and must be mixed to ensure homogeneity. Mixing can be done prior to uploading to the meter-mix machine tank or within the curative tank via recirculating pump.

Formulation Stoichiometry

When reacting ADIPRENE® Low Free MDI prepolymers with VIBRACURE® curatives, a value of 95% theory is typically used to achieve an optimal balance of physical properties of the cured polyurethane elastomer. Varying the formulation stoichiometry will enable maximization of specific properties and characteristics.

Prepolymer Meltdown Procedure

ADIPRENE® Low Free MDI prepolymers must be pre-heated to 80-85°C for processing. Devices such as melting ovens, thermostatically controlled warming blankets or drum heaters can be used to pre-heat these prepolymers. Approximate pre-heat times at 70°C are:

20.4 Kgs / 1 pail for 10-12 hours
204 Kgs / 1 drum for 16-24 hours

Prepolymer exposed to temperatures lower than 24°C during shipment and/or storage may require longer meltdown times.

Note: Do not loosen the pail or drum to relieve the pressure. This will allow moisture into the prepolymer which can damage the material.

Heat Stability

The NCO content of ADIPRENE® Low Free MDI prepolymers decreases with time upon exposure to heat. Prolonged heat exposure will result in lower than expected final hardness of the cured elastomer and longer demold times. Maximum recommended heating times as a function of temperature are shown below.

Temperature	Duration
70°C	2 Days
85°C	36 Hours

Catalysts

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives require catalysis. Chemtura offers VIBRACAT® catalysts. Depending on the demolding time required, the most appropriate grade will be recommended by the Chemtura Technical Service team.

Meter-Mix Machine Turbine Speed

Due to the very low viscosity of these ADIPRENE® LF MDI systems, the turbine speed for meter-mix machines should be within the region of 1500-2000 rpm to avoid the creation of micro-bubbles within the mixing chamber.

The design of the mixing turbine and the flow output of the machine should be considered when deciding on mixing turbine speed.

Mold Temperatures & Cure Profile

Factors such as final component size, material flow path length & complexity, and required productivity will influence the mold temperature decision.

Typical mold and post cure temperatures are 100-120°C. Typical post cure conditions are 16 hours at 100-120°C.

Demold Time

Demolding times are depending on part thickness and material formulation, including use of catalysts.

Industrial Hygiene

For detailed industrial hygiene information for all ADIPRENE® Low Free MDI prepolymers and VIBRACURE® curatives included in this document, please refer to the relevant Safety Data Sheet (SDS).

For more detailed information on the use of DURACURE® curatives or VIBRACAT® catalysts, please refer to the appropriate technical data sheets.

Prepolymer Properties		Unit	Typical Value
NCO Range		%	5.95-6.35
Amine Equivalent			662-706
Free MDI Content		%	< 1.0
Brookfield Viscosity @ 50°C		Centipoise	3600
Brookfield Viscosity @ 70°C		Centipoise	1100
Brookfield Viscosity @ 100°C		Centipoise	300
Density @ 70°C		g/cm ³	1.12
Appearance @ 25°C			White solid

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	DIN 53505	Shore A or D	55D
50% Modulus	DIN 53504-s2	MPa	15.9
100% Modulus	DIN 53504-s2	MPa	17.3
200% Modulus	DIN 53504-s2	MPa	18.7
300% Modulus	DIN 53504-s2	MPa	23.1
Stress at Break	DIN 53504-s2	MPa	67.0
Strain at Break	DIN 53504-s2	%	506
Tear Strength	DIN 53515 / ISO 34-1	kN/m	123.1
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	39.0
Rebound Resilience	DIN 53512	%	41.5
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	33.4
Specific Gravity	DIN 53479		1.15

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	DIN 53505	Shore A or D	50D
50% Modulus	DIN 53504-s2	MPa	12.2
100% Modulus	DIN 53504-s2	MPa	13.7
200% Modulus	DIN 53504-s2	MPa	14.5
300% Modulus	DIN 53504-s2	MPa	16.8
Stress at Break	DIN 53504-s2	MPa	43.2
Strain at Break	DIN 53504-s2	%	525
Tear Strength	DIN 53515 / ISO 34-1	kN/m	119.3
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	32.6
Rebound Resilience	DIN 53512	%	35.7
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	48.7
Specific Gravity	DIN 53479		1.15

Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	ASTM D2240	Shore A or D	55D
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	18.9
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	20.4
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	21.2
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	23.8
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	58.8
Strain at Break	ASTM D412 Die C / ISO 037 II	%	503
Tear Strength	ASTM D624 Die C	kN/m	116.1
Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	ASTM D2240	Shore A or D	50D
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	14.5
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	16.4
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	17.2
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	18.7
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	35.7
Strain at Break	ASTM D412 Die C / ISO 037 II	%	530
Tear Strength	ASTM D624 Die C	kN/m	107.8

Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Твердость	DIN 53505A	ед. Шор A(D)	55D
Модуль при 50% растяжении	GOST 270-75 Type II	МПа	16.6
Модуль при 100% растяжении	GOST 270-75 Type II	МПа	18.4
Модуль при 200% растяжении	GOST 270-75 Type II	МПа	19.4
Модуль при 300% растяжении	GOST 270-75 Type II	МПа	22.3
Предел прочности на разрыв	GOST 270-75 Type II	МПа	56.8
Относительное удлинение при разрыве	GOST 270-75 Type II	%	517
Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Твердость	DIN 53505A	ед. Шор A(D)	50D
Модуль при 50% растяжении	GOST 270-75 Type II	МПа	12.6
Модуль при 100% растяжении	GOST 270-75 Type II	МПа	14.4
Модуль при 200% растяжении	GOST 270-75 Type II	МПа	15.1
Модуль при 300% растяжении	GOST 270-75 Type II	МПа	16.5
Предел прочности на разрыв	GOST 270-75 Type II	МПа	31.5
Относительное удлинение при разрыве	GOST 270-75 Type II	%	525

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ADIPRENE® LFM E730

Low Free MDI-Terminated Polyether Prepolymer

ADIPRENE® Low Free MDI prepolymers are available in polyether, polyester and polycaprolactone compositions. In comparison to conventional MDI prepolymers, the level of Free MDI is less than 1%.

Benefits of ADIPRENE® LF MDI Prepolymers:

- Unsurpassed Health & Safety
- Excellent Performance
- Superior Processing & High Productivity

Unsurpassed Health & Safety

ADIPRENE® Low Free MDI prepolymers have low free MDI content (1%) for improved health and safety during handling and processing. The ADIPRENE® LF technology enables Chemtura to create a range of complete LF MDI-based systems, including the prepolymer, curative, and catalyst, with a “non-toxic” classification.

Excellent Performance

These systems are often selected as an alternative for TDI and LF TDI-based prepolymers cured with MbOCA. They are especially suited for applications requiring higher end performance, including rollers, mining, oil & gas, and tires & wheels.

Superior Processing & High Productivity

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives offer exceptionally low viscosity and extended pot life up to 8 minutes without a catalyst, enabling the casting of very large and complex parts. With a catalyst, these systems result in shorter demold times which offer the processor the ability to achieve very high productivity. They can be processed using meter-mix machines without the need for retrofitting.

VIBRACURE® Curative Properties	Unit	VIBRACURE® 2101	VIBRACURE® A260
Equivalent Weight		101	93.6
Appearance at Room Temperature		White pellet	White solid
% Theory	%	95	95
Melting Point	°C (°F)	107-110 (225-230)	107 - 100 (225 - 230)
Processing Temperature	°C (°F)	120 (248)	120 (248)

Curative Processing

VIBRACURE® curatives used with ADIPRENE® LF MDI must be processed above their melting temperatures (>120°C) to ensure that process lines, pumps and valves do not block. They can be dried by melting and placing under vacuum. VIBRACURE® A260 is a blend and must be mixed to ensure homogeneity. Mixing can be done prior to uploading to the meter-mix machine tank or within the curative tank via recirculating pump.

Formulation Stoichiometry

When reacting ADIPRENE® Low Free MDI prepolymers with VIBRACURE® curatives, a value of 95% theory is typically used to achieve an optimal balance of physical properties of the cured polyurethane elastomer. Varying the formulation stoichiometry will enable maximization of specific properties and characteristics.

Prepolymer Meltdown Procedure

ADIPRENE® Low Free MDI prepolymers must be pre-heated to 80-85°C for processing. Devices such as melting ovens, thermostatically controlled warming blankets or drum heaters can be used to pre-heat these prepolymers. Approximate pre-heat times at 70°C are:

20.4 Kgs / 1 pail for 10-12 hours
204 Kgs / 1 drum for 16-24 hours

Prepolymer exposed to temperatures lower than 24°C during shipment and/or storage may require longer meltdown times.

Note: Do not loosen the pail or drum to relieve the pressure. This will allow moisture into the prepolymer which can damage the material.

Heat Stability

The NCO content of ADIPRENE® Low Free MDI prepolymers decreases with time upon exposure to heat. Prolonged heat exposure will result in lower than expected final hardness of the cured elastomer and longer demold times. Maximum recommended heating times as a function of temperature are shown below.

Temperature	Duration
70°C	2 Days
85°C	36 Hours

Catalysts

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives require catalysis. Chemtura offers VIBRACAT® catalysts. Depending on the demolding time required, the most appropriate grade will be recommended by the Chemtura Technical Service team.

Meter-Mix Machine Turbine Speed

Due to the very low viscosity of these ADIPRENE® LF MDI systems, the turbine speed for meter-mix machines should be within the region of 1500-2000 rpm to avoid the creation of micro-bubbles within the mixing chamber.

The design of the mixing turbine and the flow output of the machine should be considered when deciding on mixing turbine speed.

Mold Temperatures & Cure Profile

Factors such as final component size, material flow path length & complexity, and required productivity will influence the mold temperature decision.

Typical mold and post cure temperatures are 100-120°C. Typical post cure conditions are 16 hours at 100-120°C.

Demold Time

Demolding times are depending on part thickness and material formulation, including use of catalysts.

Industrial Hygiene

For detailed industrial hygiene information for all ADIPRENE® Low Free MDI prepolymers and VIBRACURE® curatives included in this document, please refer to the relevant Safety Data Sheet (SDS).

For more detailed information on the use of DURACURE® curatives or VIBRACAT® catalysts, please refer to the appropriate technical data sheets.

Prepolymer Properties		Unit	Typical Value
NCO Range		%	7.15-7.55
Amine Equivalent			557-588
Free MDI Content		%	< 1.0
Brookfield Viscosity @ 50°C		Centipoise	6300
Brookfield Viscosity @ 70°C		Centipoise	1688
Brookfield Viscosity @ 100°C		Centipoise	425
Density @ 70°C		g/cm ³	1.09
Appearance @ 25°C			White solid

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	DIN 53505	Shore A or D	60D
50% Modulus	DIN 53504-s2	MPa	22.8
100% Modulus	DIN 53504-s2	MPa	22.7
200% Modulus	DIN 53504-s2	MPa	23.2
300% Modulus	DIN 53504-s2	MPa	26.8
Stress at Break	DIN 53504-s2	MPa	64.0
Strain at Break	DIN 53504-s2	%	469
Tear Strength	DIN 53515 / ISO 34-1	kN/m	152.4
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	65.4
Rebound Resilience	DIN 53512	%	41.5
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	48.0
Specific Gravity	DIN 53479		1.17

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	DIN 53505	Shore A or D	58D
50% Modulus	DIN 53504-s2	MPa	18.2
100% Modulus	DIN 53504-s2	MPa	20.7
200% Modulus	DIN 53504-s2	MPa	23.7
300% Modulus	DIN 53504-s2	MPa	30.3
Stress at Break	DIN 53504-s2	MPa	56.2
Strain at Break	DIN 53504-s2	%	416
Tear Strength	DIN 53515 / ISO 34-1	kN/m	140.5
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	60.5
Rebound Resilience	DIN 53512	%	34.5
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	43.8
Specific Gravity	DIN 53479		1.17

Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	ASTM D2240	Shore A or D	60D
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	22.9
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	23.0
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	22.9
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	25.2
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	43.6
Strain at Break	ASTM D412 Die C / ISO 037 II	%	434
Tear Strength	ASTM D624 Die C	kN/m	150.1
Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	ASTM D2240	Shore A or D	58D
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	19.8
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	22.2
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	24.2
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	26.9
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	39.2
Strain at Break	ASTM D412 Die C / ISO 037 II	%	428
Tear Strength	ASTM D624 Die C	kN/m	131.8

Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Твердость	DIN 53505A	ед. Шор A(D)	60D
Модуль при 50% растяжении	GOST 270-75 Type II	мПа	23.5
Модуль при 100% растяжении	GOST 270-75 Type II	мПа	23.3
Модуль при 200% растяжении	GOST 270-75 Type II	мПа	22.6
Модуль при 300% растяжении	GOST 270-75 Type II	мПа	24.3
Предел прочности на разрыв	GOST 270-75 Type II	мПа	49.0
Относительное удлинение при разрыве	GOST 270-75 Type II	%	451
Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Твердость	DIN 53505A	ед. Шор A(D)	58D
Модуль при 50% растяжении	GOST 270-75 Type II	мПа	18.6
Модуль при 100% растяжении	GOST 270-75 Type II	мПа	20.9
Модуль при 200% растяжении	GOST 270-75 Type II	мПа	22.8
Модуль при 300% растяжении	GOST 270-75 Type II	мПа	26.6
Предел прочности на разрыв	GOST 270-75 Type II	мПа	46.3
Относительное удлинение при разрыве	GOST 270-75 Type II	%	424

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ADIPRENE® LFM S430

Low Free MDI-Terminated Polyester Prepolymer

ADIPRENE® Low Free MDI prepolymers are available in polyether, polyester and polycaprolactone compositions. In comparison to conventional MDI prepolymers, the level of Free MDI is less than 1%.

Benefits of ADIPRENE® LF MDI Prepolymers:

- Unsurpassed Health & Safety
- Excellent Performance
- Superior Processing & High Productivity

Unsurpassed Health & Safety

ADIPRENE® Low Free MDI prepolymers have low free MDI content (1%) for improved health and safety during handling and processing. The ADIPRENE® LF technology enables Chemtura to create a range of complete LF MDI-based systems, including the prepolymer, curative, and catalyst, with a “non-toxic” classification.

Excellent Performance

These systems are often selected as an alternative for TDI and LF TDI-based prepolymers cured with MbOCA. They are especially suited for applications requiring higher end performance, including rollers, mining, oil & gas, and tires & wheels.

Superior Processing & High Productivity

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives offer exceptionally low viscosity and extended pot life up to 8 minutes without a catalyst, enabling the casting of very large and complex parts. With a catalyst, these systems result in shorter demold times which offer the processor the ability to achieve very high productivity. They can be processed using meter-mix machines without the need for retrofitting.

VIBRACURE® Curative Properties	Unit	VIBRACURE® 2101	VIBRACURE® A260
Equivalent Weight		101	93.6
Appearance at Room Temperature		White pellet	White solid
% Theory	%	95	95
Melting Point	°C (°F)	107-110 (225-230)	107 - 100 (225 - 230)
Processing Temperature	°C (°F)	120 (248)	120 (248)

Curative Processing

VIBRACURE® curatives used with ADIPRENE® LF MDI must be processed above their melting temperatures (>120°C) to ensure that process lines, pumps and valves do not block. They can be dried by melting and placing under vacuum. VIBRACURE® A260 is a blend and must be mixed to ensure homogeneity. Mixing can be done prior to uploading to the meter-mix machine tank or within the curative tank via recirculating pump.

Formulation Stoichiometry

When reacting ADIPRENE® Low Free MDI prepolymers with VIBRACURE® curatives, a value of 95% theory is typically used to achieve an optimal balance of physical properties of the cured polyurethane elastomer. Varying the formulation stoichiometry will enable maximization of specific properties and characteristics.

Prepolymer Meltdown Procedure

ADIPRENE® Low Free MDI prepolymers must be pre-heated to 80-85°C for processing. Devices such as melting ovens, thermostatically controlled warming blankets or drum heaters can be used to pre-heat these prepolymers. Approximate pre-heat times at 70°C are:

20.4 Kgs / 1 pail for 10-12 hours
204 Kgs / 1 drum for 16-24 hours

Prepolymer exposed to temperatures lower than 24°C during shipment and/or storage may require longer meltdown times.

Note: Do not loosen the pail or drum to relieve the pressure. This will allow moisture into the prepolymer which can damage the material.

Heat Stability

The NCO content of ADIPRENE® Low Free MDI prepolymers decreases with time upon exposure to heat. Prolonged heat exposure will result in lower than expected final hardness of the cured elastomer and longer demold times. Maximum recommended heating times as a function of temperature are shown below.

Temperature	Duration
70°C	2 Days
85°C	36 Hours

Catalysts

ADIPRENE® Low Free MDI prepolymers cured with VIBRACURE® curatives require catalysis. Chemtura offers VIBRACAT® catalysts. Depending on the demolding time required, the most appropriate grade will be recommended by the Chemtura Technical Service team.

Meter-Mix Machine Turbine Speed

Due to the very low viscosity of these ADIPRENE® LF MDI systems, the turbine speed for meter-mix machines should be within the region of 1500-2000 rpm to avoid the creation of micro-bubbles within the mixing chamber.

The design of the mixing turbine and the flow output of the machine should be considered when deciding on mixing turbine speed.

Mold Temperatures & Cure Profile

Factors such as final component size, material flow path length & complexity, and required productivity will influence the mold temperature decision.

Typical mold and post cure temperatures are 100-120°C. Typical post cure conditions are 16 hours at 100-120°C.

Demold Time

Demolding times are depending on part thickness and material formulation, including use of catalysts.

Industrial Hygiene

For detailed industrial hygiene information for all ADIPRENE® Low Free MDI prepolymers and VIBRACURE® curatives included in this document, please refer to the relevant Safety Data Sheet (SDS).

For more detailed information on the use of DURACURE® curatives or VIBRACAT® catalysts, please refer to the appropriate technical data sheets.

Prepolymer Properties		Unit	Typical Value
NCO Range		%	4.1-4.5
Amine Equivalent			934-1025
Free MDI Content		%	< 1.0
Brookfield Viscosity @ 50°C		Centipoise	16,800
Brookfield Viscosity @ 70°C		Centipoise	4050
Brookfield Viscosity @ 100°C		Centipoise	895
Density @ 70°C		g/cm ³	1.01
Appearance @ 25°C			White solid

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	DIN 53505	Shore A or D	90A
50% Modulus	DIN 53504-s2	MPa	6.4
100% Modulus	DIN 53504-s2	MPa	7.7
200% Modulus	DIN 53504-s2	MPa	9.6
300% Modulus	DIN 53504-s2	MPa	12.9
Stress at Break	DIN 53504-s2	MPa	62.9
Strain at Break	DIN 53504-s2	%	547
Tear Strength	DIN 53515 / ISO 34-1	kN/m	100.4
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	20.4
Rebound Resilience	DIN 53512	%	38.4
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	32.5
Specific Gravity	DIN 53479		1.25

Physical Properties	DIN Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	DIN 53505	Shore A or D	88A
50% Modulus	DIN 53504-s2	MPa	4.6
100% Modulus	DIN 53504-s2	MPa	5.9
200% Modulus	DIN 53504-s2	MPa	7.8
300% Modulus	DIN 53504-s2	MPa	10.4
Stress at Break	DIN 53504-s2	MPa	47.9
Strain at Break	DIN 53504-s2	%	500
Tear Strength	DIN 53515 / ISO 34-1	kN/m	91.6
Abrasion Loss	DIN 53516 Method A/ ISO 4649	mm ³	18.0
Rebound Resilience	DIN 53512	%	30.2
Compression Set @ 70°C, 24 hrs	DIN 53517 Method B / ISO 815	%	53.4
Specific Gravity	DIN 53479		1.25

Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Hardness	ASTM D2240	Shore A or D	90A
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	6.8
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	8.2
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	10.0
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	13.0
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	59.7
Strain at Break	ASTM D412 Die C / ISO 037 II	%	530
Tear Strength	ASTM D624 Die C	kN/m	100.5
Physical Properties	ASTM Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Hardness	ASTM D2240	Shore A or D	88A
50% Modulus	ASTM D412 Die C / ISO 037 II	MPa	5.5
100% Modulus	ASTM D412 Die C / ISO 037 II	MPa	6.9
200% Modulus	ASTM D412 Die C / ISO 037 II	MPa	8.5
300% Modulus	ASTM D412 Die C / ISO 037 II	MPa	10.9
Stress at Break	ASTM D412 Die C / ISO 037 II	MPa	61.5
Strain at Break	ASTM D412 Die C / ISO 037 II	%	534
Tear Strength	ASTM D624 Die C	kN/m	84.8

Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® 2101
Твердость	DIN 53505A	ед. Шор A(D)	90A
Модуль при 50% растяжении	GOST 270-75 Type II	мПа	6.5
Модуль при 100% растяжении	GOST 270-75 Type II	мПа	7.9
Модуль при 200% растяжении	GOST 270-75 Type II	мПа	9.7
Модуль при 300% растяжении	GOST 270-75 Type II	мПа	12.4
Предел прочности на разрыв	GOST 270-75 Type II	мПа	63.0
Относительное удлинение при разрыве	GOST 270-75 Type II	%	568
Physical Properties	GOST Standard	Unit	Typical Value
Curative			VIBRACURE® A260
Твердость	DIN 53505A	ед. Шор A(D)	88A
Модуль при 50% растяжении	GOST 270-75 Type II	мПа	4.5
Модуль при 100% растяжении	GOST 270-75 Type II	мПа	6.0
Модуль при 200% растяжении	GOST 270-75 Type II	мПа	7.8
Модуль при 300% растяжении	GOST 270-75 Type II	мПа	10.2
Предел прочности на разрыв	GOST 270-75 Type II	мПа	56.2
Относительное удлинение при разрыве	GOST 270-75 Type II	%	542

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Version 1.1

Revision Date 11.09.2015

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SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : ADIPRENE® LFM E265

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Polyurethane prepolymer

Recommended restrictions on use : Reserved for industrial and professional use.

