TEMPLATE

for third party submission of information on alternatives for
Applications for Authorisation

NON-CONFIDENTIAL

Legal name of submitter(s): Heubach GmbH, Germany
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1. ALTERNATIVE ID AND PROPERTIES

There is not a single alternative pigment existing to exactly replace a specific PY 34 or PR 104 pigment. The solution to reformulate lead-containing paints is the smart combination of suitable organic and inorganic pigments.

The formulation of colours using pigment combinations is state of the art. For this reason pigment combinations, hybrid pigments and pigment preparations have already been in use to replace lead pigments for a long time. This can be seen from the worldwide figures in consumption of PR 104 and PY 34:

Overview on global consumption of PY34 and PR 104:
2000: 90.000 t (Source: European Coatings; Vincentz Verlag)
2006: 68.000 t (Source: Strategic Research Insights)
2010: approx. 40.000 t (Estimation by Heubach)

Tico for plastics
These are countertypes, developed to match the colour space that is usually covered by the traditional Chrome Yellow and Molybdate Red pigments.

These Titanium based colorants exhibit maximum gloss, opacity strength and durability. It is made by a proprietary co-finishing process to attach the organic colorants to the surface of the titanium carrier pigments.

This Hybrid-Pigment series can also be used to generate all of the RAL colour tones that are usually made with Chrome Yellow and Molybdate Red pigments.

Ecopaque for Plastics Series 13
Ecopaque pigments of the 13-series are special preparations based upon the high temperature resistant range of Heucodur Pigments combined with high performance organic pigments. Ecopaque pigments are alternatives to traditional Chrome Yellow and Molybdate Red pigments.

They are recommended for use in PE, PVC, PP, PS and ABS systems.

The 7 grades represent the colour space of Lemon Chrome via Middle chrome to scarlet pigments.

HEUCOFIT® LR
This series is developed as direct alternative to the traditional Chrome Yellow and Molybdate Red Heucotron® grades

Heucotron® Yellow 1064    Middle Chrome
Heucotron® Yellow 1070    Red Shade chrome
Heucotron® Red 220        Scarlet.
The three counter grades are preparations of heat stable inorganic pigments based on Nickel and Chrome Rutile pigments to achieve opacity and utilizing the brilliance and colour strength of relevant organic pigments.

The 3 preparations are showing a similar opacity and are very close in respect to colour strength and brilliance.

The light and weather stability of these preparations are in line or better than the traditional Chrome Yellow and Molybdate Red pigments. The yellow preparations are suitable for temperatures up to 190°C and the red version is suitable to 230°C. With this heat stability most of the PVC and PO applications can be met.
2. TECHNICAL FEASIBILITY

**Tico® for plastics**

These Hybrid pigments are made by a proprietary co-finishing process to attach the organic colorants on the surface of titanium yellow carrier pigments. The colour match is demonstrated in the plaques in Polystyrene below:

**Fig 1**: Colour comparison Tico Yellow and Red vs. Chrome Yellow and Molybdate Red
The tinting strength advantage that allows reduced pigmentation is demonstrated in the following diagram:

Graph 1: Tinting strength comparison Tico Yellow vs. lead chromates

The superior heat stability in HDPE of the Hybrid Pigments is demonstrated in the following graphs:

Graph 2: Heat stability of Tico Yellow vs. Chrome Yellow
And the light and weather fastness is matching or superior to the traditional Chrome Yellow and Molybdate Red pigments as demonstrated in the graph below.

**Graph 3:** Xenon test results of Tico Yellow vs. Standard Chrome Yellow

The same principles are valid for the replacement of the scarlet pigment. Also here the tinting strength advantage allows reduced pigmentation and is demonstrated in the following diagram:

**Graph 4:** Tinting strength and hiding power comparison of Tico Red vs. Molybate Reds
The superior heat stability in HD PE of the Hybrid Pigments compared to a typical high temperature Molybdate pigment is demonstrated in the following graphs:

**Graph 5**: Heat stability of Tico Red vs. Molybdate Red

And the light and weather fastness is matching or superior to the traditional Chrome Yellow and Molybdate Red pigments as demonstrated in the graph below.

**Graph 6**: Xenon test results of Tico Red vs. Molybdate Red

**Ecopaque® for Plastics**

This is a set of special preparations based upon the high temperature resistant range of Heucodur Pigments combined with high performance organic pigments.

The temperature stability is >250°C for the Ecopaque preparations and the light stability offers similar to better performance compared with the traditional Chrome Yellow and Molybdate Red pigments and are judged to be in the range of 6–7.

The colour comparison as shown below demonstrates the colour space that can be covered with these special pigment preparations:
HEUCOFIT® LR

*Heucofit LR Yellow vs. Chrome Yellows*

This series is developed as direct alternative to the major lead chromate pigments in coatings applications, but can also be used in low temperature plastics application like PVC.

