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1. ALTERNATIVE ID AND PROPERTIES

Unmodified phenolic resins are available under the generic CAS number 9003-35-4 in both solid (novolac) and liquid (resol) forms. They are polymers manufactured by the reaction of phenol and formaldehyde and, depending on the molar ratio of monomers used, they either proceed to full cross-linking through additional heat alone (resols) or through the addition of a formaldehyde donor (typically hexamethylenetetramine 'hexa') in order to complete the cross-linking process. The cross-linked polymer arising from the reaction of powder novolac resins and hexa is sometimes identified by the specific CAS number 68585-23-9.

2. TECHNICAL FEASIBILITY

The particular characteristic of the fully-cured phenolic resin that makes it highly appropriate for refractory uses is that, when carbonised under refractory processing conditions, it has a very high carbon yield which is important for graphite and carbon products. The technical feasibility has been well-established over many years and was already referenced in the Annex XV dossier on CTPHT prepared by the Netherlands and published by ECHA in 2009[1] on page 84 and, in more detail in Section A.5.2. Applications for which phenolic resins are particularly well suited include the manufacture of carbon-bonded brick, iso-pressed products, tap-hole clay resins and monolithic applications.

3. ECONOMIC FEASIBILITY

While CTPHT and other alternatives are less expensive on a weight-for-weight basis when compared with phenolic resins, the economics of their use is well-established. Any counter-arguments to their use are typically based on performance criteria for specific applications and not on cost. Since the approach based on phenolic resins is a completely separate route to carbon-based products, the cost comparison needs to be made on a holistic basis.

4. HAZARDS AND RISKS OF THE ALTERNATIVE

Phenolic resins have been well studied from a hazard/risk perspective over many years and their continued widespread use is testimony to the fact that the phenol-formaldehyde polymer itself is of low concern. Any hazard profiling relates typically to the free monomers (phenol or formaldehyde) present in the resins as processed and this will depend to a large degree on the average molecular weight of resins as supplied. This is something that can be managed with the individual resin manufacturers/suppliers. The fully-cross-linked resin produced from either novolacs or resols is largely inert (recall Bakelite radios).

5. AVAILABILITY

Both novolacs and resols are widely available in Europe for a variety of uses, including refractory. From the statistics collected by the European Phenolic Resins Association, there are a number of manufacturers of resins that can be, and are, used in the refractory sector, so availability is not seen as an issue.

[1] https://echa.europa.eu/documents/10162/f3c8e758-8030-fc0b-0ce3-13a66193af9b

6. CONCLUSION ON SUITABILITY AND AVAILABILITY OF THE ALTERNATIVE

While phenolic resins are especially preferred for certain refractory applications, EPRA believes that this alternative route to a high-yield carbon matrix is available for most refractory applications, with the possible exception of electrode manufacture where the aromatic content needs to be particularly high.

7. OTHER COMMENTS

The promotion of CTPHTHT (Carbores) as an alternative to CTPHT is understood to be a 'reduced risk' approach since the level of PAHs (typically benzo-α-pyrene) is still sufficient to classify CTPHTHT as a Category 1B Carcinogen. Phenolic resins would not be considered as offering a 'reduced risk' approach, since the hazards associated with fully-cured phenolic resins are insignificant. The phenolic resin alternative therefore offers the ability to reduce or remove hazard.

REFERENCES

Annex XV dossier prepared by the Netherlands and published by ECHA in 2008/9 (see footnoted hyperlink on previous page)

https://epra.eu/phenolic-resin/application-areas/refractory/

APPENDIXES

No appendices attached.