1.3 Details of the supplier of the safety data sheet

Company:

Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by

Further information for the safety data sheet :

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Respiratory sensitisation, Category 1 H334: May cause allergy or asthma symptoms or

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breathing difficulties if inhaled.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word : Danger

Hazard statements : H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Supplemental Hazard Statements : EUH204 Contains isocyanates. May produce an allergic reaction.

Precautionary statements : **Prevention:**
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P284 Wear respiratory protection.
Response:
P304 + P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P342 + P311 If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.
Disposal:
P501 Dispose of contents/ container to an approved waste disposal plant.

Hazardous components which must be listed on the label:
4,4'-methylenediphenyl diisocyanate

2.3 Other hazards

No data available

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical Name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration (%)
4,4'-methylenediphenyl diisocyanate	101-68-8 202-966-0	Acute Tox.4; H332 Skin Irrit.2; H315	>= 0.1 - < 1



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		Eye Irrit.2; H319 Resp. Sens.1; H334 Skin Sens.1; H317 Carc.2; H351 STOT SE3; H335 STOT RE2; H373	
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For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

- If inhaled : Move to fresh air in case of accidental inhalation of dust or fumes from overheating or combustion.
If symptoms persist, call a physician.
- In case of skin contact : Wash off with soap and plenty of water.
- In case of eye contact : IF IN EYES: Rinse cautiously with water for several minutes.
Remove contact lenses, if present and easy to do. Continue rinsing.
- If swallowed : Rinse mouth with water.
If victim is fully conscious, give a cupful of water.
DO NOT induce vomiting unless directed to do so by a physician or poison control center.
Never give anything by mouth to an unconscious person.
Do not give milk or alcoholic beverages.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : No information available.
- Risks : No information available.

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : The first aid procedure should be established in consultation with the doctor responsible for industrial medicine.

SECTION 5: Firefighting measures

5.1 Extinguishing media

- Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.



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5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting : Burning produces irritant fumes.

5.3 Advice for firefighters

Special protective equipment for firefighters : Wear full protective clothing and self-contained breathing apparatus.

Further information : Standard procedure for chemical fires.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Ensure adequate ventilation.
Remove all sources of ignition.
Evacuate personnel to safe areas.
Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

6.2 Environmental precautions

Environmental precautions : Try to prevent the material from entering drains or water courses.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).
Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : For personal protection see section 8.
No special handling advice required.

Advice on protection against fire and explosion : Normal measures for preventive fire protection.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. When using do not smoke. Wash hands before breaks and at the end of workday.



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7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep container tightly closed. Keep in a dry, cool and well-ventilated place. Keep under nitrogen. Container can be pressurized by carbon dioxide due to reaction with humid air and/or water. Protect from moisture.

Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)

Specific use(s) : Polyurethane prepolymer

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Biological occupational exposure limits

Substance name	CAS-No.	Control parameters	Sampling time	Basis
	101-68-8	urinary diamine: 100 µg/Lµmol/mol creatinine (Urine)	Post task	GB EH40 BAT

8.2 Exposure controls

Personal protective equipment

Eye protection : Eye wash bottle with pure water
Tightly fitting safety goggles

Hand protection

: Polyvinyl alcohol or nitrile- butyl-rubber gloves
The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
Before removing gloves clean them with soap and water.

Skin and body protection

: Protective suit

impervious clothing
Choose body protection according to the amount and concentration of the dangerous substance at the work place.

Respiratory protection

: In the case of vapour formation use a respirator with an approved filter.

Environmental exposure controls

General advice : Try to prevent the material from entering drains or water courses.



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SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	: viscous liquid
Colour	: amber, light yellow
Odour	: slight
Odour Threshold	: not determined
pH	: neutral
Melting point/freezing point	: not determined
Boiling point/boiling range	: not determined
Flash point	: Not applicable
Evaporation rate	: No data available
Flammability (solid, gas)	: No data available
Upper explosion limit	: No data available
Lower explosion limit	: No data available
Vapour pressure	: No data available
Relative vapour density	: No data available
Relative density	: No data available
Density	: No data available
Solubility(ies)	
Water solubility	: Reacts
Solubility in other solvents	: No data available
Partition coefficient: n-octanol/water	: No data available
Auto-ignition temperature	: No data available



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Thermal decomposition : No data available

Viscosity

Viscosity, dynamic : No data available

Viscosity, kinematic : No data available

9.2 Other information

Self-Accelerating decomposition temperature (SADT) : Method: No information available.

Oxidising potential : No information available.

SECTION 10: Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.

Stable under recommended storage conditions.

10.2 Chemical stability

No decomposition if stored and applied as directed.

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions : No hazards to be specially mentioned.

10.4 Conditions to avoid

Conditions to avoid : No data available

No data available

10.5 Incompatible materials

Materials to avoid : Alcohols
Water
Strong oxidizing agents

10.6 Hazardous decomposition products

Hazardous decomposition products : No hazardous decomposition products are known.
Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).
Nitrogen oxides (NOx)
Hydrogen cyanide
Isocyanates



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SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:

Acute oral toxicity : Remarks: Not classified due to lack of data.

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Acute oral toxicity : LD50 (Rat): 31,690 mg/kg

Skin corrosion/irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Skin irritation

Serious eye damage/eye irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Eye irritation

Respiratory or skin sensitisation

Product:

Remarks: Causes sensitisation.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Guinea pig

Assessment: May cause sensitisation by inhalation.

Result: Causes sensitisation.



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Species: Guinea pig
Assessment: May cause sensitisation by skin contact.
Result: Causes sensitisation.

Germ cell mutagenicity

Product:

Germ cell mutagenicity
Assessment : Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Genotoxicity in vitro : Test Type: Ames test
Result: positive

Carcinogenicity

Product:

Carcinogenicity
Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity
Assessment : Not classified due to lack of data.

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.

STOT - repeated exposure

Product:

Assessment: Not classified due to lack of data.

Aspiration toxicity

Further information

Product:

Remarks: No data available



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SECTION 12: Ecological information

12.1 Toxicity

Product:

Toxicity to fish : Remarks: No data available

Components:

4,4'-methylenediphenyl diisocyanate:

Toxicity to fish : LC50 (Danio rerio (zebra fish)): > 1,000 mg/l
Exposure time: 96 h

Toxicity to daphnia and other : LC50 (Daphnia magna (Water flea)): > 1,000 mg/l
aquatic invertebrates Exposure time: 48 h

12.2 Persistence and degradability

Product:

Biodegradability : Remarks: No data available

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : No data available
: This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

Product:

Additional ecological : Remarks: An environmental hazard cannot be excluded in the
information event of unprofessional handling or disposal.
This product has no known ecotoxicological effects.



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SECTION 13: Disposal considerations

13.1 Waste treatment methods

- Product : Dispose of wastes in an approved waste disposal facility.
In accordance with local and national regulations.
Can be landfilled or incinerated, when in compliance with local regulations.
- Contaminated packaging : Dispose of as unused product.
Empty containers should be taken to an approved waste handling site for recycling or disposal.
Do not re-use empty containers.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Not applicable

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals : Not applicable

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59). : Not applicable

Regulation (EC) No 1005/2009 on substances that deplete the ozone layer : Not applicable



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Regulation (EC) No 850/2004 on persistent organic pollutants : Not applicable

Major Accident Hazard Legislation

Seveso Directive

Seveso II - Directive 2003/105/EC amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances

Not applicable

The components of this product are reported in the following inventories:

United States TSCA Inventory : On TSCA Inventory

Canadian Domestic Substances List (DSL) : This product contains the following components listed on the Canadian NDSL. All other components are on the Canadian DSL.

Australia Inventory of Chemical Substances (AICS) : Not in compliance with the inventory

New Zealand. Inventory of Chemical Substances : Not in compliance with the inventory

Japan. ENCS - Existing and New Chemical Substances Inventory : Not in compliance with the inventory

Korea. Korean Existing Chemicals Inventory (KECI) : Not in compliance with the inventory

Philippines Inventory of Chemicals and Chemical Substances (PICCS) : Not in compliance with the inventory

China. Inventory of Existing Chemical Substances in China (IECSC) : Not in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H334 : May cause allergy or asthma symptoms or breathing difficulties if inhaled.

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Emergency Phone Number

<u>Europe:</u>	All European Countries	+44 (0) 1235 239 670 (NCEC)
<u>Asia Pacific:</u>	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



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SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : ADIPRENE® LFM E295

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Polyurethane prepolymer

Recommended restrictions on use : Reserved for industrial and professional use.

1.3 Details of the supplier of the safety data sheet

Company:

Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by

Further information for the safety data sheet :

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Respiratory sensitisation, Category 1 H334: May cause allergy or asthma symptoms or

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breathing difficulties if inhaled.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word :

Danger

Hazard statements :

H334

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Supplemental Hazard Statements :

EUH204

Contains isocyanates. May produce an allergic reaction.

Precautionary statements :

Prevention:
P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P284

Wear respiratory protection.

Response:

P304 + P340

IF INHALED: Remove person to fresh air and keep comfortable for breathing.

P342 + P311

If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.

Disposal:

P501

Dispose of contents/ container to an approved waste disposal plant.

Hazardous components which must be listed on the label:

4,4'-methylenediphenyl diisocyanate

2.3 Other hazards

No data available

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical Name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration (%)
4,4'-methylenediphenyl diisocyanate	101-68-8 202-966-0	Acute Tox.4; H332 Skin Irrit.2; H315	>= 0.1 - < 1



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		Eye Irrit.2; H319 Resp. Sens.1; H334 Skin Sens.1; H317 Carc.2; H351 STOT SE3; H335 STOT RE2; H373	
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For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

- If inhaled : Move to fresh air in case of accidental inhalation of dust or fumes from overheating or combustion.
If symptoms persist, call a physician.
- In case of skin contact : Wash off with soap and plenty of water.
Take off contaminated clothing and wash before reuse.
- In case of eye contact : If eye irritation persists, consult a specialist.
- If swallowed : Clean mouth with water and drink afterwards plenty of water.
Do not give milk or alcoholic beverages.
Never give anything by mouth to an unconscious person.
Obtain medical attention.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : No information available.
- Risks : No information available.

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : No information available.

SECTION 5: Firefighting measures

5.1 Extinguishing media

- Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture

- Specific hazards during firefighting : No information available.



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5.3 Advice for firefighters

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.

Further information : Standard procedure for chemical fires.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Avoid dust formation.
Avoid breathing dust.
Ensure adequate ventilation.

6.2 Environmental precautions

Environmental precautions : Try to prevent the material from entering drains or water courses.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Pick up and arrange disposal without creating dust.
Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : Avoid formation of respirable particles.
Avoid exceeding the given occupational exposure limits (see section 8).
For personal protection see section 8.
Persons with a history of skin sensitisation problems or asthma, allergies, chronic or recurrent respiratory disease should not be employed in any process in which this mixture is being used.
Smoking, eating and drinking should be prohibited in the application area.
Provide sufficient air exchange and/or exhaust in work rooms.

Advice on protection against fire and explosion : Avoid dust formation. Provide appropriate exhaust ventilation at places where dust is formed.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. When using do not smoke. Wash hands before breaks and at the end of workday.



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7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep container tightly closed in a dry and well-ventilated place. Protect from moisture. Container can be pressurized by carbon dioxide due to reaction with humid air and/or water. Keep under nitrogen.

Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)

Specific use(s) : Polyurethane prepolymer

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Biological occupational exposure limits

Substance name	CAS-No.	Control parameters	Sampling time	Basis
	101-68-8	urinary diamine: 100 µg/Lµmol/mol creatinine (Urine)	Post task	GB EH40 BAT

8.2 Exposure controls

Personal protective equipment

Eye protection : Eye wash bottle with pure water
Tightly fitting safety goggles

Hand protection

: Polyvinyl alcohol or nitrile- butyl-rubber gloves
The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
Before removing gloves clean them with soap and water.

Skin and body protection : Dust impervious protective suit
Choose body protection according to the amount and concentration of the dangerous substance at the work place.

Respiratory protection : In the case of dust or aerosol formation use respirator with an approved filter.

Environmental exposure controls

General advice : Try to prevent the material from entering drains or water courses.



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SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	: viscous liquid
Colour	: amber, light yellow
Odour	: slight
Odour Threshold	: not determined
pH	: neutral
	: not determined
	: not determined
Flash point	: Not applicable
Evaporation rate	: No data available
Flammability (solid, gas)	: No data available
Upper explosion limit	: No data available
Lower explosion limit	: No data available
Vapour pressure	: No data available
Relative vapour density	: Not applicable
Relative density	: No data available
Density	: No data available
Solubility(ies)	
Water solubility	: Reacts
Solubility in other solvents	: No data available
Partition coefficient: n-octanol/water	: No data available
Auto-ignition temperature	: No data available



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Thermal decomposition : No data available

Viscosity

Viscosity, dynamic : No data available

Viscosity, kinematic : No data available

9.2 Other information

Self-Accelerating decomposition temperature (SADT) : Method: No information available.

Oxidising potential : No information available.

SECTION 10: Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.

10.2 Chemical stability

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions : Stable under recommended storage conditions.
No decomposition if used as directed.

10.4 Conditions to avoid

Conditions to avoid : No data available

10.5 Incompatible materials

Materials to avoid : None known.

10.6 Hazardous decomposition products

Hazardous decomposition products : No hazardous decomposition products are known.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:

Acute oral toxicity : Remarks: Not classified due to lack of data.

Acute inhalation toxicity : Remarks: Not classified due to lack of data.



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Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Acute oral toxicity : LD50 (Rat): 31,690 mg/kg

Skin corrosion/irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Skin irritation

Serious eye damage/eye irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Eye irritation

Respiratory or skin sensitisation

Product:

Remarks: Causes sensitisation.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Guinea pig

Assessment: May cause sensitisation by inhalation.

Result: Causes sensitisation.

Species: Guinea pig

Assessment: May cause sensitisation by skin contact.

Result: Causes sensitisation.

Germ cell mutagenicity

Product:

Germ cell mutagenicity

Assessment : Not classified due to lack of data.



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Components:

4,4'-methylenediphenyl diisocyanate:

Genotoxicity in vitro : Test Type: Ames test
Result: positive

Carcinogenicity

Product:

Carcinogenicity
Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity
Assessment : Not classified due to lack of data.

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.

STOT - repeated exposure

Product:

Assessment: Not classified due to lack of data.

Aspiration toxicity

Further information

Product:

Remarks: No data available

SECTION 12: Ecological information

12.1 Toxicity

Product:

Toxicity to fish : Remarks: No data available

Components:

4,4'-methylenediphenyl diisocyanate:

Toxicity to fish : LC50 (Danio rerio (zebra fish)): > 1,000 mg/l
Exposure time: 96 h

Toxicity to daphnia and other : LC50 (Daphnia magna (Water flea)): > 1,000 mg/l



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aquatic invertebrates

Exposure time: 48 h

12.2 Persistence and degradability

Product:

Biodegradability : Remarks: No data available

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : No data available

: This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

Product:

Additional ecological information : Remarks: An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
This product has no known ecotoxicological effects.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Dispose of wastes in an approved waste disposal facility.
In accordance with local and national regulations.
Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with chemical or used container.

Contaminated packaging : Dispose of as unused product.
Empty containers should be taken to an approved waste handling site for recycling or disposal.
Do not re-use empty containers.



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SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Remarks : Not classified as dangerous in the meaning of transport regulations.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals : Not applicable

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59). : Not applicable

Regulation (EC) No 1005/2009 on substances that deplete the ozone layer : Not applicable

Regulation (EC) No 850/2004 on persistent organic pollutants : Not applicable

Major Accident Hazard Legislation

Seveso Directive

Seveso II - Directive 2003/105/EC amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances
Not applicable

The components of this product are reported in the following inventories:

United States TSCA Inventory : On TSCA Inventory



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- Canadian Domestic Substances List (DSL) : This product contains the following components listed on the Canadian NDSL. All other components are on the Canadian DSL.
- Australia Inventory of Chemical Substances (AICS) : Not in compliance with the inventory
- New Zealand. Inventory of Chemical Substances : Not in compliance with the inventory
- Japan. ENCS - Existing and New Chemical Substances Inventory : Not in compliance with the inventory
- Korea. Korean Existing Chemicals Inventory (KECI) : Not in compliance with the inventory
- Philippines Inventory of Chemicals and Chemical Substances (PICCS) : Not in compliance with the inventory
- China. Inventory of Existing Chemical Substances in China (IECSC) : Not in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

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Emergency Phone Number

Europe:	All European Countries	+44 (0) 1235 239 670 (NCEC)
Asia Pacific:	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751



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	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



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Version 1.1

Revision Date 11.09.2015

Print Date 23.06.2016

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : ADIPRENE® LFM E370

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the : Polyurethane prepolymer
Substance/Mixture

1.3 Details of the supplier of the safety data sheet

Company:

Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by

Further information for the safety data sheet :

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Respiratory sensitisation, Category 1 H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled.

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2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word : Danger

Hazard statements : H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Supplemental Hazard Statements : EUH204 Contains isocyanates. May produce an allergic reaction.

Precautionary statements : **Prevention:**
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P285 In case of inadequate ventilation wear respiratory protection.
Response:
P304 + P341 IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.
P342 + P311 If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.
Disposal:
P501 Dispose of contents/ container to an approved waste disposal plant.

Hazardous components which must be listed on the label:

4,4'-methylenediphenyl diisocyanate

Additional Labelling:

EUH204 .Contains isocyanates. May produce an allergic reaction.

2.3 Other hazards

No data available

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical Name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration (%)
4,4'-methylenediphenyl	101-68-8	Acute Tox.4; H332	>= 0.1 - < 1



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diisocyanate	202-966-0	Skin Irrit.2; H315 Eye Irrit.2; H319 Resp. Sens.1; H334 Skin Sens.1; H317 Carc.2; H351 STOT SE3; H335 STOT RE2; H373	
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For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

- General advice : Move out of dangerous area.
Consult a physician.
Show this safety data sheet to the doctor in attendance.
- If inhaled : Move to fresh air in case of accidental inhalation of dust or fumes from overheating or combustion.
If symptoms persist, call a physician.
- In case of skin contact : Take off contaminated clothing and shoes immediately.
Wash off with soap and plenty of water.
- In case of eye contact : Flush eyes with water as a precaution.
Remove contact lenses.
Protect unharmed eye.
Keep eye wide open while rinsing.
If eye irritation persists, consult a specialist.
- If swallowed : Clean mouth with water and drink afterwards plenty of water.
Do not give milk or alcoholic beverages.
Never give anything by mouth to an unconscious person.
Obtain medical attention.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : Lachrymation
Breathing difficulties
- Risks : sensitising effects

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : Oxygen, if needed.
For specialist advice physicians should contact the Poisons Information Service.



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SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting : No information available.

5.3 Advice for firefighters

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.

Further information : Standard procedure for chemical fires.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Ensure adequate ventilation.

6.2 Environmental precautions

Environmental precautions : Try to prevent the material from entering drains or water courses.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).
Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : Avoid formation of aerosol.
Avoid exceeding the given occupational exposure limits (see section 8).
For personal protection see section 8.
Persons with a history of skin sensitisation problems or asthma, allergies, chronic or recurrent respiratory disease



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should not be employed in any process in which this mixture is being used.

Smoking, eating and drinking should be prohibited in the application area.

Provide sufficient air exchange and/or exhaust in work rooms.

Advice on protection against fire and explosion : Normal measures for preventive fire protection.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. When using do not smoke. Wash hands before breaks and at the end of workday.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep container tightly closed. Keep in a dry, cool and well-ventilated place. Keep under nitrogen. Isocyanate based products react with water liberating carbon dioxide, which can lead to excessive pressure in closed containers, and form solid insoluble polymers, which can block pipes, valves, etc. Contact with copper or copper alloys and galvanized surfaces must be avoided and valves etc made of these materials must not be used in equipment for storing and handling diisocyanates. Do not store in open containers.

Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)

Specific use(s) : Polyurethane prepolymer

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

8.2 Exposure controls

Personal protective equipment

Eye protection : Eye wash bottle with pure water
Tightly fitting safety goggles

Hand protection

: Polyvinyl alcohol or nitrile- butyl-rubber gloves
The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
Before removing gloves clean them with soap and water.