The following colour comparison indicates the colour match in Chroma and Hue of the yellow alternatives.
**Colour match in LLDPE**

<table>
<thead>
<tr>
<th>Standard Lemon Chrome</th>
<th>Standard Middle Chrome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heucofit LR 1006401</td>
<td>Heucofit LR 1007001</td>
</tr>
<tr>
<td>Heucotron 1064</td>
<td>Heucotron 1070</td>
</tr>
</tbody>
</table>

△E 1:5 reduction 1,5

△E 1:5 reduction 0,7

**Fig. 3**: Colour comparison of Heucofit LR Yellows vs. Chrome Yellows

Even though the numerical DE values in full tone shows some variation, the real comparison in the colour shows a close match.

The heat stability in plastics of 200°C in HDPE, with no significant colour change, allows the use in LLDPE and PVC applications. The following picture illustrates the heat stability is similar to the traditional Chrome Yellow. The heat stability limit of 200°C is related to the stability of one component of the preparation.

**Fig. 4**: Heat stability of Heucofit LR Yellow vs. Chrome Yellow

The light fastness of 7 according to EN ISO 105 B01 and the weathering results performed in coating systems according EN ISO 20105-A02 also show the same performance as a traditional Chrome Yellow pigments.
**Heucofit LR vs. Molybdate Red**

Similar to the Chrome Yellows an alternative preparation for the scarlet version was developed. The following draw down indicates a very close match in Chroma, Hue and Opacity for the scarlet alternative of traditional Molybdate Red pigments.

![Standard Scarlet Comparison](image)

**Fig. 5**: Colour comparison of Heucofit LR Red vs. Molybdate Red

Even though the numerical DE values in full tone show some variation, the real comparison in the colour shows a close match. The products can be used to achieve the colour space that is usually met by the traditional Chrome Yellow and Molybdate Red pigments.

The light fastness of 7 according to EN ISO 105 B01 and the weathering results performed in coating systems according EN ISO 20105-A02 also show the same performance as a traditional Molybdate Red pigment.

The heat stability in plastics of 240° C is the same as a standard Molybdate red, as illustrated below and allows the use in most Polyolefin and PVC applications.
**Ecopaque for Plastics**

This is a set of special preparations based upon the high temperature resistant range of Heucodur Pigments blended with high performance organic pigments.

The temperature stability is 280°C for all the Ecopaque preparations and the light stability offers similar to better performance compared with the traditional Chrome Yellow and Molybdate Red pigments and are judged to be in the range of 6-7.

The colour comparison as shown below demonstrates the colour space that can be covered with these special pigment preparations:

### 3. ECONOMIC FEASIBILITY

As demonstrated above the Hybrid pigments and the selected pigment preparations offer an increased tinting strength, a superior brilliance and better hiding power. Therefore it is not realistic to compare the prices of the pigments directly. To understand the economic impact it is necessary to compare the final formulation. In certain RAL colours it could be shown that the cost for the pigments is in the range of 1,5 – 2,5 times the cost of using traditional Chrome Yellow and Molybdate Red pigments.

At the same time, due to the low amount of pigments (in the range of 0.1% to 5%) being used to achieve a final colour, the impact of the cost of pigments in the final products like a truck tarpaulin, a plastic chair is or a window frame is only minor. Even with higher prices for the pigments it is unlikely that this will lead to a higher price for the finished goods.
4. HAZARDS AND RISKS OF THE ALTERNATIVE


The majority of the alternative pigments or pigment preparations are not classified as hazardous according to CLP regulation. Therefore we consider the alternatives to be significantly less hazardous than the lead chromate based pigments.

Details of the classification of the described alternative pigments are given in the table in Appendix I.

5. AVAILABILITY

All the above mentioned pigment preparations based on pigments which are industrial products that are produced already for a long period at several pigment producers around the world. Current capacity for most of these pigments is higher than demand. And producers like Heubach have debottlenecking projects ready in case the demand is picking up more than expected.

As demonstrated over the last 10 years when the demand of for the traditional Chrome Yellow and Molybdate Red pigments has decreased from 90,000 tpy to roughly one third today, the pigment producers could easily cope with the demand for substitute pigments.

6. CONCLUSION ON SUITABILITY AND AVAILABILITY OF THE ALTERNATIVE

The replacement of lead chromates and molybdate reds in plastics and other thermoplastic materials is technically possible by several pigment preparations. Higher costs for these pigment preparations must however often be accepted, but very often the price increase of the pigments preparations is a negligible percentage of the production cost of the whole article. Availability of these standard pigments that are used in these combinations is given or can be made available through debottlenecking projects.

7. OTHER COMMENTS

[Insert text here]

REFERENCES

[Insert text here]
## Appendix I: Classification of the alternative pigments and pigment preparations

<table>
<thead>
<tr>
<th>Product</th>
<th>Colour Index</th>
<th>Substance</th>
<th>Classification</th>
<th>Reference for classification</th>
<th>Remarks</th>
<th>Supplier</th>
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<tr>
<td><strong>Lead chromate based pigments</strong></td>
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<td>Mixture contains an diarylide pigment. In general diarylide pigments are not recommended for application above 200 °C, due to decomposition of the pigment which might lead to the formation of aromatic amines. However it is a suitable alternative for low temperature applications.</td>
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