Skin and body protection : impervious clothing
Choose body protection according to the amount and



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concentration of the dangerous substance at the work place.

Respiratory protection : In the case of vapour formation use a respirator with an approved filter.

Environmental exposure controls

General advice : Try to prevent the material from entering drains or water courses.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance : viscous liquid

Colour : clear, cloudy

Odour : slight

Odour Threshold : No data available

pH : neutral

Melting point/range : Not applicable

Boiling point/boiling range : No data available

Flash point : > 150 °C

Evaporation rate : No data available

Flammability (solid, gas) : No data available

Upper explosion limit : No data available

Lower explosion limit : No data available

Vapour pressure : No data available

Relative vapour density : No data available

Relative density : No data available

Density : No data available

Solubility(ies)
Water solubility : Reacts



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Solubility in other solvents : soluble
Solvent: Organic solvents

Partition coefficient: n-octanol/water : No data available

Auto-ignition temperature :
No data available

Thermal decomposition : No data available

Viscosity
Viscosity, dynamic : $\geq 1,000$ mPa.s

Viscosity, kinematic : No data available

9.2 Other information

Self-Accelerating decomposition temperature (SADT) : Method: No information available.

Oxidising potential : No information available.

SECTION 10: Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.

10.2 Chemical stability

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions : Stable under recommended storage conditions.
No decomposition if used as directed.

10.4 Conditions to avoid

Conditions to avoid : No data available

10.5 Incompatible materials

Materials to avoid : Alcohols
Water
Strong oxidizing agents

10.6 Hazardous decomposition products

Hazardous decomposition products : Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).



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Nitrogen oxides (NO_x)
Hydrogen cyanide
Isocyanates

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:

Acute oral toxicity : Remarks: Not classified due to lack of data.

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Acute oral toxicity : LD50 (Rat): 31,690 mg/kg

Skin corrosion/irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Skin irritation

Serious eye damage/eye irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Eye irritation

Respiratory or skin sensitisation

Product:

Remarks: May cause sensitisation by inhalation.

Components:



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4,4'-methylenediphenyl diisocyanate:

Species: Guinea pig

Assessment: May cause sensitisation by inhalation.

Result: Causes sensitisation.

Species: Guinea pig

Assessment: May cause sensitisation by skin contact.

Result: Causes sensitisation.

Germ cell mutagenicity

Product:

Germ cell mutagenicity

Assessment : Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Genotoxicity in vitro : Test Type: Ames test

Result: positive

Carcinogenicity

Product:

Carcinogenicity

Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity

Assessment : Not classified due to lack of data.

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.

STOT - repeated exposure

Product:

Assessment: Not classified due to lack of data.

Aspiration toxicity

Product:

No aspiration toxicity classification



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Further information

Product:

Remarks: No data available

SECTION 12: Ecological information

12.1 Toxicity

Product:

Toxicity to fish : Remarks: No data is available on the product itself.

Toxicity to daphnia and other aquatic invertebrates : Remarks: No data available

Further information

The following percentage of the mixture consists of ingredient(s) with unknown hazards to the aquatic environment: 100 %

Components:

4,4'-methylenediphenyl diisocyanate:

Toxicity to fish : LC50 (Danio rerio (zebra fish)): > 1,000 mg/l
Exposure time: 96 h

Toxicity to daphnia and other aquatic invertebrates : LC50 (Daphnia magna (Water flea)): > 1,000 mg/l
Exposure time: 48 h

12.2 Persistence and degradability

Product:

Biodegradability : Remarks: No data available

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : No data available



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12.6 Other adverse effects

Product:

Additional ecological
information

: Remarks: There is no data available for this product.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

: Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with
chemical or used container.
Offer surplus and non-recyclable solutions to a licensed
disposal company.

Contaminated packaging

: Empty remaining contents.
Dispose of as unused product.
Do not re-use empty containers.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Not applicable

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

The components of this product are reported in the following inventories:

United States TSCA Inven- : On TSCA Inventory
tory



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- Canadian Domestic Substances List (DSL) : All components of this product are on the Canadian DSL.
- Australia Inventory of Chemical Substances (AICS) : On the inventory, or in compliance with the inventory
- New Zealand. Inventory of Chemical Substances : On the inventory, or in compliance with the inventory
- Japan. ENCS - Existing and New Chemical Substances Inventory : Not in compliance with the inventory
- Japan. ISHL - Inventory of Chemical Substances : Not in compliance with the inventory
- Korea. Korean Existing Chemicals Inventory (KECI) : On the inventory, or in compliance with the inventory
- Philippines Inventory of Chemicals and Chemical Substances (PICCS) : On the inventory, or in compliance with the inventory
- China. Inventory of Existing Chemical Substances in China (IECSC) : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

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Emergency Phone Number

<u>Europe:</u>	All European Countries	+44 (0) 1235 239 670 (NCEC)
<u>Asia Pacific:</u>	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293



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	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



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SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : ADIPRENE® LFM E450

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Polyurethane prepolymer

Recommended restrictions on use : Reserved for industrial and professional use.

1.3 Details of the supplier of the safety data sheet

Company:

Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by

Further information for the safety data sheet :

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Respiratory sensitisation, Category 1 H334: May cause allergy or asthma symptoms or

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breathing difficulties if inhaled.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word : Danger

Hazard statements : H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Precautionary statements : **Prevention:**
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P285 In case of inadequate ventilation wear respiratory protection.

Response:
P304 + P341 IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.
P342 + P311 If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.

Disposal:
P501 Dispose of contents/ container to an approved waste disposal plant.

Hazardous components which must be listed on the label:
4,4'-methylenediphenyl diisocyanate

Additional Labelling:

EUH204 .Contains isocyanates. May produce an allergic reaction.

2.3 Other hazards

No data available

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical Name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration (%)
4,4'-methylenediphenyl diisocyanate	101-68-8 202-966-0	Acute Tox.4; H332 Skin Irrit.2; H315 Eye Irrit.2; H319	>= 0.1 - < 1



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		Resp. Sens.1; H334 Skin Sens.1; H317 Carc.2; H351 STOT SE3; H335 STOT RE2; H373	
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For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

- General advice : Move out of dangerous area.
Consult a physician.
Show this safety data sheet to the doctor in attendance.
- If inhaled : Move to fresh air in case of accidental inhalation of dust or fumes from overheating or combustion.
If symptoms persist, call a physician.
- In case of skin contact : Take off contaminated clothing and shoes immediately.
Wash off with soap and plenty of water.
- In case of eye contact : Flush eyes with water as a precaution.
Remove contact lenses.
Protect unharmed eye.
Keep eye wide open while rinsing.
If eye irritation persists, consult a specialist.
- If swallowed : Clean mouth with water and drink afterwards plenty of water.
Do not give milk or alcoholic beverages.
Never give anything by mouth to an unconscious person.
Obtain medical attention.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : Lachrymation
Breathing difficulties
- Risks : sensitising effects

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : Oxygen, if needed.
For specialist advice physicians should contact the Poisons Information Service.



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SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting : No information available.

5.3 Advice for firefighters

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.

Further information : Standard procedure for chemical fires.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Ensure adequate ventilation.

6.2 Environmental precautions

Environmental precautions : Try to prevent the material from entering drains or water courses.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).
Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : Avoid formation of aerosol.
Avoid exceeding the given occupational exposure limits (see section 8).
For personal protection see section 8.
Persons with a history of skin sensitisation problems or asthma, allergies, chronic or recurrent respiratory disease



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should not be employed in any process in which this mixture is being used.

Smoking, eating and drinking should be prohibited in the application area.

Provide sufficient air exchange and/or exhaust in work rooms.

Advice on protection against fire and explosion : Normal measures for preventive fire protection.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. When using do not smoke. Wash hands before breaks and at the end of workday.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep container tightly closed. Keep in a dry, cool and well-ventilated place. Keep under nitrogen. Isocyanate based products react with water liberating carbon dioxide, which can lead to excessive pressure in closed containers, and form solid insoluble polymers, which can block pipes, valves, etc. Contact with copper or copper alloys and galvanized surfaces must be avoided and valves etc made of these materials must not be used in equipment for storing and handling diisocyanates. Do not store in open containers.

Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)

Specific use(s) : Polyurethane prepolymer

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

8.2 Exposure controls

Personal protective equipment

Eye protection : Eye wash bottle with pure water
Tightly fitting safety goggles

Hand protection

: Polyvinyl alcohol or nitrile- butyl-rubber gloves
The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
Before removing gloves clean them with soap and water.

Skin and body protection : impervious clothing
Choose body protection according to the amount and



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concentration of the dangerous substance at the work place.

Respiratory protection : In the case of vapour formation use a respirator with an approved filter.

Environmental exposure controls

General advice : Try to prevent the material from entering drains or water courses.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	: liquid
Colour	: opaque
Odour	: slight
Odour Threshold	: No data available
pH	: neutral
Melting point/range	: Not applicable
Boiling point/boiling range	: No data available
Flash point	: > 150 °C
Evaporation rate	: No data available
Flammability (solid, gas)	: No data available
Upper explosion limit	: No data available
Lower explosion limit	: No data available
Vapour pressure	: No data available
Relative vapour density	: No data available
Relative density	: No data available
Density	: No data available
Solubility(ies)	
Water solubility	: Reacts



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Solubility in other solvents : soluble
Solvent: Organic solvents

Partition coefficient: n-octanol/water : No data available

Auto-ignition temperature :
No data available

Thermal decomposition : No data available

Viscosity
Viscosity, dynamic : No data available

Viscosity, kinematic : No data available

9.2 Other information

Self-Accelerating decomposition temperature (SADT) : Method: No information available.

Oxidising potential : No information available.

SECTION 10: Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.

10.2 Chemical stability

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions : Stable under recommended storage conditions.
No decomposition if used as directed.

10.4 Conditions to avoid

Conditions to avoid : No data available

10.5 Incompatible materials

Materials to avoid : Alcohols
Water
Strong oxidizing agents

10.6 Hazardous decomposition products

Hazardous decomposition products : Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).



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Nitrogen oxides (NO_x)
Hydrogen cyanide
Isocyanates

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:

Acute oral toxicity : Remarks: Not classified due to lack of data.

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Acute oral toxicity : LD50 (Rat): 31,690 mg/kg

Skin corrosion/irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Skin irritation

Serious eye damage/eye irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Eye irritation

Respiratory or skin sensitisation

Product:

Remarks: May cause sensitisation by inhalation.

Components:



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4,4'-methylenediphenyl diisocyanate:

Species: Guinea pig

Assessment: May cause sensitisation by inhalation.

Result: Causes sensitisation.

Species: Guinea pig

Assessment: May cause sensitisation by skin contact.

Result: Causes sensitisation.

Germ cell mutagenicity

Product:

Germ cell mutagenicity

Assessment : Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Genotoxicity in vitro

: Test Type: Ames test

Result: positive

Carcinogenicity

Product:

Carcinogenicity

Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity

Assessment : Not classified due to lack of data.

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.

STOT - repeated exposure

Product:

Assessment: Not classified due to lack of data.

Aspiration toxicity

Product:

No aspiration toxicity classification



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Further information

Product:

Remarks: No data available

SECTION 12: Ecological information

12.1 Toxicity

Product:

Toxicity to fish : Remarks: No data is available on the product itself.

Toxicity to daphnia and other aquatic invertebrates : Remarks: No data available

Components:

4,4'-methylenediphenyl diisocyanate:

Toxicity to fish : LC50 (Danio rerio (zebra fish)): > 1,000 mg/l
Exposure time: 96 h

Toxicity to daphnia and other aquatic invertebrates : LC50 (Daphnia magna (Water flea)): > 1,000 mg/l
Exposure time: 48 h

12.2 Persistence and degradability

Product:

Biodegradability : Remarks: No data available

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : No data available

12.6 Other adverse effects

Product:

Additional ecological : Remarks: There is no data available for this product.



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information

SECTION 13: Disposal considerations

13.1 Waste treatment methods

- Product : Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with chemical or used container.
Offer surplus and non-recyclable solutions to a licensed disposal company.
- Contaminated packaging : Empty remaining contents.
Dispose of as unused product.
Do not re-use empty containers.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Not applicable

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

The components of this product are reported in the following inventories:

United States TSCA Inventory : On TSCA Inventory

Canadian Domestic Substances List (DSL) : All components of this product are on the Canadian DSL.



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Australia Inventory of Chemical Substances (AICS) : On the inventory, or in compliance with the inventory

New Zealand. Inventory of Chemical Substances : On the inventory, or in compliance with the inventory

Japan. ENCS - Existing and New Chemical Substances Inventory : Not in compliance with the inventory

Japan. ISHL - Inventory of Chemical Substances : Not in compliance with the inventory

Korea. Korean Existing Chemicals Inventory (KECI) : On the inventory, or in compliance with the inventory

Philippines Inventory of Chemicals and Chemical Substances (PICCS) : On the inventory, or in compliance with the inventory

China. Inventory of Existing Chemical Substances in China (IECSC) : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

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Emergency Phone Number

Europe:	All European Countries	+44 (0) 1235 239 670 (NCEC)
Asia Pacific:	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285



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	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



ADIPRENE® LFM E500

Version 3.2

Revision Date 15.09.2015

Print Date 23.06.2016

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : ADIPRENE® LFM E500

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the : Polyurethane prepolymer
Substance/Mixture

1.3 Details of the supplier of the safety data sheet

Company: Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by Product Safety Department

Further information for the safety data sheet :
msdsrequest@chemtura.com

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Respiratory sensitisation, Category 1 H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled.

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2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word : Danger

Hazard statements : H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Supplemental Hazard Statements : EUH204 Contains isocyanates. May produce an allergic reaction.

Precautionary statements :

Prevention:

P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P285 In case of inadequate ventilation wear respiratory protection.

Response:

P304 + P341 IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.

P342 + P311 If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.

Disposal:

P501 Dispose of contents/ container to an approved waste disposal plant.

Hazardous components which must be listed on the label:

4,4'-methylenediphenyl diisocyanate

Additional Labelling:

EUH204 .Contains isocyanates. May produce an allergic reaction.

2.3 Other hazards

No data available

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical Name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration (%)
4,4'-methylenediphenyl	101-68-8	Acute Tox.4; H332	>= 0.1 - < 1



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diisocyanate	202-966-0	Skin Irrit.2; H315 Eye Irrit.2; H319 Resp. Sens.1; H334 Skin Sens.1; H317 Carc.2; H351 STOT SE3; H335 STOT RE2; H373	
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For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

- General advice : Move out of dangerous area.
Consult a physician.
Show this safety data sheet to the doctor in attendance.
- If inhaled : Move to fresh air in case of accidental inhalation of dust or fumes from overheating or combustion.
If symptoms persist, call a physician.
- In case of skin contact : Take off contaminated clothing and shoes immediately.
Wash off with soap and plenty of water.
- In case of eye contact : Flush eyes with water as a precaution.
Remove contact lenses.
Protect unharmed eye.
Keep eye wide open while rinsing.
If eye irritation persists, consult a specialist.
- If swallowed : Clean mouth with water and drink afterwards plenty of water.
Do not give milk or alcoholic beverages.
Never give anything by mouth to an unconscious person.
Obtain medical attention.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : Lachrymation
Breathing difficulties
- Risks : sensitising effects

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : Oxygen, if needed.
For specialist advice physicians should contact the Poisons Information Service.



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SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting : No information available.

5.3 Advice for firefighters

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.

Further information : Standard procedure for chemical fires.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Ensure adequate ventilation.

6.2 Environmental precautions

Environmental precautions : Try to prevent the material from entering drains or water courses.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).
Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : Avoid formation of aerosol.
Avoid exceeding the given occupational exposure limits (see section 8).
For personal protection see section 8.
Persons with a history of skin sensitisation problems or asthma, allergies, chronic or recurrent respiratory disease



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should not be employed in any process in which this mixture is being used.

Smoking, eating and drinking should be prohibited in the application area.

Provide sufficient air exchange and/or exhaust in work rooms.

Advice on protection against fire and explosion : Normal measures for preventive fire protection.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. When using do not smoke. Wash hands before breaks and at the end of workday.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep container tightly closed. Keep in a dry, cool and well-ventilated place. Keep under nitrogen. Container can be pressurized by carbon dioxide due to reaction with humid air and/or water. Protect from moisture.

Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)

Specific use(s) : Polyurethane prepolymer

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational Exposure Limits

Components	CAS-No.	Value type (Form of exposure)	Control parameters	Basis
dimethyl phthalate	131-11-3	TWA	5 mg/m3	GB EH40
dimethyl phthalate	131-11-3	STEL	10 mg/m3	GB EH40

8.2 Exposure controls

Personal protective equipment

Eye protection : Eye wash bottle with pure water
Tightly fitting safety goggles

Hand protection

: Polyvinyl alcohol or nitrile- butyl-rubber gloves
The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
Before removing gloves clean them with soap and water.

Skin and body protection : impervious clothing



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Choose body protection according to the amount and concentration of the dangerous substance at the work place.

Respiratory protection : In the case of vapour formation use a respirator with an approved filter.

Environmental exposure controls

General advice : Try to prevent the material from entering drains or water courses.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance : viscous liquid

Colour : No data available

Odour : slight

Odour Threshold : No data available

pH : ca. 7

Melting point/range : Not applicable

Boiling point/boiling range : No data available

Flash point : > 150 °C

Evaporation rate : No data available

Flammability (solid, gas) : No data available

Upper explosion limit : No data available

Lower explosion limit : No data available

Vapour pressure : No data available

Relative vapour density : No data available

Relative density : No data available

Density : No data available

Solubility(ies)



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Water solubility	: No data available
Solubility in other solvents	: soluble Solvent: Organic solvents
Partition coefficient: n-octanol/water	: No data available
Auto-ignition temperature	: No data available
Thermal decomposition	: No data available
Viscosity	
Viscosity, dynamic	: 200 - 600 mPa.s
Viscosity, kinematic	: No data available

9.2 Other information

Self-Accelerating decomposition temperature (SADT)	: Method: No information available.
Oxidising potential	: No information available.

SECTION 10: Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.

10.2 Chemical stability

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions	: Stable under recommended storage conditions. No decomposition if used as directed.
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10.4 Conditions to avoid

Conditions to avoid	: No data available
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10.5 Incompatible materials

Materials to avoid	: Alcohols Water Strong oxidizing agents
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10.6 Hazardous decomposition products

Hazardous decomposition	: Carbon monoxide, carbon dioxide and unburned
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products
hydrocarbons (smoke).
Nitrogen oxides (NOx)
Hydrogen cyanide
Isocyanates

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:

Acute oral toxicity : Remarks: Not classified due to lack of data.

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Acute oral toxicity : LD50 (Rat): 31,690 mg/kg

Skin corrosion/irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Skin irritation

Serious eye damage/eye irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Eye irritation

Respiratory or skin sensitisation

Product:

Remarks: May cause sensitisation by skin contact.



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Components:

4,4'-methylenediphenyl diisocyanate:

Species: Guinea pig

Assessment: May cause sensitisation by inhalation.

Result: Causes sensitisation.

Species: Guinea pig

Assessment: May cause sensitisation by skin contact.

Result: Causes sensitisation.

Germ cell mutagenicity

Product:

Germ cell mutagenicity

Assessment : Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Genotoxicity in vitro : Test Type: Ames test

Result: positive

Carcinogenicity

Product:

Carcinogenicity

Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity

Assessment : Not classified due to lack of data.

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.

STOT - repeated exposure

Product:

Assessment: Not classified due to lack of data.

Aspiration toxicity

Product:

No aspiration toxicity classification



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Further information

Product:

Remarks: No data available

SECTION 12: Ecological information

12.1 Toxicity

Product:

Further information

The following percentage of the mixture consists of ingredient(s) with unknown hazards to the aquatic environment: 100 %

Components:

4,4'-methylenediphenyl diisocyanate:

Toxicity to fish : LC50 (Danio rerio (zebra fish)): > 1,000 mg/l
Exposure time: 96 h

Toxicity to daphnia and other : LC50 (Daphnia magna (Water flea)): > 1,000 mg/l
aquatic invertebrates Exposure time: 48 h

12.2 Persistence and degradability

Product:

Biodegradability : Remarks: No data available

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : No data available

12.6 Other adverse effects

Product:

Additional ecological : Remarks: There is no data available for this product.
information



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SECTION 13: Disposal considerations

13.1 Waste treatment methods

- Product : Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with chemical or used container.
Offer surplus and non-recyclable solutions to a licensed disposal company.
- Contaminated packaging : Empty remaining contents.
Dispose of as unused product.
Do not re-use empty containers.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Not applicable

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals : Not applicable

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59). : Not applicable

Regulation (EC) No 1005/2009 on substances that deplete the ozone layer : Not applicable



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Regulation (EC) No 850/2004 on persistent organic pollutants : Not applicable

Major Accident Hazard Legislation

Seveso Directive

Seveso II - Directive 2003/105/EC amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances

Not applicable

The components of this product are reported in the following inventories:

United States TSCA Inventory : On TSCA Inventory

Canadian Domestic Substances List (DSL) : All components of this product are on the Canadian DSL.

Australia Inventory of Chemical Substances (AICS) : On the inventory, or in compliance with the inventory

New Zealand. Inventory of Chemical Substances : On the inventory, or in compliance with the inventory

Japan. ENCS - Existing and New Chemical Substances Inventory : On the inventory, or in compliance with the inventory

Korea. Korean Existing Chemicals Inventory (KECI) : On the inventory, or in compliance with the inventory

Philippines Inventory of Chemicals and Chemical Substances (PICCS) : On the inventory, or in compliance with the inventory

China. Inventory of Existing Chemical Substances in China (IECSC) : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H334

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Carechem24 International Worldwide Coverage



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Emergency Phone Number

<u>Europe:</u>	All European Countries	+44 (0) 1235 239 670 (NCEC)
<u>Asia Pacific:</u>	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



SAFETY DATA SHEET
according to Regulation (EC) No. 1907/2006



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Revision Date 06.05.2013

Print Date 23.06.2016

1. Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : ADIPRENE® LFM E615

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the : Polyurethane prepolymer

Substance/Mixture

Recommended restrictions : Reserved for industrial and professional use.
on use

1.3 Details of the supplier of the safety data sheet

Company: Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by: msdsrequest@chemtura.com

Further information for the safety data sheet :
msdsrequest@chemtura.com

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of
the Safety Data Sheet.

2. Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Respiratory sensitization, Category 1 H334: May cause allergy or asthma symptoms or

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breathing difficulties if inhaled.

Classification (67/548/EEC, 1999/45/EC)

Sensitising

R42: May cause sensitization by inhalation.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word :

Danger

Hazard statements :

H334

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Precautionary statements :

Prevention:

P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P285

In case of inadequate ventilation wear respiratory protection.

Response:

P304 + P341

IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.

P342 + P311

If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.

Disposal:

P501

Dispose of contents/ container to an approved waste disposal plant.

Hazardous components which must be listed on the label:

- 101-68-8 4,4'-methylenediphenyl diisocyanate

Additional Labelling:

EUH204 Contains isocyanates. May produce an allergic reaction.

2.3 Other hazards

Contains isocyanates. See information supplied by the manufacturer.

Normal precautions common to safe manufacturing practice should be followed in handling and storage.

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3. Composition/information on ingredients**3.1 Substances**

Chemical Name	CAS-No. EINECS-No. / ELINCS No.	Concentration [%]
4,4'-methylenediphenyl diisocyanate	101-68-8 202-966-0	$\geq 0.1 - < 1$

4. First aid measures**4.1 Description of first aid measures**

- General advice : Move out of dangerous area.
Consult a physician.
Show this safety data sheet to the doctor in attendance.
- If inhaled : Move to fresh air in case of accidental inhalation of dust or fumes from overheating or combustion.
If symptoms persist, call a physician.
- In case of skin contact : Take off contaminated clothing and shoes immediately.
Wash off with soap and plenty of water.
- In case of eye contact : Flush eyes with water as a precaution.
Remove contact lenses.
Protect unharmed eye.
Keep eye wide open while rinsing.
If eye irritation persists, consult a specialist.
- If swallowed : Clean mouth with water and drink afterwards plenty of water.
Do not give milk or alcoholic beverages.
Never give anything by mouth to an unconscious person.
Obtain medical attention.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : Lachrymation
Breathing difficulties
- Risks : sensitising effects

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : Oxygen, if needed.
For specialist advice physicians should contact the Poisons Information Service.

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5. Firefighting measures**5.1 Extinguishing media**

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting : No information available.

5.3 Advice for firefighters

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.
Further information : Standard procedure for chemical fires.

6. Accidental release measures**6.1 Personal precautions, protective equipment and emergency procedures**

Personal precautions : Use personal protective equipment.
Ensure adequate ventilation.

6.2 Environmental precautions

Environmental precautions : Try to prevent the material from entering drains or water courses.

6.3 Methods and materials for containment and cleaning up

Methods for cleaning up : Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).
Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

7. Handling and storage**7.1 Precautions for safe handling**

Advice on safe handling : Avoid formation of aerosol.
Avoid exceeding of the given occupational exposure limits (see section 8).
For personal protection see section 8.
Smoking, eating and drinking should be prohibited in the application area.
Provide sufficient air exchange and/or exhaust in work rooms.

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Advice on protection against fire and explosion : Normal measures for preventive fire protection.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep containers tightly closed in a dry, cool and well-ventilated place.
Keep under nitrogen.
Protect from moisture.
Container can be pressurized by carbon dioxide due to reaction with humid air and/or water.

Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)

Specific use(s) : Polyurethane prepolymer

8. Exposure controls/personal protection

8.1 Control parameters

Components	CAS-No.	Value	Control parameters	Update	Basis
4,4'-methylenediphenyl diisocyanate	101-68-8	TWA	0.02 mg/m ³	2007-08-01	GB EH40
		STEL	0.07 mg/m ³	2007-08-01	GB EH40

8.2 Exposure controls

Personal protective equipment

Respiratory protection : In the case of vapour formation use a respirator with an approved filter.

Hand protection : Polyvinyl alcohol or nitrile- butyl-rubber gloves
The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
Before removing gloves clean them with soap and water.

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- Eye protection : Eye wash bottle with pure water
Tightly fitting safety goggles
- Skin and body protection : impervious clothing
Choose body protection according to the amount and
concentration of the dangerous substance at the work place.
- Hygiene measures : Handle in accordance with good industrial hygiene and safety
practice.
When using do not eat or drink.
When using do not smoke.
Wash hands before breaks and at the end of workday.

Environmental exposure controls

- General advice : Try to prevent the material from entering drains or water
courses.

9. Physical and chemical properties**9.1 Information on basic physical and chemical properties**

- Appearance : liquid
- Colour : opaque
- Odour : slight
- Odour Threshold : No information available.
- Flash point :
not determined
- Ignition temperature : No information available.
- Lower explosion limit : No information available.
- Upper explosion limit : No information available.
- Flammability (solid, gas) : No information available.
- Auto-ignition temperature : No information available.
- pH :
- Boiling point/boiling range : neutral
Note: not determined

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Vapour pressure	: No information available.
Density	: no data available
Relative density	: No information available.
Water solubility	: Reacts
Partition coefficient: n-octanol/water	: No information available.
Solubility in other solvents	: soluble Medium: Organic solvents
Relative vapour density	: No information available.
Evaporation rate	: No information available.

9.2 Other information

10. Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.

10.2 Chemical stability

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions : Note: Stable under recommended storage conditions., No decomposition if used as directed.

10.4 Conditions to avoid

Conditions to avoid : no data available

10.5 Incompatible materials

Materials to avoid : Alcohols
Water
Strong oxidizing agents

10.6 Hazardous decomposition products

Hazardous decomposition products : Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).
nitrogen oxides (NOx)
Hydrogen cyanide
Isocyanates

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11. Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Acute oral toxicity : Remarks: Not classified due to lack of data.

Acute oral toxicity
4,4'-methylenediphenyl
diisocyanate : LD50: 31,690 mg/kg
Species: rat

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute inhalation toxicity
4,4'-methylenediphenyl
diisocyanate : LC50: > 2.24 mg/l
Species: rat
Remarks: Irritating to respiratory system.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Skin corrosion/irritation

Skin irritation : Remarks: Not classified due to lack of data.

Skin irritation
4,4'-methylenediphenyl
diisocyanate : Species: rabbit
Result: irritating

Serious eye damage/eye irritation

Eye irritation : Remarks: Not classified due to lack of data.

Eye irritation
4,4'-methylenediphenyl
diisocyanate : Species: rabbit
Result: Eye irritation

Respiratory or skin sensitisation

Sensitisation : Remarks: May cause sensitization by inhalation.

Sensitisation
4,4'-methylenediphenyl
diisocyanate : Species: guinea pig
Classification: May cause sensitization by inhalation.
Result: Causes sensitization.



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Species: guinea pig
Classification: May cause sensitization by skin contact.
Result: Causes sensitization.

Germ cell mutagenicity
4,4'-methylenediphenyl
diisocyanate : Ames test
Result: positive

Mutagenicity Assessment

Remarks : Not classified due to lack of data.

Carcinogenicity Assessment

Remarks : Not classified due to lack of data.

Reproductive toxicity Assessment

Remarks : Not classified due to lack of data.

Target Organ Systemic Toxicant - Single exposure

: Remarks: Not classified due to lack of data.

Target Organ Systemic Toxicant - Repeated exposure

: Remarks: Not classified due to lack of data.

Aspiration hazard

Aspiration toxicity : No aspiration toxicity classification

Toxicology Assessment

Further information : no data available

12. Ecological information

12.1 Toxicity

12.2 Persistence and degradability

Biodegradability : Remarks:
no data available



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12.3 Bioaccumulative potential

Bioaccumulation : Remarks:
no data available

12.4 Mobility in soil

Mobility : Remarks:
no data available

12.5 Results of PBT and vPvB assessment

no data available

12.6 Other adverse effects

Additional ecological information : There is no data available for this product.

13. Disposal considerations

13.1 Waste treatment methods

Product : Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with chemical or used container.
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging : Empty remaining contents.
Dispose of as unused product.
Do not re-use empty containers.

14. Transport information

ADR
Not dangerous goods

IATA
Not dangerous goods

IMDG
Not dangerous goods

RID
Not dangerous goods



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15. Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Candidate List of Substances of Very High Concern for Authorisation : This product does not contain substances of very high concern (Regulation (EC) No 1907/2006 (REACH), Article 57).

Major Accident Hazard Legislation : 96/82/EC Update: 2003
Directive 96/82/EC does not apply

Notification status

US.TSCA : On TSCA Inventory
DSL : All components of this product are on the Canadian DSL list.
AICS : On the inventory, or in compliance with the inventory
NZIoC : On the inventory, or in compliance with the inventory
ENCS : Not in compliance with the inventory
ISHL : Not in compliance with the inventory
KECI : On the inventory, or in compliance with the inventory
PICCS : On the inventory, or in compliance with the inventory
IECSC : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

16. Other information

Full text of R-phrases referred to under sections 2 and 3

R42 May cause sensitization by inhalation.

Full text of H-Statements referred to under sections 2 and 3.

H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Further information

Carechem24 International Worldwide Coverage - Chemtura Corporation

Emergency Phone Number

Europe:	All European Countries	+44 (0) 1235 239 670 (NCEC)
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<u>Asia Pacific:</u>	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



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SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : ADIPRENE® LFM E730

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Raw material for industry

Recommended restrictions on use : Reserved for industrial and professional use.

1.3 Details of the supplier of the safety data sheet

Company:

Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by

Further information for the safety data sheet :

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Respiratory sensitisation, Category 1 H334: May cause allergy or asthma symptoms or

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breathing difficulties if inhaled.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word :

Danger

Hazard statements :

H334

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Supplemental Hazard Statements :

EUH204

Contains isocyanates. May produce an allergic reaction.

Precautionary statements :

Prevention:
P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P285

In case of inadequate ventilation wear respiratory protection.

Response:
P304 + P341

IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.

P342 + P311

If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.

Disposal:
P501

Dispose of contents/ container to an approved waste disposal plant.

Hazardous components which must be listed on the label:

4,4'-methylenediphenyl diisocyanate

2.3 Other hazards

No data available

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Chemical nature :

Polymer

Hazardous components

Chemical Name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration (%)



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4,4'-methylenediphenyl diisocyanate	101-68-8 202-966-0	Acute Tox.4; H332 Skin Irrit.2; H315 Eye Irrit.2; H319 Resp. Sens.1; H334 Skin Sens.1; H317 Carc.2; H351 STOT SE3; H335 STOT RE2; H373	>= 0.1 - < 1
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For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

- If inhaled : Move to fresh air.
Oxygen or artificial respiration if needed.
Get medical attention immediately.
- In case of skin contact : Remove contaminated clothing and shoes.
Wash off with warm water and soap.
If symptoms persist, call a physician.
- In case of eye contact : Rinse immediately with plenty of water, also under the eyelids,
for at least 15 minutes.
If symptoms persist, call a physician.
- If swallowed : Do NOT induce vomiting.
Rinse mouth with water.
Obtain medical attention.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : No information available.
- Risks : No information available.

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : The first aid procedure should be established in consultation
with the doctor responsible for industrial medicine.

SECTION 5: Firefighting measures

5.1 Extinguishing media

- Suitable extinguishing media : Water spray
Dry chemical



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5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting : Burning produces irritant fumes.
Exposure to decomposition products may be a hazard to health.

5.3 Advice for firefighters

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.
Wear suitable protective clothing, gloves and eye/face protection.

Further information : Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Wear suitable protective equipment.
Avoid contact with skin and eyes.

6.2 Environmental precautions

Environmental precautions : Avoid release to the environment.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Dam up.
Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).
Pick up and transfer to properly labelled containers.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : Handle in accordance with good industrial hygiene and safety practice.
Use only in area provided with appropriate exhaust ventilation.
Protect from moisture.
Keep away from heat.
Purge open drums with nitrogen before resealing.

Hygiene measures : Avoid contact with moisture and prolonged exposure to temperatures above 140°F (60°C). Purge open drums with nitrogen before resealing. Do not use spot heating devices such as band heaters or torches. Make sure contents are



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completely liquid and uniform before using. (SEE TECHNICAL BULLETIN FOR ADDITIONAL DETAILS)

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep containers tightly closed in a dry, cool and well-ventilated place. Container can be pressurized by carbon dioxide due to reaction with humid air and/or water. Protect from moisture. Keep under nitrogen.

Other data : Stable under recommended storage conditions.

7.3 Specific end use(s)

Specific use(s) : Chemical intermediate

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

8.2 Exposure controls

Engineering measures

Ensure that eyewash stations and safety showers are close to the workstation location.

Personal protective equipment

Eye protection : Safety glasses with side-shields conforming to EN166

Hand protection

: Impervious butyl rubber gloves

Skin and body protection : Full protective suit

Respiratory protection : In the case of vapour formation use a respirator with an approved filter.
Respirator with a vapour filter (EN 141)

Environmental exposure controls

General advice : Avoid release to the environment.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance : liquid



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Colour	: clear, light yellow
Odour	: slight
Odour Threshold	: No data available
pH	: neutral
Melting point/range	: Not applicable
Boiling point/boiling range	: No data available
Flash point	: > 150 °C
Evaporation rate	: No data available
Flammability (solid, gas)	: No data available
Upper explosion limit	: No data available
Lower explosion limit	: No data available
Vapour pressure	: No data available
Relative vapour density	: No data available
Relative density	: No data available
Density	: No data available
Solubility(ies)	
Water solubility	: No data available
Solubility in other solvents	: soluble Solvent: Organic solvents
Partition coefficient: n-octanol/water	: No data available
Auto-ignition temperature	: No data available
Thermal decomposition	: No data available
Viscosity	
Viscosity, dynamic	: No data available
Viscosity, kinematic	: No data available

9.2 Other information



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Self-Accelerating decomposition temperature (SADT) : Method: No information available.

Oxidising potential : No information available.

SECTION 10: Stability and reactivity

10.1 Reactivity

No dangerous reaction known under conditions of normal use.

10.2 Chemical stability

Stable under normal conditions.

10.3 Possibility of hazardous reactions

Hazardous reactions : Hazardous polymerisation does not occur.

10.4 Conditions to avoid

Conditions to avoid : Extremes of temperature and direct sunlight.

10.5 Incompatible materials

Materials to avoid : Water
Strong acids and strong bases
Alcohols

10.6 Hazardous decomposition products

Hazardous decomposition products : Hydrocarbons
Carbon oxides
Nitrogen oxides (NO_x)
Hydrogen cyanide
Isocyanates

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:

Acute oral toxicity : Remarks: Not classified due to lack of data.

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:



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4,4'-methylenediphenyl diisocyanate:

Acute oral toxicity : LD50 (Rat): 31,690 mg/kg

Skin corrosion/irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Skin irritation

Serious eye damage/eye irritation

Product:

Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Eye irritation

Respiratory or skin sensitisation

Product:

Remarks: May cause sensitisation by inhalation.

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Guinea pig

Assessment: May cause sensitisation by inhalation.

Result: Causes sensitisation.

Species: Guinea pig

Assessment: May cause sensitisation by skin contact.

Result: Causes sensitisation.

Germ cell mutagenicity

Product:

Germ cell mutagenicity

Assessment : Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Genotoxicity in vitro : Test Type: Ames test

Result: positive



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Carcinogenicity

Product:

Carcinogenicity
Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity
Assessment : Not classified due to lack of data.

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.

STOT - repeated exposure

Product:

Assessment: Not classified due to lack of data.

Aspiration toxicity

Further information

Product:

Remarks: No data is available on the product itself.

SECTION 12: Ecological information

12.1 Toxicity

Product:

Toxicity to fish : Remarks: No data available

Further information

The following percentage of the mixture consists of ingredient(s) with unknown hazards to the aquatic environment: 100 %

Components:

4,4'-methylenediphenyl diisocyanate:

Toxicity to fish : LC50 (Danio rerio (zebra fish)): > 1,000 mg/l
Exposure time: 96 h

Toxicity to daphnia and other aquatic invertebrates : LC50 (Daphnia magna (Water flea)): > 1,000 mg/l
Exposure time: 48 h



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12.2 Persistence and degradability

Product:

Biodegradability : Remarks: No data available

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : No data available

12.6 Other adverse effects

Product:

Additional ecological information : Remarks: There is no data available for this product.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with chemical or used container.
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging : Empty remaining contents.
Dispose of as unused product.
Do not re-use empty containers.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good



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14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Not applicable

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

International Chemical Weapons Convention (CWC) : Neither banned nor restricted
Schedules of Toxic Chemicals and Precursors

REACH - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, preparations and articles (Annex XVII) : Neither banned nor restricted

Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals : Neither banned nor restricted

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59). : This product does not contain substances of very high concern (Regulation (EC) No 1907/2006 (REACH), Article 57).

REACH - List of substances subject to authorisation (Annex XIV) : Neither banned nor restricted

Regulation (EC) No 1005/2009 on substances that deplete the ozone layer : Neither banned nor restricted

Major Accident Hazard Legislation

Seveso Directive

Directive 96/82/EC does not apply

The components of this product are reported in the following inventories:

United States TSCA Inventory : On TSCA Inventory

Canadian Domestic Substances List : All components of this product are on the Canadian DSL.



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stances List (DSL)

Australia Inventory of Chemical Substances (AICS) : On the inventory, or in compliance with the inventory

New Zealand. Inventory of Chemical Substances : On the inventory, or in compliance with the inventory

Japan. ENCS - Existing and New Chemical Substances Inventory : On the inventory, or in compliance with the inventory

Korea. Korean Existing Chemicals Inventory (KECI) : On the inventory, or in compliance with the inventory

Philippines Inventory of Chemicals and Chemical Substances (PICCS) : On the inventory, or in compliance with the inventory

China. Inventory of Existing Chemical Substances in China (IECSC) : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Carechem24 International Worldwide Coverage

Emergency Phone Number

<u>Europe:</u>	All European Countries	+44 (0) 1235 239 670 (NCEC)
<u>Asia Pacific:</u>	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255



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	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



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SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : ADIPRENE® LFM E760

Substance name : Reaction product of methylene bis p-phenyl isocyanate (MDI) and poly (oxytetra-methylene) glycol. (PTMEG-250 and PTMEG-650)

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Polyurethane prepolymer

Recommended restrictions on use : Reserved for industrial and professional use.

1.3 Details of the supplier of the safety data sheet

Company: Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by Product Safety Department

Further information for the safety data sheet :
msdsrequest@chemtura.com

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

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SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Respiratory sensitisation, Category 1

H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms

:



Signal word

: Danger

Hazard statements

: H334

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Supplemental Hazard Statements

: EUH204

Contains isocyanates. May produce an allergic reaction.

Precautionary statements

: **Prevention:**

P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P284

Wear respiratory protection.

Response:

P304 + P340

IF INHALED: Remove person to fresh air and keep comfortable for breathing.

P342 + P311

If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.

Disposal:

P501

Dispose of contents/ container to an approved waste disposal plant.

Hazardous components which must be listed on the label:

4,4'-methylenediphenyl diisocyanate

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.



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SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical Name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration (%)
4,4'-methylenediphenyl diisocyanate	101-68-8 202-966-0	Acute Tox.4; H332 Skin Irrit.2; H315 Eye Irrit.2; H319 Resp. Sens.1; H334 Skin Sens.1; H317 Carc.2; H351 STOT SE3; H335 STOT RE2; H373	$\geq 0.1 - < 1$

For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

- If inhaled : Remove victim to fresh air and keep at rest in a position comfortable for breathing.
If not breathing, give artificial respiration.
Call a physician or poison control centre immediately.
If breathing is difficult, give oxygen.
Keep respiratory tract clear.
- In case of skin contact : Take off contaminated clothing and shoes immediately.
Wash off with soap and plenty of water.
If symptoms persist, call a physician.
- In case of eye contact : If eye irritation persists, consult a specialist.
- If swallowed : Call a physician or poison control centre immediately.
Rinse mouth with water.
If victim is fully conscious, give a cupful of water.
DO NOT induce vomiting unless directed to do so by a physician or poison control center.
Never give anything by mouth to an unconscious person.
Do not give milk or alcoholic beverages.
Obtain medical attention.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : No information available.



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Risks : No information available.

4.3 Indication of any immediate medical attention and special treatment needed

Treatment : The first aid procedure should be established in consultation with the doctor responsible for industrial medicine.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting : Burning produces noxious and toxic fumes.

5.3 Advice for firefighters

Special protective equipment for firefighters : Wear full protective clothing and self-contained breathing apparatus.

Further information : Standard procedure for chemical fires.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Avoid dust formation.
Avoid breathing dust.
Ensure adequate ventilation.
Evacuate personnel to safe areas.
Material can create slippery conditions.

6.2 Environmental precautions

Environmental precautions : Do not flush into surface water or sanitary sewer system.
Prevent further leakage or spillage if safe to do so.
The product should not be allowed to enter drains, water courses or the soil.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Pick up and arrange disposal without creating dust.
Keep in suitable, closed containers for disposal.



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6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

- Advice on safe handling : Avoid formation of respirable particles.
For personal protection see section 8.
- Advice on protection against fire and explosion : Avoid dust formation. Provide appropriate exhaust ventilation at places where dust is formed.
- Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. When using do not smoke. Wash hands before breaks and at the end of workday.

7.2 Conditions for safe storage, including any incompatibilities

- Requirements for storage areas and containers : Keep container tightly closed in a dry and well-ventilated place. Container can be pressurized by carbon dioxide due to reaction with humid air and/or water. Protect from moisture. Keep under nitrogen.
- Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)

- Specific use(s) : Used in polyurethane manufacturing.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Engineering measures

Provide sufficient air exchange and/or exhaust in work rooms.

Personal protective equipment

Eye protection : Eye wash bottle with pure water
Tightly fitting safety goggles

Hand protection

: Polyvinyl alcohol or nitrile- butyl-rubber gloves
Before removing gloves clean them with soap and water.



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- Skin and body protection : Dust impervious protective suit
Choose body protection according to the amount and concentration of the dangerous substance at the work place.
- Respiratory protection : In the case of dust or aerosol formation use respirator with an approved filter.

Environmental exposure controls

- General advice : Do not flush into surface water or sanitary sewer system., Prevent further leakage or spillage if safe to do so., The product should not be allowed to enter drains, water courses or the soil.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

- Appearance : solid
- Colour : off-white
- Odour : slight
- Odour Threshold : not determined
- pH : neutral
- Melting point/freezing point : not determined
- Boiling point/boiling range : not determined
- Flash point : not determined
- Relative density : No data available
- Solubility(ies)
Water solubility : Water reactive
- Viscosity
Viscosity, dynamic : No data available
- Viscosity, kinematic : No data available

9.2 Other information

No data available



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SECTION 10: Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.

10.2 Chemical stability

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions : Stable under recommended storage conditions.
No decomposition if used as directed.

10.4 Conditions to avoid

Conditions to avoid : No data available

10.5 Incompatible materials

Materials to avoid : No data available

10.6 Hazardous decomposition products

Hazardous decomposition products : No hazardous decomposition products are known.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Acute oral toxicity : LD50 (Rat): 31,690 mg/kg

Skin corrosion/irritation

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Skin irritation



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Serious eye damage/eye irritation

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Eye irritation

Respiratory or skin sensitisation

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Guinea pig

Assessment: May cause sensitisation by inhalation.

Result: Causes sensitisation.

Species: Guinea pig

Assessment: May cause sensitisation by skin contact.

Result: Causes sensitisation.

Germ cell mutagenicity

Components:

4,4'-methylenediphenyl diisocyanate:

Genotoxicity in vitro : Test Type: Ames test
Result: positive

Carcinogenicity

Product:

Carcinogenicity

Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity

Assessment : Not classified due to lack of data.

STOT - single exposure

Product:

Remarks: Not classified due to lack of data.

STOT - repeated exposure

Aspiration toxicity

Further information

Product:



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Remarks: No data available

SECTION 12: Ecological information

12.1 Toxicity

Components:

4,4'-methylenediphenyl diisocyanate:

Toxicity to fish : LC50 (Danio rerio (zebra fish)): > 1,000 mg/l
Exposure time: 96 h

Toxicity to daphnia and other : LC50 (Daphnia magna (Water flea)): > 1,000 mg/l
aquatic invertebrates Exposure time: 48 h

12.2 Persistence and degradability

Product:

Biodegradability : Remarks: No data available

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

Product:

Additional ecological : Remarks: This product has no known ecotoxicological effects.
information An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.



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SECTION 13: Disposal considerations

13.1 Waste treatment methods

- Product : Dispose of wastes in an approved waste disposal facility.
In accordance with local and national regulations.
Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with
chemical or used container.
- Contaminated packaging : Dispose of as unused product.
Do not re-use empty containers.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

- Remarks : Not classified as dangerous in the meaning of transport regulations.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals : Not applicable

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59). : Not applicable

Regulation (EC) No 1005/2009 on substances that deplete the ozone layer : Not applicable



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Print Date 23.06.2016

Regulation (EC) No 850/2004 on persistent organic pollutants : Not applicable

Major Accident Hazard Legislation

Seveso Directive

Seveso II - Directive 2003/105/EC amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances
Not applicable

The components of this product are reported in the following inventories:

United States TSCA Inventory : On TSCA Inventory

Canadian Domestic Substances List (DSL) : All components of this product are on the Canadian DSL

Australia Inventory of Chemical Substances (AICS) : On the inventory, or in compliance with the inventory

New Zealand. Inventory of Chemical Substances : On the inventory, or in compliance with the inventory

Japan. ENCS - Existing and New Chemical Substances Inventory : Not in compliance with the inventory

Korea. Korean Existing Chemicals Inventory (KECI) : On the inventory, or in compliance with the inventory

Philippines Inventory of Chemicals and Chemical Substances (PICCS) : On the inventory, or in compliance with the inventory

China. Inventory of Existing Chemical Substances in China (IECSC) : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H334 : May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Carechem24 International Worldwide Coverage



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Emergency Phone Number

<u>Europe:</u>	All European Countries	+44 (0) 1235 239 670 (NCEC)
<u>Asia Pacific:</u>	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



ADIPRENE® LFM S345

Version 1.1

Revision Date 11.09.2015

Print Date 23.06.2016

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : ADIPRENE® LFM S345

Substance name : Reaction product of methylene bis p-phenyl isocyanate (MDI) and polyethylene adipate glycol. (PEAG-1000 and PEAG-2000)

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Polyurethane prepolymer

Recommended restrictions on use : Reserved for industrial and professional use.

1.3 Details of the supplier of the safety data sheet

Company: Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by Product Safety Department

Further information for the safety data sheet :
msdsrequest@chemtura.com

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

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Version 1.1

Revision Date 11.09.2015

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SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Respiratory sensitisation, Category 1

H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms

:



Signal word

: Danger

Hazard statements

: H334

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Precautionary statements

: **Prevention:**

P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P284

Wear respiratory protection.

Response:

P304 + P340

IF INHALED: Remove person to fresh air and keep comfortable for breathing.

P342 + P311

If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.

Disposal:

P501

Dispose of contents/ container to an approved waste disposal plant.

Hazardous components which must be listed on the label:

4,4'-methylenediphenyl diisocyanate

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical Name	CAS-No. EC-No.	Classification (REGULATION (EC) No	Concentration (%)
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	Registration number	1272/2008)	
4,4'-methylenediphenyl diisocyanate	101-68-8 202-966-0	Acute Tox.4; H332 Skin Irrit.2; H315 Eye Irrit.2; H319 Resp. Sens.1; H334 Skin Sens.1; H317 Carc.2; H351 STOT SE3; H335 STOT RE2; H373	$\geq 0.1 - < 1$

For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

- If inhaled : Remove victim to fresh air and keep at rest in a position comfortable for breathing.
If not breathing, give artificial respiration.
Call a physician or poison control centre immediately.
If breathing is difficult, give oxygen.
Keep respiratory tract clear.
- In case of skin contact : Take off contaminated clothing and shoes immediately.
Wash off with soap and plenty of water.
If symptoms persist, call a physician.
- In case of eye contact : If eye irritation persists, consult a specialist.
- If swallowed : Call a physician or poison control centre immediately.
Rinse mouth with water.
If victim is fully conscious, give a cupful of water.
DO NOT induce vomiting unless directed to do so by a physician or poison control center.
Never give anything by mouth to an unconscious person.
Do not give milk or alcoholic beverages.
Obtain medical attention.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : No information available.
- Risks : No information available.

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : The first aid procedure should be established in consultation with the doctor responsible for industrial medicine.



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SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting : Burning produces irritant fumes.
Burning produces noxious and toxic fumes.

5.3 Advice for firefighters

Special protective equipment for firefighters : Wear full protective clothing and self-contained breathing apparatus.

Further information : Standard procedure for chemical fires.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Avoid dust formation.
Avoid breathing dust.
Ensure adequate ventilation.
Evacuate personnel to safe areas.
Material can create slippery conditions.

6.2 Environmental precautions

Environmental precautions : Do not flush into surface water or sanitary sewer system.
Prevent further leakage or spillage if safe to do so.
Avoid release to the environment.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Pick up and arrange disposal without creating dust.
Sweep up and shovel.
Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : Avoid formation of respirable particles.



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For personal protection see section 8.
No special handling advice required.

Advice on protection against fire and explosion : Avoid dust formation. Provide appropriate exhaust ventilation at places where dust is formed.

Hygiene measures : General industrial hygiene practice.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep container tightly closed in a dry and well-ventilated place. Container can be pressurized by carbon dioxide due to reaction with humid air and/or water. Protect from moisture. Keep under nitrogen.

Advice on common storage : No special restrictions on storage with other products.

Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)

Specific use(s) : Chemical intermediate

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Contains no substances with occupational exposure limit values.

Biological occupational exposure limits

Substance name	CAS-No.	Control parameters	Sampling time	Basis
	101-68-8	urinary diamine: 100 µg/Lµmol/mol creatinine (Urine)	Post task	GB EH40 BAT

8.2 Exposure controls

Engineering measures

Provide sufficient air exchange and/or exhaust in work rooms.

Personal protective equipment

Eye protection : Tightly fitting safety goggles

Hand protection

: For prolonged or repeated contact use protective gloves.

Skin and body protection : Protective suit

Respiratory protection : No personal respiratory protective equipment normally required.



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Environmental exposure controls

General advice : Do not flush into surface water or sanitary sewer system.,
Prevent further leakage or spillage if safe to do so., Avoid
release to the environment.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	: solid
Colour	: off-white
Odour	: slight
Odour Threshold	: not determined
pH	: neutral
Melting point/freezing point	: not determined
Boiling point/boiling range	: not determined
Flash point	: not determined
Relative density	: No data available
Solubility(ies)	
Water solubility	: Water reactive
Viscosity	
Viscosity, dynamic	: No data available
Viscosity, kinematic	: No data available

9.2 Other information

No data available

SECTION 10: Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.



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10.2 Chemical stability

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions : No hazards to be specially mentioned.

10.4 Conditions to avoid

Conditions to avoid : Exposure to moisture

10.5 Incompatible materials

Materials to avoid : Acids and bases
Ammonia
Water

10.6 Hazardous decomposition products

Hazardous decomposition products : No hazardous decomposition products are known.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Acute oral toxicity : LD50 (Rat): 31,690 mg/kg

Skin corrosion/irritation

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Skin irritation

Serious eye damage/eye irritation

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit

Result: Eye irritation



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Respiratory or skin sensitisation

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Guinea pig

Assessment: May cause sensitisation by inhalation.

Result: Causes sensitisation.

Species: Guinea pig

Assessment: May cause sensitisation by skin contact.

Result: Causes sensitisation.

Germ cell mutagenicity

Components:

4,4'-methylenediphenyl diisocyanate:

Genotoxicity in vitro : Test Type: Ames test
Result: positive

Carcinogenicity

Product:

Carcinogenicity

Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity

Assessment : Not classified due to lack of data.

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.

STOT - repeated exposure

Product:

Assessment: Not classified due to lack of data.

Aspiration toxicity

SECTION 12: Ecological information

12.1 Toxicity

Product:



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Toxicity to fish : Remarks: No data available

Components:

4,4'-methylenediphenyl diisocyanate:

Toxicity to fish : LC50 (Danio rerio (zebra fish)): > 1,000 mg/l
Exposure time: 96 h

Toxicity to daphnia and other : LC50 (Daphnia magna (Water flea)): > 1,000 mg/l
aquatic invertebrates Exposure time: 48 h

12.2 Persistence and degradability

Product:

Biodegradability : Remarks: No data available

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

Product:

Additional ecological : Remarks: An environmental hazard cannot be excluded in the
information event of unprofessional handling or disposal.
This product has no known ecotoxicological effects.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Dispose of wastes in an approved waste disposal facility.
In accordance with local and national regulations.
Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with



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chemical or used container.

Contaminated packaging : Dispose of as unused product.
Empty containers should be taken to an approved waste
handling site for recycling or disposal.
Do not re-use empty containers.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Remarks : Not classified as dangerous in the meaning of transport regulations.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals : Not applicable

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59). : Not applicable

Regulation (EC) No 1005/2009 on substances that deplete the ozone layer : Not applicable

Regulation (EC) No 850/2004 on persistent organic pollutants : Not applicable

Major Accident Hazard Legislation
Seveso Directive



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Revision Date 11.09.2015

Print Date 23.06.2016

Seveso II - Directive 2003/105/EC amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances

Not applicable

The components of this product are reported in the following inventories:

United States TSCA Inventory : On TSCA Inventory

Canadian Domestic Substances List (DSL) : All components of this product are on the Canadian DSL.

Australia Inventory of Chemical Substances (AICS) : Not in compliance with the inventory

New Zealand. Inventory of Chemical Substances : On the inventory, or in compliance with the inventory

Japan. ENCS - Existing and New Chemical Substances Inventory : Not in compliance with the inventory

Korea. Korean Existing Chemicals Inventory (KECI) : On the inventory, or in compliance with the inventory

Philippines Inventory of Chemicals and Chemical Substances (PICCS) : On the inventory, or in compliance with the inventory

China. Inventory of Existing Chemical Substances in China (IECSC) : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H334 : May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Carechem24 International Worldwide Coverage

Emergency Phone Number

Europe:	All European Countries	+44 (0) 1235 239 670 (NCEC)
Asia Pacific:	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558



SAFETY DATA SHEET
according to Regulation (EC) No. 1907/2006

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Version 1.1

Revision Date 11.09.2015

Print Date 23.06.2016

	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



ADIPRENE® LFM S430

Version 1.0

Revision Date 15.01.2016

Print Date 23.06.2016

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : ADIPRENE® LFM S430

Substance name : Reaction product of methylene bis p-phenyl isocyanate (MDI) and polyethylene adipate glycol. (PEAG-1000 and PEAG-2000)

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Polyurethane prepolymer

1.3 Details of the supplier of the safety data sheet

Company: Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by Product Safety Department

Further information for the safety data sheet :
msdsrequest@chemtura.com

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Respiratory sensitisation, Category 1 H334: May cause allergy or asthma symptoms or

ADIPRENE® LFM S430

Version 1.0

Revision Date 15.01.2016

Print Date 23.06.2016

breathing difficulties if inhaled.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word : Danger

Hazard statements : H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Precautionary statements :

Prevention:	
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P284	Wear respiratory protection.
Response:	
P304 + P340	IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P342 + P311	If experiencing respiratory symptoms: Call a POISON CENTER or doctor/ physician.
Disposal:	
P501	Dispose of contents/ container to an approved waste disposal plant.

Hazardous components which must be listed on the label:

4,4'-methylenediphenyl diisocyanate

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical Name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration (%)
4,4'-methylenediphenyl diisocyanate	101-68-8 202-966-0	Acute Tox.4; H332 Skin Irrit.2; H315 Eye Irrit.2; H319 Resp. Sens.1; H334 Skin Sens.1; H317 Carc.2; H351	>= 0.1 - < 1



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		STOT SE3; H335 STOT RE2; H373	
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For explanation of abbreviations see section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

- If inhaled : Remove victim to fresh air and keep at rest in a position comfortable for breathing.
If not breathing, give artificial respiration.
Call a physician or poison control centre immediately.
If breathing is difficult, give oxygen.
Keep respiratory tract clear.
- In case of skin contact : Wash off with soap and plenty of water.
Take off contaminated clothing and wash before reuse.
- In case of eye contact : If eye irritation persists, consult a specialist.
- If swallowed : Call a physician or poison control centre immediately.
Rinse mouth with water.
If victim is fully conscious, give a cupful of water.
DO NOT induce vomiting unless directed to do so by a physician or poison control center.
Never give anything by mouth to an unconscious person.
Do not give milk or alcoholic beverages.
Obtain medical attention.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : No information available.
- Risks : No information available.

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : The first aid procedure should be established in consultation with the doctor responsible for industrial medicine.

SECTION 5: Firefighting measures

5.1 Extinguishing media

- Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.



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5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting : Burning produces irritant fumes.
Burning produces noxious and toxic fumes.

5.3 Advice for firefighters

Special protective equipment for firefighters : Wear full protective clothing and self-contained breathing apparatus.

Further information : Standard procedure for chemical fires.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Avoid dust formation.
Avoid breathing dust.
Ensure adequate ventilation.
Evacuate personnel to safe areas.
Material can create slippery conditions.

6.2 Environmental precautions

Environmental precautions : Do not flush into surface water or sanitary sewer system.
Prevent further leakage or spillage if safe to do so.
Avoid release to the environment.
The product should not be allowed to enter drains, water courses or the soil.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Pick up and arrange disposal without creating dust.
Sweep up and shovel.
Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : Avoid formation of respirable particles.
For personal protection see section 8.
No special handling advice required.

Advice on protection against fire and explosion : Avoid dust formation. Provide appropriate exhaust ventilation at places where dust is formed.



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Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. When using do not smoke. Wash hands before breaks and at the end of workday.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep container tightly closed in a dry and well-ventilated place. Container can be pressurized by carbon dioxide due to reaction with humid air and/or water. Protect from moisture. Keep under nitrogen.

Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)

Specific use(s) : Polyurethane prepolymer

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Engineering measures

Provide sufficient air exchange and/or exhaust in work rooms.

Personal protective equipment

Eye protection : Eye wash bottle with pure water
Tightly fitting safety goggles

Hand protection

: Polyvinyl alcohol or nitrile- butyl-rubber gloves
Before removing gloves clean them with soap and water.

Skin and body protection : Dust impervious protective suit
Choose body protection according to the amount and concentration of the dangerous substance at the work place.

Respiratory protection : In the case of dust or aerosol formation use respirator with an approved filter.

Environmental exposure controls

General advice : Do not flush into surface water or sanitary sewer system., Prevent further leakage or spillage if safe to do so., Avoid release to the environment., The product should not be allowed to enter drains, water courses or the soil.



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SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	: solid
Colour	: off-white
Odour	: slight
Odour Threshold	: not determined
pH	: neutral
Melting point/freezing point	: not determined
Boiling point/boiling range	: not determined
Flash point	: not determined
Relative density	: No data available
Solubility(ies)	
Water solubility	: Water reactive
Viscosity	
Viscosity, dynamic	: No data available
Viscosity, kinematic	: No data available

9.2 Other information

No data available

SECTION 10: Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.

10.2 Chemical stability

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions : Stable under recommended storage conditions.
No decomposition if used as directed.

10.4 Conditions to avoid



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Print Date 23.06.2016

Conditions to avoid : Exposure to air or moisture over prolonged periods.

10.5 Incompatible materials

Materials to avoid : None known.
Acids and bases
Ammonia
Water

10.6 Hazardous decomposition products

Hazardous decomposition products : No hazardous decomposition products are known.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:

4,4'-methylenediphenyl diisocyanate:

Acute oral toxicity : LD50 (Rat): 31,690 mg/kg

Skin corrosion/irritation

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit
Result: Skin irritation

Serious eye damage/eye irritation

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Rabbit
Result: Eye irritation

Respiratory or skin sensitisation

Components:

4,4'-methylenediphenyl diisocyanate:

Species: Guinea pig
Assessment: May cause sensitisation by inhalation.



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Result: Causes sensitisation.

Species: Guinea pig

Assessment: May cause sensitisation by skin contact.

Result: Causes sensitisation.

Germ cell mutagenicity

Components:

4,4'-methylenediphenyl diisocyanate:

Genotoxicity in vitro : Test Type: Ames test
Result: positive

Carcinogenicity

Product:

Carcinogenicity

Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity

Assessment : Not classified due to lack of data.

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.

STOT - repeated exposure

Product:

Assessment: Not classified due to lack of data.

Aspiration toxicity

Further information

Product:

Remarks: No data available

SECTION 12: Ecological information

12.1 Toxicity

Components:

4,4'-methylenediphenyl diisocyanate:



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Toxicity to fish : LC50 (Danio rerio (zebra fish)): > 1,000 mg/l
Exposure time: 96 h

Toxicity to daphnia and other : LC50 (Daphnia magna (Water flea)): > 1,000 mg/l
aquatic invertebrates Exposure time: 48 h

12.2 Persistence and degradability

Product:

Biodegradability : Remarks: No data available

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

Product:

Additional ecological : Remarks: This product has no known ecotoxicological effects.
information An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Dispose of wastes in an approved waste disposal facility.
In accordance with local and national regulations.
Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with chemical or used container.

Contaminated packaging : Dispose of as unused product.
Empty containers should be taken to an approved waste handling site for recycling or disposal.



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Do not re-use empty containers.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Remarks : Not classified as dangerous in the meaning of transport regulations.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals : Not applicable

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59). : Not applicable

Regulation (EC) No 1005/2009 on substances that deplete the ozone layer : Not applicable

Regulation (EC) No 850/2004 on persistent organic pollutants : Not applicable

Major Accident Hazard Legislation

Seveso Directive

Seveso II - Directive 2003/105/EC amending Council Directive 96/82/EC on the control of major accident hazards involving dangerous substances

Not applicable



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The components of this product are reported in the following inventories:

United States TSCA Inventory : On TSCA Inventory

Canadian Domestic Substances List (DSL) : All components of this product are on the Canadian DSL

Australia Inventory of Chemical Substances (AICS) : On the inventory, or in compliance with the inventory

New Zealand. Inventory of Chemical Substances : On the inventory, or in compliance with the inventory

Japan. ENCS - Existing and New Chemical Substances Inventory : On the inventory, or in compliance with the inventory

Korea. Korean Existing Chemicals Inventory (KECI) : On the inventory, or in compliance with the inventory

Philippines Inventory of Chemicals and Chemical Substances (PICCS) : On the inventory, or in compliance with the inventory

China. Inventory of Existing Chemical Substances in China (IECSC) : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Carechem24 International Worldwide Coverage

Emergency Phone Number

<u>Europe:</u>	All European Countries	+44 (0) 1235 239 670 (NCEC)
<u>Asia Pacific:</u>	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293



SAFETY DATA SHEET
according to Regulation (EC) No. 1907/2006

ADIPRENE® LFM S430

Version 1.0

Revision Date 15.01.2016

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	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



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Version 1.2

Revision Date 15.09.2015

Print Date 23.06.2016

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : VIBRACURE® 2101
Substance name : 2,2'-(1,4-phenylenebis(oxy))bisethanol
CAS-No. : 104-38-1

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Chemical intermediate
Recommended restrictions on use : Reserved for industrial and professional use.

1.3 Details of the supplier of the safety data sheet

Company: Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by Product Safety Department

Further information for the safety data sheet :
msdsrequest@chemtura.com

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

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SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Eye irritation, Category 2
Skin irritation, Category 2

H319: Causes serious eye irritation.
H315: Causes skin irritation.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word : Warning

Hazard statements : H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements : **Prevention:**
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/ eye protection/ face protection.

Response:
P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332 + P313 If skin irritation occurs: Get medical advice/ attention.

2.3 Other hazards

This substance is not considered to be persistent, bioaccumulating and toxic (PBT).

SECTION 3: Composition/information on ingredients

3.1 Substances

Hazardous components

Chemical Name	CAS-No. EC-No.	Concentration (%)
2,2'-p-phenylenedioxydiethanol	104-38-1 203-197-3	>= 89



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SECTION 4: First aid measures

4.1 Description of first aid measures

- | | |
|-------------------------|---|
| General advice | : Move out of dangerous area.
Consult a physician.
Show this safety data sheet to the doctor in attendance. |
| If inhaled | : Move to fresh air in case of accidental inhalation of dust or fumes from overheating or combustion.
If symptoms persist, call a physician. |
| In case of skin contact | : Take off contaminated clothing and shoes immediately.
Wash off with soap and plenty of water.
If symptoms persist, call a physician. |
| In case of eye contact | : Immediately flush eye(s) with plenty of water.
Remove contact lenses.
Protect unharmed eye.
Keep eye wide open while rinsing.
If eye irritation persists, consult a specialist. |
| If swallowed | : Clean mouth with water and drink afterwards plenty of water.
Do not give milk or alcoholic beverages.
Never give anything by mouth to an unconscious person.
Obtain medical attention. |

4.2 Most important symptoms and effects, both acute and delayed

- | | |
|----------|--------------------|
| Symptoms | : irritant effects |
| Risks | : irritant effects |

4.3 Indication of any immediate medical attention and special treatment needed

- | | |
|-----------|--|
| Treatment | : The first aid procedure should be established in consultation with the doctor responsible for industrial medicine. |
|-----------|--|

SECTION 5: Firefighting measures

5.1 Extinguishing media

- | | |
|------------------------------|--|
| Suitable extinguishing media | : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Water mist
Foam
Carbon dioxide (CO ₂)
Dry chemical |
|------------------------------|--|



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5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting : Avoid generating dust; fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

5.3 Advice for firefighters

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.

Further information : Standard procedure for chemical fires.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Avoid dust formation.
Avoid breathing dust.
Ensure adequate ventilation.

6.2 Environmental precautions

Environmental precautions : Try to prevent the material from entering drains or water courses.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Pick up and arrange disposal without creating dust.
Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : Avoid contact with skin and eyes.
For personal protection see section 8.
Smoking, eating and drinking should be prohibited in the application area.

Advice on protection against fire and explosion : Avoid dust formation. Provide appropriate exhaust ventilation at places where dust is formed.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. When using do not smoke. Wash hands before breaks and at the end of workday.



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7.2 Conditions for safe storage, including any incompatibilities

- Requirements for storage areas and containers : Keep container tightly closed in a dry and well-ventilated place.
- Advice on common storage : Never allow product to get in contact with water during storage.
- Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)

- Specific use(s) : Chemical intermediate

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

8.2 Exposure controls

Engineering measures

Ensure that eyewash stations and safety showers are close to the workstation location.

Personal protective equipment

- Eye protection : Eye wash bottle with pure water
Tightly fitting safety goggles
- Hand protection : Polyvinyl alcohol or nitrile- butyl-rubber gloves
The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
Before removing gloves clean them with soap and water.
- Skin and body protection : Dust impervious protective suit
Choose body protection according to the amount and concentration of the dangerous substance at the work place.
- Respiratory protection : In the case of dust or aerosol formation use respirator with an approved filter.
- #### **Environmental exposure controls**
- General advice : Try to prevent the material from entering drains or water courses.



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SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance : Crystalline powder

Colour : white

Odour : No data available

Odour Threshold : No data available

pH : Not applicable

Melting point/range : -38 °C

Boiling point/boiling range : 190 °C

Flash point : 224 °C

Evaporation rate : Not applicable

Flammability (solid, gas) : No data available

Upper explosion limit : No data available

Lower explosion limit : No data available

Vapour pressure : < 0.01 hPa (25 °C)

Relative vapour density : Not applicable

Relative density : No data available

Density : 1.15 g/cm³

Solubility(ies)

Water solubility : < 1 g/l

No data available

Solubility in other solvents : No data available

Partition coefficient: n-octanol/water : log Pow: 0.61

Auto-ignition temperature : 468 °C



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Thermal decomposition : No data available

Viscosity

Viscosity, dynamic : Not applicable

Viscosity, kinematic : Not applicable

9.2 Other information

Self-Accelerating decomposition temperature (SADT) : Method: No information available.

Oxidising potential : No information available.

Molecular weight : 198.2 g/mol

SECTION 10: Stability and reactivity

10.1 Reactivity

No dangerous reaction known under conditions of normal use.

10.2 Chemical stability

Stable under normal conditions.

10.3 Possibility of hazardous reactions

Hazardous reactions : No decomposition if used as directed.

10.4 Conditions to avoid

Conditions to avoid : Extremes of temperature and direct sunlight.

10.5 Incompatible materials

Materials to avoid : Strong acids and strong bases
Strong oxidizing agents

10.6 Hazardous decomposition products

Hazardous decomposition products : Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:



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Acute oral toxicity : LD50 (Rat): > 3,200 mg/kg
Acute inhalation toxicity : Remarks: Not classified due to lack of data.
Acute dermal toxicity : LD50 (Guinea pig): > 1,000 mg/kg

Components:

2,2'-p-phenylenedioxydiethanol:

Acute oral toxicity : LD50 (Rat, male and female): > 5,000 mg/kg
GLP: yes
Acute dermal toxicity : LD50 (Rat, male and female): > 2,000 mg/kg
GLP: yes

Skin corrosion/irritation

Components:

2,2'-p-phenylenedioxydiethanol:

Result: Skin irritation

Serious eye damage/eye irritation

Product:

Assessment: Irritating to eyes.

Components:

2,2'-p-phenylenedioxydiethanol:

Result: Eye irritation

Respiratory or skin sensitisation

Product:

Remarks: Did not cause sensitisation on laboratory animals.

Germ cell mutagenicity

Components:

2,2'-p-phenylenedioxydiethanol:

Genotoxicity in vitro : Test Type: Ames test
Metabolic activation: with and without metabolic activation
Method: Mutagenicity (Escherichia coli - reverse mutation assay)
Result: negative
: Test Type: Chromosome aberration test in vitro
Metabolic activation: with and without metabolic activation
Result: negative
Genotoxicity in vivo : Test Type: In vivo micronucleus test



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Test species: Mouse (male and female)
Application Route: Oral
Method: Mutagenicity (micronucleus test)
Result: negative
GLP: yes

Germ cell mutagenicity
Assessment : Animal testing did not show any mutagenic effects.

Carcinogenicity

Product:

Carcinogenicity
Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity
Assessment : Not classified due to lack of data.

Components:

2,2'-p-phenylenedioxydiethanol:

Reproductive toxicity
Assessment : No toxicity to reproduction
No effects on or via lactation

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.

STOT - repeated exposure

Components:

2,2'-p-phenylenedioxydiethanol:

Exposure routes: Oral
Assessment: The substance or mixture is not classified as specific target organ toxicant, repeated exposure.

Aspiration toxicity

Product:

No aspiration toxicity classification



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SECTION 12: Ecological information

12.1 Toxicity

Product:

Toxicity to fish : LC50 (Pimephales promelas (fathead minnow)): > 1,043.7 mg/l
Exposure time: 96 h

Toxicity to daphnia and other aquatic invertebrates : EC50 (Daphnia magna (Water flea)): > 100.2 mg/l
Exposure time: 48 h

Ecotoxicology Assessment
Acute aquatic toxicity : This product has no known ecotoxicological effects.

Components:

2,2'-p-phenylenedioxydiethanol:

Toxicity to fish : LC50 (Pimephales promelas (fathead minnow)): > 1,043.7 mg/l
Exposure time: 96 h
Test Type: static test
Method: OECD Test Guideline 203
GLP: yes

Toxicity to daphnia and other aquatic invertebrates : EC50 (Daphnia magna (Water flea)): > 100.2 mg/l
Exposure time: 48 h
Test Type: static test
Method: OECD Test Guideline 202
GLP: yes

Toxicity to algae : EC50 (Scenedesmus quadricauda (Green algae)): > 970 mg/l
Exposure time: 72 h
Test Type: static test
Method: OECD Test Guideline 201

12.2 Persistence and degradability

Product:

Biodegradability : Result: Biodegradable

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

Components:

2,2'-p-phenylenedioxydiethanol:

Partition coefficient: n-octanol/water : log Pow: 0.61



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Version 1.2

Revision Date 15.09.2015

Print Date 23.06.2016

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This substance is not considered to be persistent, bioaccumulating and toxic (PBT).

12.6 Other adverse effects

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with chemical or used container.
Offer surplus and non-recyclable solutions to a licensed disposal company.
Dispose of in accordance with the European Directives on waste and hazardous waste.

Contaminated packaging : Empty remaining contents.
Dispose of as unused product.
Do not re-use empty containers.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Remarks : Not classified as dangerous in the meaning of transport regu-



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Print Date 23.06.2016

lations.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

International Chemical Weapons Convention (CWC) : Neither banned nor restricted
Schedules of Toxic Chemicals and Precursors

Restrictions on the marketing and use of certain dangerous substances and preparations : Neither banned nor restricted

Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals : Neither banned nor restricted

Candidate List of Substances of Very High Concern for Authorisation : Neither banned nor restricted

Major Accident Hazard Legislation

Seveso Directive

Directive 96/82/EC does not apply

Water contaminating class (Germany) : WGK 1 slightly water endangering
Code Number: 1,579
Remarks: List with water hazardous substances (Class 1 till 3) in VwVwS

The components of this product are reported in the following inventories:

United States TSCA Inventory : On TSCA Inventory

Canadian Domestic Substances List (DSL) : All components of this product are on the Canadian DSL.

Australia Inventory of Chemical Substances (AICS) : On the inventory, or in compliance with the inventory

New Zealand. Inventory of Chemical Substances : Not in compliance with the inventory

Japan. ENCS - Existing and New Chemical Substances Inventory : Not in compliance with the inventory

Korea. Korean Existing : On the inventory, or in compliance with the inventory



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Chemicals Inventory (KECI)

Philippines Inventory of
Chemicals and Chemical
Substances (PICCS) : Not in compliance with the inventory

China. Inventory of Existing
Chemical Substances in Chi-
na (IECSC) : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

No information available.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H319 Causes serious eye irritation.
H315 Causes skin irritation.

Carechem24 International Worldwide Coverage

Emergency Phone Number

<u>Europe:</u>	All European Countries	+44 (0) 1235 239 670 (NCEC)
<u>Asia Pacific:</u>	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763



VIBRACURE® 2101

Version 1.2

Revision Date 15.09.2015

Print Date 23.06.2016

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



VIBRACURE® A 263

Version 1.1

Revision Date 11.09.2015

Print Date 23.06.2016

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : VIBRACURE® A 263

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Chemical intermediate

Recommended restrictions on use : Reserved for industrial and professional use.

1.3 Details of the supplier of the safety data sheet

Company: Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by Product Safety Department

Further information for the safety data sheet :
msdsrequest@chemtura.com

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Skin irritation, Category 2 H315: Causes skin irritation.
Eye irritation, Category 2 H319: Causes serious eye irritation.

VIBRACURE® A 263

Version 1.1

Revision Date 11.09.2015

Print Date 23.06.2016

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word : Warning

Hazard statements : H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements : **Prevention:**
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/ eye protection/ face protection.

Response:
P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P332 + P313 If skin irritation occurs: Get medical advice/ attention.
P337 + P313 If eye irritation persists: Get medical advice/ attention.
P362 Take off contaminated clothing and wash before reuse.

2.3 Other hazards

No data available

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical Name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration (%)
2,2'-p-phenylenedioxydiethanol	104-38-1 203-197-3	Eye Irrit.2; H319 Skin Irrit.2; H315	>= 50 - <= 100
cyclohex-1,4-ylenedimethanol	105-08-8 203-268-9	Eye Irrit.2; H319	< 10

For explanation of abbreviations see section 16.



VIBRACURE® A 263

Version 1.1

Revision Date 11.09.2015

Print Date 23.06.2016

SECTION 4: First aid measures

4.1 Description of first aid measures

- General advice : Move out of dangerous area.
Consult a physician.
Show this safety data sheet to the doctor in attendance.
- If inhaled : Move to fresh air in case of accidental inhalation of dust or fumes from overheating or combustion.
If symptoms persist, call a physician.
- In case of skin contact : Take off contaminated clothing and shoes immediately.
Wash off with soap and plenty of water.
If symptoms persist, call a physician.
- In case of eye contact : Immediately flush eye(s) with plenty of water.
Remove contact lenses.
Protect unharmed eye.
Keep eye wide open while rinsing.
If eye irritation persists, consult a specialist.
- If swallowed : Clean mouth with water and drink afterwards plenty of water.
Do not give milk or alcoholic beverages.
Never give anything by mouth to an unconscious person.
Obtain medical attention.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : irritant effects

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : The first aid procedure should be established in consultation with the doctor responsible for industrial medicine.

SECTION 5: Firefighting measures

5.1 Extinguishing media

- Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture

- Specific hazards during firefighting : Do not allow run-off from fire fighting to enter drains or water courses.

5.3 Advice for firefighters

- Special protective equipment : In the event of fire, wear self-contained breathing apparatus.



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for firefighters

Further information : Standard procedure for chemical fires.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Use personal protective equipment.
Avoid dust formation.
Avoid breathing dust.
Ensure adequate ventilation.

6.2 Environmental precautions

Environmental precautions : Try to prevent the material from entering drains or water courses.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Pick up and arrange disposal without creating dust.
Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : Avoid contact with skin and eyes.
For personal protection see section 8.
Smoking, eating and drinking should be prohibited in the application area.

Advice on protection against fire and explosion : Avoid dust formation. Provide appropriate exhaust ventilation at places where dust is formed.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. When using do not smoke. Wash hands before breaks and at the end of workday.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep container tightly closed in a dry and well-ventilated place.

Other data : No decomposition if stored and applied as directed.

7.3 Specific end use(s)



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Specific use(s) : Used in polyurethane manufacturing.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Personal protective equipment

Eye protection : Eye wash bottle with pure water
Tightly fitting safety goggles

Hand protection

: Polyvinyl alcohol or nitrile- butyl-rubber gloves
The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
Before removing gloves clean them with soap and water.

Skin and body protection : Dust impervious protective suit
Choose body protection according to the amount and concentration of the dangerous substance at the work place.

Respiratory protection : In the case of dust or aerosol formation use respirator with an approved filter.

Environmental exposure controls

General advice : Try to prevent the material from entering drains or water courses.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance : solid

Colour : off-white

Odour : mild

Odour Threshold : No data available

: No data available



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	: No data available
Flash point	: No data available
Evaporation rate	: Not applicable
Flammability (solid, gas)	: No data available
Upper explosion limit	: No data available
Lower explosion limit	: No data available
Vapour pressure	: Not applicable
Relative vapour density	: Not applicable
Density	: 1 g/cm ³ (25 °C)
Solubility(ies)	
Water solubility	: slightly soluble
Solubility in other solvents	: soluble Solvent: Organic solvents
Partition coefficient: n-octanol/water	: No data available
Auto-ignition temperature	: No data available
Viscosity	
Viscosity, kinematic	: Not applicable

9.2 Other information

Self-Accelerating decomposition temperature (SADT)	: Method: No information available.
Oxidising potential	: No information available.

SECTION 10: Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.

10.2 Chemical stability

No decomposition if stored and applied as directed.



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10.3 Possibility of hazardous reactions

Hazardous reactions : Stable under recommended storage conditions.
No decomposition if used as directed.

10.4 Conditions to avoid

Conditions to avoid : No data available

10.5 Incompatible materials

Materials to avoid : Strong oxidizing agents
Acids and bases

10.6 Hazardous decomposition products

Hazardous decomposition products : Carbon dioxide (CO₂), carbon monoxide (CO), oxides of nitrogen (NO_x), dense black smoke.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product:

Acute oral toxicity : Remarks: Not classified due to lack of data.

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:

2,2'-p-phenylenedioxydiethanol:

Acute oral toxicity : LD50 (Rat, male and female): > 5,000 mg/kg
GLP: yes

Acute dermal toxicity : LD50 (Rat, male and female): > 2,000 mg/kg
GLP: yes

cyclohex-1,4-ylenedimethanol:

Acute oral toxicity : LD50 (Rat): 3,200 mg/kg
GLP: no

Acute dermal toxicity : (Guinea pig): > 1,000 mg/kg

Skin corrosion/irritation

Components:

2,2'-p-phenylenedioxydiethanol:

Result: Skin irritation



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cyclohex-1,4-ylenedimethanol:

Species: Guinea pig

Result: No skin irritation

Serious eye damage/eye irritation

Product:

Remarks: Eye irritation

Components:

2,2'-p-phenylenedioxydiethanol:

Result: Eye irritation

cyclohex-1,4-ylenedimethanol:

Species: Rabbit

Result: Eye irritation

Respiratory or skin sensitisation

Product:

Remarks: No data available

Components:

cyclohex-1,4-ylenedimethanol:

Species: Guinea pig

Assessment: Did not cause sensitisation on laboratory animals.

Germ cell mutagenicity

Product:

Germ cell mutagenicity

Assessment : Not classified due to lack of data.

Components:

2,2'-p-phenylenedioxydiethanol:

Genotoxicity in vitro

: Test Type: Ames test

Metabolic activation: with and without metabolic activation

Method: Mutagenicity (Escherichia coli - reverse mutation assay)

Result: negative

: Test Type: Chromosome aberration test in vitro

Metabolic activation: with and without metabolic activation

Result: negative

Genotoxicity in vivo

: Test Type: In vivo micronucleus test

Test species: Mouse (male and female)

Application Route: Oral



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Method: Mutagenicity (micronucleus test)
Result: negative
GLP: yes

Germ cell mutagenicity
Assessment

: Animal testing did not show any mutagenic effects.

cyclohex-1,4-ylenedimethanol:

Genotoxicity in vitro

: Test Type: in vitro assay
Metabolic activation: with and without metabolic activation
Result: negative
GLP: no

Genotoxicity in vivo

: Test Type: in vivo assay
Test species: Rat (male and female)
Cell type: Bone marrow
Application Route: Oral
Result: negative
GLP: yes

Germ cell mutagenicity
Assessment

: Animal testing did not show any mutagenic effects.

Carcinogenicity

Product:

Carcinogenicity
Assessment

: Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity
Assessment

: Not classified due to lack of data.

Components:

2,2'-p-phenylenedioxydiethanol:

Reproductive toxicity
Assessment

: No toxicity to reproduction
No effects on or via lactation

cyclohex-1,4-ylenedimethanol:

Reproductive toxicity
Assessment

: No toxicity to reproduction
No effects on or via lactation

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.



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STOT - repeated exposure

Product:

Assessment: Not classified due to lack of data.

Components:

2,2'-p-phenylenedioxydiethanol:

Exposure routes: Oral

Assessment: The substance or mixture is not classified as specific target organ toxicant, repeated exposure.

cyclohex-1,4-ylenedimethanol:

Exposure routes: Oral

Assessment: The substance or mixture is not classified as specific target organ toxicant, repeated exposure.

Aspiration toxicity

Further information

Product:

Remarks: No data available

SECTION 12: Ecological information

12.1 Toxicity

Product:

Further information

The following percentage of the mixture consists of ingredient(s) with unknown hazards to the aquatic environment: 9.5 %

Components:

2,2'-p-phenylenedioxydiethanol:

Toxicity to fish : LC50 (Pimephales promelas (fathead minnow)): > 1,043.7 mg/l
Exposure time: 96 h
Test Type: static test
Method: OECD Test Guideline 203
GLP: yes

Toxicity to daphnia and other aquatic invertebrates : EC50 (Daphnia magna (Water flea)): > 100.2 mg/l
Exposure time: 48 h
Test Type: static test
Method: OECD Test Guideline 202
GLP: yes

Toxicity to algae : EC50 (Scenedesmus quadricauda (Green algae)): > 970 mg/l
Exposure time: 72 h
Test Type: static test



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Method: OECD Test Guideline 201

cyclohex-1,4-ylenedimethanol:

Toxicity to fish : LC50 (Pimephales promelas (fathead minnow)): > 125.3 mg/l
Exposure time: 96 h
Test Type: static test
Test substance: see user defined free text
Method: OECD Test Guideline 203
GLP: yes

Toxicity to daphnia and other aquatic invertebrates : LC50 (Daphnia magna (Water flea)): > 100 mg/l
Exposure time: 96 h
Test Type: static test
GLP: no

Toxicity to algae : NOEC (Scenedesmus quadricauda (Green algae)): 122.9 mg/l
Exposure time: 72 h
Test Type: Growth inhibition
Test substance: see user defined free text
GLP: yes

12.2 Persistence and degradability

Product:

Biodegradability : Remarks: No data available

Components:

cyclohex-1,4-ylenedimethanol:

Biodegradability : Test Type: Zahn-Wellens Test
Result: Readily biodegradable
Biodegradation: 98 %
Exposure time: 19 d
GLP: yes
Remarks: Readily biodegradable

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

Components:

2,2'-p-phenylenedioxydiethanol:

Partition coefficient: n-octanol/water : log Pow: 0.61

cyclohex-1,4-ylenedimethanol:

Partition coefficient: n-octanol/water : log Pow: 1.49



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12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : No data available

12.6 Other adverse effects

Product:

Additional ecological information : Remarks: An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
This product has no known ecotoxicological effects.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Do not dispose of waste into sewer.
Do not contaminate ponds, waterways or ditches with chemical or used container.
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging : Empty remaining contents.
Dispose of as unused product.
Do not re-use empty containers.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good



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14.6 Special precautions for user

Not applicable

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

International Chemical Weapons Convention (CWC)
Schedules of Toxic Chemicals and Precursors : Neither banned nor restricted

REACH - Restrictions on the manufacture, placing on
the market and use of certain dangerous substances,
preparations and articles (Annex XVII) : Neither banned nor restricted

Regulation (EC) No 649/2012 of the European Parlia-
ment and the Council concerning the export and import
of dangerous chemicals : Neither banned nor restricted

REACH - Candidate List of Substances of Very High
Concern for Authorisation (Article 59). : This product does not contain sub-
stances of very high concern (Regu-
lation (EC) No 1907/2006 (REACH),
Article 57).

REACH - List of substances subject to authorisation
(Annex XIV) : Neither banned nor restricted

Regulation (EC) No 1005/2009 on substances that de-
plete the ozone layer : Neither banned nor restricted

Major Accident Hazard Legislation

Seveso Directive

Directive 96/82/EC does not apply

The components of this product are reported in the following inventories:

United States TSCA Inven- : On TSCA Inventory
tory

Canadian Domestic Sub- : All components of this product are on the Canadian DSL.
stances List (DSL)

Australia Inventory of Chemi- : On the inventory, or in compliance with the inventory
cal Substances (AICS)

New Zealand. Inventory of : On the inventory, or in compliance with the inventory
Chemical Substances

Japan. ENCS - Existing and : Not in compliance with the inventory
New Chemical Substances
Inventory



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Korea. Korean Existing Chemicals Inventory (KECI) : On the inventory, or in compliance with the inventory

Philippines Inventory of Chemicals and Chemical Substances (PICCS) : Not in compliance with the inventory

China. Inventory of Existing Chemical Substances in China (IECSC) : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H315 Causes skin irritation.
H319 Causes serious eye irritation.

Carechem24 International Worldwide Coverage

Emergency Phone Number

<u>Europe:</u>	All European Countries	+44 (0) 1235 239 670 (NCEC)
<u>Asia Pacific:</u>	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670



SAFETY DATA SHEET
according to Regulation (EC) No. 1907/2006

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	Mexico	+52 555 004 8763
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Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



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SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : VIBRACURE® A 260

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Curing chemical, Used in polyurethane manufacturing.

Recommended restrictions on use : Reserved for industrial and professional use.

1.3 Details of the supplier of the safety data sheet

Company: Chemtura Manufacturing UK Limited
Tenax Road, Trafford Park
Manchester
United Kingdom
M17 1WT

Customer Service: +44 161 875 3800
Prepared by Product Safety Department

Further information for the safety data sheet :
msdsrequest@chemtura.com

1.4 Emergency telephone number

Emergency telephone number: +44 (0) 1235 239 670 (NCEC)
For additional emergency telephone numbers see section 16 of the Safety Data Sheet.

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Skin irritation, Category 2 H315: Causes skin irritation.
Eye irritation, Category 2 H319: Causes serious eye irritation.

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2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :



Signal word : Warning

Hazard statements : H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements : **Prevention:**
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/ eye protection/ face protection.

Response:
P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P332 + P313 If skin irritation occurs: Get medical advice/ attention.
P337 + P313 If eye irritation persists: Get medical advice/ attention.
P362 Take off contaminated clothing and wash before reuse.

2.3 Other hazards

This mixture contains no substance considered to be persistent, bioaccumulating and toxic (PBT).

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Hazardous components

Chemical Name	CAS-No. EC-No. Registration number	Classification (REGULATION (EC) No 1272/2008)	Concentration (%)
2,2'-p-phenylenedioxydiethanol	104-38-1 203-197-3	Eye Irrit.2; H319 Skin Irrit.2; H315	>= 50 - <= 100
cyclohex-1,4-ylenedimethanol	105-08-8 203-268-9	Eye Irrit.2; H319	>= 10 - < 20

For explanation of abbreviations see section 16.



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SECTION 4: First aid measures

4.1 Description of first aid measures

- | | |
|-------------------------|--|
| If inhaled | : Remove to fresh air.
If symptoms persist, call a physician. |
| In case of skin contact | : Wash off with warm water and soap.
If skin irritation occurs, seek medical advice/attention.
Wash contaminated clothing before re-use. |
| In case of eye contact | : Rinse immediately with plenty of water, also under the eyelids,
for at least 15 minutes.
If symptoms persist, call a physician. |
| If swallowed | : Do NOT induce vomiting.
Rinse mouth with water.
Obtain medical attention. |

4.2 Most important symptoms and effects, both acute and delayed

- | | |
|----------|--------------------|
| Symptoms | : irritant effects |
| Risks | : irritant effects |

4.3 Indication of any immediate medical attention and special treatment needed

- | | |
|-----------|---|
| Treatment | : The first aid procedure should be established in consultation
with the doctor responsible for industrial medicine. |
|-----------|---|

SECTION 5: Firefighting measures

5.1 Extinguishing media

- | | |
|--------------------------------|---|
| Suitable extinguishing media | : Carbon dioxide (CO ₂)
Dry powder
Foam
Water mist |
| Unsuitable extinguishing media | : Water spray |

5.2 Special hazards arising from the substance or mixture

- | | |
|--------------------------------------|-----------------------------|
| Specific hazards during firefighting | : No information available. |
|--------------------------------------|-----------------------------|

5.3 Advice for firefighters

- | | |
|---|--|
| Special protective equipment for firefighters | : Complete suit protecting against chemicals In the event of fire,
wear self-contained breathing apparatus. |
|---|--|



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Further information : Use water spray to cool unopened containers.
Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Ensure adequate ventilation.
Avoid contact with skin and eyes.
Wear suitable protective equipment.
Avoid dust formation.
In the case of dust or aerosol formation use respirator with an approved filter.

6.2 Environmental precautions

Environmental precautions : Do not allow contact with soil, surface or ground water.
Do not allow uncontrolled discharge of product into the environment.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Remove all sources of ignition.
Avoid dust formation.
Clean up promptly by scoop or vacuum.
Do not create a powder cloud by using a brush or compressed air.
Keep in suitable, closed containers for disposal.
Ventilate the area.

6.4 Reference to other sections

Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : Handle and open container with care.
Slacken off drum bungs before heating to prevent any pressure build up.
Avoid contact with moisture and prolonged exposure to temperatures above 140°F (60°C).
Purge open drums with nitrogen before resealing.
Do not use spot heating devices such as band heaters or torches.
Make sure contents are completely liquid and uniform before using.
(SEE TECHNICAL BULLETIN FOR ADDITIONAL DETAILS)
Keep container closed when not in use.



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Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. Ensure adequate ventilation, especially in confined areas. Avoid contact with skin, eyes and clothing. Wear suitable gloves and eye/face protection. When using do not eat, drink or smoke. Wash thoroughly after handling. Keep working clothes separately. Remove and wash contaminated clothing before re-use.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep container tightly closed. Keep in a well-ventilated place. Keep away from heat. In case of occurrence of dust, risk of dust explosion.

Other data : Stable under recommended storage conditions.

7.3 Specific end use(s)

Specific use(s) : Used in polyurethane manufacturing.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Engineering measures

Use mechanical ventilation for general area control.
Ensure that extracted air cannot be returned to the workplace through the ventilation system.
Ensure that eyewash stations and safety showers are close to the workstation location.

Personal protective equipment

Eye protection : Safety goggles

Hand protection

: PVC or other plastic material gloves

Skin and body protection

: Long sleeved clothing
Remove and wash contaminated clothing before re-use.

Respiratory protection

: Breathing apparatus only if aerosol or dust is formed.

Environmental exposure controls

General advice : Do not allow contact with soil, surface or ground water., Do not allow uncontrolled discharge of product into the environment.



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SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	: Wax like, solid
Colour	: off-white
Odour	: mild, sweet
Odour Threshold	: No data available
pH	: Not applicable
Melting point/range	: 106 - 116 °C
Boiling point/boiling range	: Not applicable
Flash point	: > 167 °C
Evaporation rate	: Not applicable
Flammability (solid, gas)	: No data available
Upper explosion limit	: No data available
Lower explosion limit	: No data available
Vapour pressure	: Not applicable
Relative vapour density	: Not applicable
Relative density	: No data available
Density	: 1.02 - 1.15 g/cm ³
Solubility(ies)	
Water solubility	: No data available
Solubility in other solvents	: No data available
Partition coefficient: n-octanol/water	: No data available
Auto-ignition temperature	: No data available



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Thermal decomposition : No data available

Viscosity

Viscosity, dynamic : Not applicable

Viscosity, kinematic : Not applicable

9.2 Other information

Self-Accelerating decomposition temperature (SADT) : Method: No information available.

Oxidising potential : No information available.

SECTION 10: Stability and reactivity

10.1 Reactivity

No dangerous reaction known under conditions of normal use.

10.2 Chemical stability

Stable under normal conditions.

10.3 Possibility of hazardous reactions

Hazardous reactions : Hazardous polymerisation does not occur.

10.4 Conditions to avoid

Conditions to avoid : Extremes of temperature and direct sunlight.

10.5 Incompatible materials

Materials to avoid : Strong acids and oxidizing agents

10.6 Hazardous decomposition products

Hazardous decomposition products : Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Information on likely routes of exposure : Skin contact
Eye contact
Inhalation

Acute toxicity

Product:



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Acute oral toxicity : Remarks: Not classified due to lack of data.

Acute inhalation toxicity : Remarks: Not classified due to lack of data.

Acute dermal toxicity : Remarks: Not classified due to lack of data.

Components:

2,2'-p-phenylenedioxydiethanol:

Acute oral toxicity : LD50 (Rat, male and female): > 5,000 mg/kg
GLP: yes

Acute dermal toxicity : LD50 (Rat, male and female): > 2,000 mg/kg
GLP: yes

cyclohex-1,4-ylenedimethanol:

Acute oral toxicity : LD50 (Rat): 3,200 mg/kg
GLP: no

Acute dermal toxicity : (Guinea pig): > 1,000 mg/kg

Skin corrosion/irritation

Components:

2,2'-p-phenylenedioxydiethanol:

Result: Skin irritation

cyclohex-1,4-ylenedimethanol:

Species: Guinea pig
Result: No skin irritation

Serious eye damage/eye irritation

Product:

Remarks: Irritating to eyes.

Components:

2,2'-p-phenylenedioxydiethanol:

Result: Eye irritation

cyclohex-1,4-ylenedimethanol:

Species: Rabbit
Result: Eye irritation

Respiratory or skin sensitisation

Product:

Remarks: Not classified due to lack of data.

Components:



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cyclohex-1,4-ylenedimethanol:

Species: Guinea pig

Assessment: Did not cause sensitisation on laboratory animals.

Germ cell mutagenicity

Product:

Germ cell mutagenicity

Assessment : Not classified due to lack of data.

Components:

2,2'-p-phenylenedioxydiethanol:

Genotoxicity in vitro : Test Type: Ames test
Metabolic activation: with and without metabolic activation
Method: Mutagenicity (Escherichia coli - reverse mutation assay)
Result: negative

: Test Type: Chromosome aberration test in vitro
Metabolic activation: with and without metabolic activation
Result: negative

Genotoxicity in vivo : Test Type: In vivo micronucleus test
Test species: Mouse (male and female)
Application Route: Oral
Method: Mutagenicity (micronucleus test)
Result: negative
GLP: yes

Germ cell mutagenicity
Assessment : Animal testing did not show any mutagenic effects.

cyclohex-1,4-ylenedimethanol:

Genotoxicity in vitro : Test Type: in vitro assay
Metabolic activation: with and without metabolic activation
Result: negative
GLP: no

Genotoxicity in vivo : Test Type: in vivo assay
Test species: Rat (male and female)
Cell type: Bone marrow
Application Route: Oral
Result: negative
GLP: yes

Germ cell mutagenicity
Assessment : Animal testing did not show any mutagenic effects.

Carcinogenicity

Product:



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Carcinogenicity
Assessment : Not classified due to lack of data.

Reproductive toxicity

Product:

Reproductive toxicity
Assessment : Not classified due to lack of data.

Components:

2,2'-p-phenylenedioxydiethanol:

Reproductive toxicity
Assessment : No toxicity to reproduction
No effects on or via lactation

cyclohex-1,4-ylenedimethanol:

Reproductive toxicity
Assessment : No toxicity to reproduction
No effects on or via lactation

STOT - single exposure

Product:

Assessment: Not classified due to lack of data.

STOT - repeated exposure

Product:

Assessment: Not classified due to lack of data.

Components:

2,2'-p-phenylenedioxydiethanol:

Exposure routes: Oral
Assessment: The substance or mixture is not classified as specific target organ toxicant,
repeated exposure.

cyclohex-1,4-ylenedimethanol:

Exposure routes: Oral
Assessment: The substance or mixture is not classified as specific target organ toxicant,
repeated exposure.

Aspiration toxicity

Further information

Product:

Remarks: The product itself has not been tested.



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SECTION 12: Ecological information

12.1 Toxicity

Product:

Further information

The following percentage of the mixture consists of ingredient(s) with unknown hazards to the aquatic environment: 8.4603 %

Components:

2,2'-p-phenylenedioxydiethanol:

Toxicity to fish : LC50 (Pimephales promelas (fathead minnow)): > 1,043.7 mg/l
Exposure time: 96 h
Test Type: static test
Method: OECD Test Guideline 203
GLP: yes

Toxicity to daphnia and other aquatic invertebrates : EC50 (Daphnia magna (Water flea)): > 100.2 mg/l
Exposure time: 48 h
Test Type: static test
Method: OECD Test Guideline 202
GLP: yes

Toxicity to algae : EC50 (Scenedesmus quadricauda (Green algae)): > 970 mg/l
Exposure time: 72 h
Test Type: static test
Method: OECD Test Guideline 201

cyclohex-1,4-ylenedimethanol:

Toxicity to fish : LC50 (Pimephales promelas (fathead minnow)): > 125.3 mg/l
Exposure time: 96 h
Test Type: static test
Test substance: see user defined free text
Method: OECD Test Guideline 203
GLP: yes

Toxicity to daphnia and other aquatic invertebrates : LC50 (Daphnia magna (Water flea)): > 100 mg/l
Exposure time: 96 h
Test Type: static test
GLP: no

Toxicity to algae : NOEC (Scenedesmus quadricauda (Green algae)): 122.9 mg/l
Exposure time: 72 h
Test Type: Growth inhibition
Test substance: see user defined free text
GLP: yes

12.2 Persistence and degradability

Product:



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Biodegradability : Remarks: No data available

Components:

cyclohex-1,4-ylenedimethanol:

Biodegradability : Test Type: Zahn-Wellens Test
Result: Readily biodegradable
Biodegradation: 98 %
Exposure time: 19 d
GLP: yes
Remarks: Readily biodegradable

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: No data available

Components:

2,2'-p-phenylenedioxydiethanol:

Partition coefficient: n- : log Pow: 0.61
octanol/water

cyclohex-1,4-ylenedimethanol:

Partition coefficient: n- : log Pow: 1.49
octanol/water

12.4 Mobility in soil

Product:

Mobility : Remarks: No data available

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This mixture contains no substance considered to be persistent, bioaccumulating and toxic (PBT).

12.6 Other adverse effects

Product:

Additional ecological : Remarks: An environmental hazard cannot be excluded in the
information event of unprofessional handling or disposal.
This product has no known ecotoxicological effects.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Dispose of waste material in compliance with all federal, state,



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and local regulations.

SECTION 14: Transport information

14.1 UN number

Not regulated as a dangerous good

14.2 UN proper shipping name

Not regulated as a dangerous good

14.3 Transport hazard class(es)

Not regulated as a dangerous good

14.4 Packing group

Not regulated as a dangerous good

14.5 Environmental hazards

Not regulated as a dangerous good

14.6 Special precautions for user

Remarks : Not classified as dangerous in the meaning of transport regulations.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

International Chemical Weapons Convention (CWC) : Neither banned nor restricted
Schedules of Toxic Chemicals and Precursors

REACH - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, preparations and articles (Annex XVII) : Neither banned nor restricted

Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals : Neither banned nor restricted

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59). : This product does not contain substances of very high concern (Regulation (EC) No 1907/2006 (REACH), Article 57).

REACH - List of substances subject to authorisation (Annex XIV) : Neither banned nor restricted

Regulation (EC) No 1005/2009 on substances that deplete the ozone layer : Neither banned nor restricted



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Regulation (EC) No 850/2004 on persistent organic pollutants : Neither banned nor restricted

Major Accident Hazard Legislation

Seveso Directive

Directive 96/82/EC of 9th December 1996

Directive 96/82/EC does not apply

Water contaminating class (Germany) : WGK 1 slightly water endangering
Classification according VwVwS, Annex 4.

The components of this product are reported in the following inventories:

United States TSCA Inventory : On TSCA Inventory

Canadian Domestic Substances List (DSL) : All components of this product are on the Canadian DSL.

Australia Inventory of Chemical Substances (AICS) : On the inventory, or in compliance with the inventory

New Zealand. Inventory of Chemical Substances : On the inventory, or in compliance with the inventory

Japan. ENCS - Existing and New Chemical Substances Inventory : Not in compliance with the inventory

Korea. Korean Existing Chemicals Inventory (KECI) : On the inventory, or in compliance with the inventory

Philippines Inventory of Chemicals and Chemical Substances (PICCS) : Not in compliance with the inventory

China. Inventory of Existing Chemical Substances in China (IECSC) : On the inventory, or in compliance with the inventory

15.2 Chemical Safety Assessment

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H315 Causes skin irritation.

H319 Causes serious eye irritation.

Carechem24 International Worldwide Coverage



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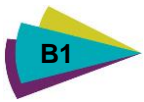
Print Date 23.06.2016

Emergency Phone Number

<u>Europe:</u>	All European Countries	+44 (0) 1235 239 670 (NCEC)
<u>Asia Pacific:</u>	East / South East Asia – Regional Number	+65 3158 1074
	Australia	+61 2801 44558
	New Zealand	+64 9929 1483
	China Taiwan	+86 10 5100 3039
	Japan	+81 345 789 341
	Indonesia	00780 3011 0293
	Malaysia	+60 3 6207 4347
	Thailand	001800 1 2066 6751
	Korea	+65 3158 1285
	Vietnam	+65 3158 1255
	India	+65 3158 1198
	Pakistan	+65 3158 1329
	Philippines	+65 31581203
	Sri Lanka	+65 3158 1195
	Bangladesh	+65 3158 1200
<u>Middle East / Africa:</u>	Arabic speaking countries	+44 (0) 1235 239 671
	All other countries	+44 (0) 1235 239 670
<u>America</u>	United States / Canada	001866 928 0789
<u>Latin America:</u>	Brazil	+55 113 711 9144
	All other countries	+44 (0) 1235 239 670
	Mexico	+52 555 004 8763

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.



Appendix B

Extract from UK HSE report on MbOCA

An extract is provided in this Appendix from a survey of occupational exposure to MbOCA in the polyurethane elastomer industry in Great Britain 2005-2006 (UK Health and Safety Executive). This outlines risk management measures recommended for MbOCA.

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11.19 One of the suppliers provided evidence of MbOCA contamination on imported kegs. The contamination was high in relation to that recorded from kegs sampled at most producers. It is highly likely that imported kegs will continue to be contaminated.

11.20 The concentrations of MbOCA on the outer gloves were in general much larger than those on the inner gloves. It was not possible to statistically assess for correlation between inner and outer gloves. However, it was possible to show that the concentration of urinary MbOCA was related to the quantity present on the outer gloves only. This would indicate a lack of good hygiene practice eg in removal of gloves.

Urinary MbOCA results

11.21 A total of 78 urine samples were collected to determine the concentration of urinary MbOCA in those directly and indirectly exposed to the chemical. Over half of these urine samples had measurable MbOCA concentrations.

11.22 There were noticeable differences between the directly and indirectly exposed groups. Surprisingly, urinary MbOCA concentrations in the indirectly exposed group were higher than expected (median 2.53 $\mu\text{mol/mol}$ creatinine). This may reflect skin exposure via surface contamination.

11.23 Three of the urine samples in the directly exposed group were above the BMGV of 15 $\mu\text{mol/mol}$ creatinine (set at 90th percentile). The 90th percentile of the present study is 8.85 $\mu\text{mol/mol}$ creatinine, suggesting that there have been improvements in occupational hygiene practice within the industry since 1995. A BMGV revised to 10 $\mu\text{mol/mol}$ creatinine would reflect today's good practice in the polyurethane industry.

11.24 The urine samples were also analysed for isocyanate diamines eg 2,4 toluenediamine. Many results were above the BGMV of 1 $\mu\text{mol/mol}$ creatinine for isocyanate metabolites thus indicating poor exposure control to the substance.

11.25 There was a strong statistical association between urinary MbOCA and urinary isocyanate diamines.

11.26 It can be finally concluded that if the principles of good practice as outlined in COSHH regulation 7(7) Schedule 2A are **applied at all times** then exposure to MbOCA (and isocyanates) should be well controlled during polyurethane elastomer manufacture.

12 Recommendations

Risk assessment

12.1 Each company needs to ensure that they have a suitable and sufficient assessment of the risks to health whilst handling MbOCA and isocyanates and on the measures to prevent or control exposure. It is important that the COSHH risk assessment applies specifically to the work carried out, ie it should not be a generic risk assessment.

12.2 Relevant information to include in the risk assessment can be found in the Safety Data Sheets supplied by the suppliers of MbOCA and isocyanate-based pre-polymer resins. A competent person should carry out the risk assessment. An experienced MbOCA handler may be the most relevant person to undertake the assessment in some cases.

12.3 The risk assessment should be reviewed regularly. This is critical especially if the results of monitoring frequently indicate 'high' urinary MbOCA levels ($> 8 \mu\text{mol/mol}$ creatinine). It should also be reviewed if there are regular changes in the volume or rate of elastomer production etc.

12.4 Further information to help with producing the COSHH risk assessment can be found in HSE's COSHH essentials available on www.coshh-essentials.org.uk and in HSE's publication *A step by step guide to COSHH assessment* HSG97 (Second edition) HSE Books 2004. The trade association, ie Polyurethane Elastomers Group, also provides relevant information.

Exposure control – general

12.5 Because MbOCA has been assigned the risk phrase R45 'May cause cancer' all the principles of good practice for the control of exposure to substances hazardous to health, ie COSHH Schedule 2A should be applied **at all times**. If applied conscientiously the principles of good practice will prevent or adequately control exposure to MbOCA and isocyanates.

12.6 Although all companies use some of the principles of good practice to mitigate exposure to MbOCA, for example the use of LEV, wearing gloves to prevent skin exposure etc there are still some specific areas that need addressing (see below).

12.7 No unspecified person(s), for example office workers and visitors, should be in the segregated area(s) when MbOCA is being handled unless supervised. There is a risk of exposure to MbOCA via inhalation, skin or by ingestion. It is unlikely they will be wearing PPE.

12.8 Where appropriate, in-use MbOCA kegs should be lidded when not required and stored in a dedicated dry area ideally away from the main MbOCA work area. This will prevent or reduce the risk of contamination to the outside of the keg(s) during handling.

12.9 Manual scooping of MbOCA from kegs should be carried out under extraction to reduce the risks of airborne dust exposure. Any spillage of MbOCA pellets or granules in particular in the area surrounding hoppers should be immediately cleaned up using an industrial vacuum.

12.10 Companies with automatic dispensers should pour the liquid carefully to prevent splashing, provide LEV at or around the dispenser to remove airborne contaminants and have an appropriately positioned drip tray to capture any drips. Molten liquid polyurethane should be covered with a lid if it is to be transported to another part of the work room.

12.11 The weighing, melting, mixing and casting of MbOCA should be carried out under LEV, for example a partially enclosed extraction booth, fume cupboard, canopy or downdraft table that is efficient and effective. For a fume cupboard or booth the average face velocity should be not less than 0.5 m/s. The average capture velocity for appropriate LEV systems should not fall below 0.8 m/s.

12.12 The molten MbOCA should be poured carefully into the pre-polymer resin to prevent surface contamination. The stirrer should not be placed onto the surface liner, eg polypropylene, as it will contain excess mixture; it should be allowed to rain back into the mixture. Any splashing should be cleaned immediately with a rag otherwise a build-up of material may develop.

12.13 The heated mixture should only be transferred from one part of the work area to another in a lidded container to prevent spillage onto the skin and onto surrounding surfaces and to prevent airborne exposure to vapour.

12.14 During casting, any local spillage should be immediately cleaned. This includes the cleaning of any spillage on and/or inside the curing ovens. There should be extraction on the inside or outside of the curing ovens to remove evolved vapours during curing. The removal of moulds following curing does not need to be under extraction. It is highly unlikely that there will be any MbOCA vapour release from the moulds or any free surface MbOCA that may be absorbed.

Exposure control - PPE/RPE

12.15 It is essential that during the handling of MbOCA the skin is protected from contamination and subsequent dermal absorption. All operatives handling MbOCA should wear appropriate PPE at all times, eg overalls, safety shoes, safety glasses and gloves.

12.16 There is no standardisation of the types of gloves to be worn but cotton lined inner gloves and leather outer gloves would provide suitable protection during the handling of MbOCA. Terry towelling outer gloves are not recommended for wearing as they are easily contaminated and retain the contaminants.

12.17 All gloves should be put on and removed correctly to reduce the potential for skin contamination. Under no circumstances should gloves be left on a bench or other contaminated surface when not in use.

12.18 The outer gloves should be changed frequently, ie when heavily contaminated or damaged to prevent a build-up of contaminants on the surface that may be permeate through the glove. It is expected that disposable gloves will be changed at least four times daily.

12.19 Barrier creams may be worn to provide additional skin protection. Their use should not replace the wearing of gloves.

12.20 It is essential that the wearers of tight-fitting facepieces, eg disposable dust mask respirators, half and full-face mask respirators, are facepiece fit tested.

12.21 For disposable dust mask and half-face mask respirators a qualitative fit test should suffice but for full-face masks a quantitative test should be used. Users of powered (fan-assisted) respirators with hoods and those using airfed breathing apparatus with hoods or visors will not require fit-testing. Further information can be found in *Fit testing of respiratory protective equipment facepieces* OC 282/28 HSE 2003 available on www.hse.gov.uk.

Exposure control - housekeeping and welfare

12.22 Standards of housekeeping tended to be poor and therefore in need of improving. This can be achieved by one or a combination of the following:

- installing stainless steel surfaces and/or polypropylene plastic where appropriate to make the cleaning of surfaces easier;
- cleaning liquid spillages immediately with rags;
- using an industrial vacuum to remove dust regularly; and
- placing all contaminated material in a dedicated waste bin.

12.23 Companies need to ensure that their employees have high standards of personal hygiene. This can be achieved by preventing eating, drinking and smoking in work areas, removing all PPE when leaving the work area, washing the hands etc. All companies should ensure that adequate washing facilities are provided at all times.

Use of controls

12.24 Employees should ensure that the measures provided to control exposure to MbOCA (and isocyanates) by all routes are used for example, wearing gloves when handling MbOCA and follow the defined methods of work.

12.25 Employees should practice a high standard of personal hygiene.

12.26 Employers should provide adequate supervision during all stages of MbOCA handling to ensure that the defined methods of work are carried out. They also need to ensure that any controls provided to reduce the risks of exposure to MbOCA (and isocyanates) are properly used.

12.27 Any reported faults or defects in the control measures used should be promptly dealt with, for example providing sufficient pairs of gloves to replace those that are damaged or heavily contaminated.

Maintenance

12.28 All polyurethane elastomer producers should ensure that their LEV systems are thoroughly examined and tested at least once every 14 months. Any defects found in the systems and reported by the examiner should be promptly repaired.

12.29 LEV systems should be checked on a regular basis, eg about once a week, using an anemometer and/or smoke tube to ensure that the air velocity required to contain or capture the airborne contaminants is adequate and to monitor airflow patterns respectively.

12.30 The average face velocity of partially enclosed booths and fume cupboards should not drop below 0.5 m/s to ensure effective containment within the system. The capture velocity of a LEV system should not fall below 0.8 m/s otherwise the airborne contaminants will not be effectively extracted and could escape into the local environment.

12.31 Those companies that use pegs to hang PPE should consider the use of lockers. The lockers should be in the workshop so that contamination on clothing is not spread when the clothing is removed.

12.32 Laundry facilities should be provided to wash contaminated clothing where appropriate. No worker should take contaminated clothing such as overalls home to wash.

12.33 All PPE should be checked during use to ensure that it is not damaged or heavily contaminated, particularly gloves.

12.34 RPE should be well maintained to include cleaning, disinfection, examination, repair, testing, safe storage and record keeping. This is especially important for reusable RPE, eg powered (fan-assisted) respirators that require the use of replaceable filters or cartridges.

Biological monitoring

12.35 Biological monitoring for urinary MbOCA should be carried out on relevant employees **once every six months**. The urine samples should be collected towards the end of the shift from all personnel handling the MbOCA.

12.36 **Suppliers of MbOCA** should carry out biological monitoring of personnel who handle MbOCA for quality control purposes, on those who need to split kegs and transfer MbOCA to smaller containers and on those involved in cleaning MbOCA from surfaces following an accidental release.

12.37 If there are any excursions above 15 $\mu\text{mol/mol}$ creatinine or even readings approaching half the limit then a full investigation into the effectiveness of the control measures used should be carried out. Once the investigation is complete then repeat urine sampling should be undertaken.

12.38 There is the risk of high exposure to MbOCA during maintenance duties such as cleaning the LEV systems and reactor vessels. Maintenance personnel carrying out such work should have their urines collected at the end of the shift for measurement of urinary MbOCA

12.39 Biological monitoring should be considered for isocyanate urinary metabolites when samples are collected for urinary MbOCA monitoring. A urinary concentration of urinary diamine above the BMGV of 1 $\mu\text{mol/mol}$ creatinine would indicate poor control practice and warrant an investigation of the handling of the isocyanate based pre-polymer resin.

Personal inhalation exposure monitoring etc

12.40 Regular airborne monitoring for MbOCA is not required. However, if following biological monitoring the BMGV for urinary MbOCA is exceeded or regarded as high (based on a company's previous results), then monitoring personal inhalation exposure to MbOCA may be useful as part of an overall investigation of the effectiveness of the control measures.

12.41 Those companies that carry out regular monitoring of airborne exposure to MbOCA as part of their annual risk assessment review should continue to do so.

12.42 Regular monitoring of surfaces using a wipe sampling technique to detect and assess MbOCA surface contamination and to assess the spread of contamination should be undertaken and the results incorporated into company workplace risk assessments.

Health surveillance

12.43 All workers handling isocyanates should have appropriate health surveillance. Health surveillance will include lung function testing, completion of a suitable questionnaire etc.

12.44 It is recommended that health surveillance for isocyanate handlers should include a pre-exposure examination, examination at about six weeks and 12 weeks after work has started and then at annual intervals while exposure continues.

12.45 A number of companies provide health surveillance for their isocyanate workers on a more regular basis (eg every six months); this is fine. It fits in with the recommended time for urine sampling for the monitoring of urinary MbOCA.

12.46 Furthermore, workers should be informed that if they develop symptoms such as wheezing, coughing, breathlessness etc whilst working with isocyanates it should be reported. Further exposure should be avoided and medical advice obtained.

12.47 A health record should be kept for each worker having health surveillance. It must be kept for at least 40 years.

Information, instruction and training

12.48 The provision of information, instruction and training in the polyurethane elastomer industry is poor and in need of improvement.

12.49 It is important that all future employees who may handle MbOCA and pre-polymer resin are provided with information on the nature of the hazards, the routes of exposure and the measures to control exposure as part of induction training. Where necessary, present employees handling MbOCA/resin should also be provided with the same information.

12.50 Instruction and training should be provided to all MbOCA/resin handlers on how to use the control measures provided for example, the correct method for removing gloves, how to maintain RPE etc. Refresher courses should be provided as and when required. This may be when a new control method is introduced or there is a change in the defined method of work.

12.51 It may be useful to keep records of each workers training and add to it as circumstances arise, eg attending a course, obtaining a professional qualification etc. All records (employers and employees) should be kept for an indefinite time period.

12.52 Relevant information on the handling of MbOCA, the exposure control measures used etc must be made available to safety representatives at an appropriate time. This may be at a regular health and safety meeting or through a Trades Union representative. In those smaller companies such information may be transferred personally on a one-to-one basis.

Appendix 1: Brief descriptions of workplaces and exposure control

Company A – The firm employs about 30 people; four work with MbOCA directly, ie about 1.25 kg/day. The MbOCA is handled inside a fume cupboard that extracts to atmosphere and is used for work with other chemicals. The oven used for curing the castings is situated inside a fume cupboard. Both fume cupboards are thoroughly examined and tested yearly. There is a reduced airflow into the cupboards.

MbOCA handlers wear overalls, lab coats, safety glasses, disposable latex or nitrile inner gloves and leather heat-resistant outer gloves. A disposable half-mask respirator FFP1 is provided but not worn. There is little surface contamination. It is mainly inside the fume cupboard. Urinary MbOCA concentrations are generally low.

Company B – This company employs over 60 workers and even though there are five dedicated MbOCA handlers, other staff may be involved with handling the substance directly. Approximately 30 kg is used on a daily basis. It is weighed,

Appendix C

Economic feasibility calculations

Table C1 Product specific raw material costs (TDI prepolymer/MbOCA to LFMDI prepolymer/HQEE, € per year)

	Assuming MbOCA market at 500 t/yr	Assuming MbOCA market at 1,000 t/yr
TDI prepolymer to LFMDI prepolymer		
(Old system) ADIPRENE® L 167/MbOCA	€ 13,000,000	€ 26,000,000
(New System) ADIPRENE® LFM E500/HQEE	€ 20,000,000	€ 41,000,000
(Old System) ADIPRENE® L 100/MbOCA	€ 13,000,000	€ 26,000,000
(New System) ADIPRENE® LM E370/HQEE	€ 20,000,000	€ 39,000,000
Total Raw Material Costs (TDI prepolymer to LFMDI prepolymer)		
Transition to ADIPRENE® LFM E500/HQEE	€ 8,000,000	€ 15,000,000
Transition to ADIPRENE® LFM E370/HQEE	€ 6,000,000	€ 13,000,000
Average increase used in analysis	€7,000,000	€14,000,000

Source: Amec Foster Wheeler, based on price data provided by Chemtura, 23 June 2016, comparative costs assessment that takes into account material, production costs, curative costs, freight and duty costs and gross profit margin. These prices have been multiplied by 5,500 and 11,000 respectively (tonnes of prepolymer + curative), as well as taking into account the extent of the market estimated to be switching from TDI and LFTDI systems respectively (Table 4.1). Note numbers have been rounded.

Table C2 Product specific raw material costs (LFTDI prepolymer/MbOCA to LFMDI prepolymer/HQEE, € per year)

	Assuming MbOCA market at 500 t/yr	Assuming MbOCA market at 1,000 t/yr
LF TDI prepolymer to LF MDI prepolymer		
(Old System) ADIPRENE® LF950A/MbOCA	€ 13,000,000	€ 26,000,000
(New System) ADIPRENE® LFM E500/HQEE	€ 17,000,000	€ 35,000,000
(Old System) ADIPRENE® LF9000A/MbOCA	€ 14,000,000	€ 28,000,000
(New System) ADIPRENE® LFM E500/HQEE	€ 17,000,000	€ 33,000,000
Total Raw Material Costs (LFTDI prepolymer to LFMDI prepolymer)		
Transition to ADIPRENE® LFM E500/HQEE (from ADIPRENE® LF950A/MbOCA)	€ 4,000,000	€ 8,500,000
Transition to ADIPRENE® LFM E500/HQEE (from ADIPRENE® LF900A/MbOCA)	€ 3,000,000	€ 5,100,000
Average increase used in analysis	€3.5,000,000	€7,000,000

Source: Amec Foster Wheeler, based on price data provided by Chemtura, 23 June 2016, comparative costs assessment that takes into account material, production costs, curative costs, freight and duty costs and gross profit margin... These prices have been multiplied by 5,500 and 11,000 respectively, as well as taking into account the extent of the market estimated to be switching from TDI prepolymer and LF TDI prepolymer systems respectively (Table 4.1). Note numbers have been rounded, which is why the average LFTDI prepolymer to LFMDI prepolymer figure differs from the product specific costs.

Table C3 Estimating average costs per company, based on production volumes (€, per year, per company)

	Average (Prod Vol)	Small (Prod Vol)	Large (Prod Vol)
TDI prepolymer to LFMDI prepolymer			
Transition to ADIPRENE® LFM E500/HQEE	€ 199,000	€ 29,000	€ 1,429,000
Transition to ADIPRENE® LFM E370/HQEE	€ 167,000	€ 24,000	€ 1,201,000
Average	€ 183,000	€ 26,000	€ 1,315,000
LF TDI prepolymer to LF MDI prepolymer			
Transition to ADIPRENE® LFM E500/HQEE (from ADIPRENE® LF950A/MbOCA)	€ 128,000	€ 18,000	€ 921,000
Transition to ADIPRENE® LFM E500/HQEE (from ADIPRENE® LF930A/MbOCA)	€ 77,000	€ 11,000	€ 551,000
Average	€ 102,000	€ 15,000	€ 736,000

Source: Amec Foster Wheeler, based on price data provided by Chemtura, 23 June 2016. Based on calculation of the total number of MbOCA processors active in the EU provided by Chemtura, 18 February 2015 (c.50, using c.350 tonnes of MbOCA). This indicates average MbOCA usage of 7 tonnes per company.

Table C4 Estimating savings per company from avoided Risk Management Measures (€, per year, per company)

	Average (Prod Vol)	Small (Prod Vol)	Large (Prod Vol)
Biological Monitoring [1]	€ 4,896	€ 2,000	€ 24,000
Extraction System (Low)	€ 1,000	€ 1,000	€ 1,000
Extraction System (High)	€ 2,000	€ 2,000	€ 2,000
LEV (Low)	€ 5,700	€ 5,700	€ 5,700
LEV (High)	€ 25,000	€ 25,000	€ 25,000
Total Saving per firm (Low)	€ 12,000	€ 9,000	€ 31,000
Total Saving per firm (High)	€ 32,000	€ 29,000	€ 51,000
Total Saving per firm (Average)	€22,000	€19,000	€41,000

Source: Amec Foster Wheeler, based on IOM 2011 et al. Note that figures have been rounded.

Table Notes [1]: Costs are based on average cost per firm of €400 per employee and an average of 12 employees. (5 (small processor) and 60 (large processor)). The average saving per firm is used in the analysis. The analysis has not quantified the costs associated with waste disposal, which are expected to be significant (some €450 per drum/keg containing MbOCA).



CONFIDENTIAL

Appendix D

Justifications for confidentiality claims

Blanked reference	out item	Pages	Justification for confidentiality
#1		2, 23	Customer's confidential business information
#2		24, 27, 34, 35, 41, 42, 45	Business sensitive information
#3		28, C1, C2	Business critical information
#4		29, 30, 33, 34, 35, 36, 44, 45, C1, C2	Pricing / price sensitive information

