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INSTITUTE OF CHEMICAL TECHNOLOGY

Technical Brief

Ref No: TechBrief/2021/16

Eco-friendly novel phenalkamines as curing agents for industrial coatings

Technology Summary

High molecular weight phenalkamines derived from cashew nutshell liquid were synthesized and demonstrated to be effective cross-linkers for epoxy based coatings, with superior anticorrosive properties and chemical and solvent resistance.

Background

Metal corrosion under different environments such as marine, industrial, urban, rural etc, compromises the useful properties of metals resulting in huge direct or indirect losses. In India, an estimated loss of Rs. 36,000 Crores occurs every year due to corrosion and at least 25 % of this could be avoided by using appropriate anti-corrosive coatings, such as epoxy, and polyesters. Though these petroleum derived resins have played a vital role in the coating industry, their exponential rising prices and high depletion rate has led to an increasing interest in environment friendly, non-toxic coatings with improved overall properties.

Technology Description

Phenalkamines with variable molecular weights were prepared using different molar concentrations of cardanol, formaldehyde, and isophorone diamine (IPDA). The reaction mixture was heated to 80–85 ∘ C and maintained for 3 h. The temperature was then raised to 100 ∘ C to remove water of condensation. Once the required amount of water was removed, the reaction mixture was cooled. The final products were washed with lukewarm water to remove traces of unreacted amine. The phenalkamines produced were evaluated by determination of amine value, FTIR, NMR, gel permeation chromatography (GPC). The commercially available phenalkamine ARK351 and the phenalkamines prepared in this study were used as curing agents for epoxy resin based coating formulations. The coatings were applied on mild steel substrates and cured at 120 for 15–20 min. The coatings were also cured under atmospheric conditions for 7 days. The mechanical, chemical, thermal and thermo-mechanical properties of the cured coatings were also evaluated by various techniques. In addition, the anticorrosive properties of the coatings were evaluated by salt spray and electrochemical impedance spectroscopy.

Market Potential

The epoxy curing agent market is estimated at USD 3.61 billion in 2017 and is projected to reach USD 5.02 billion by 2022, at a CAGR of 6.84% from 2017 to 2022. The amine-based segment is expected to grow at the highest CAGR in terms of value, due to its many favorable properties compared to other curing agents.

Value Proposition

- Uses a renewable biomaterial - cashew nutshell liquid (CNSL) - as a starting material.
- Mechanical properties of the epoxy coatings can be controlled depending on the molecular weight of the phenalkamine and the type of amine used.
- Faster drying time compared to commercial phenalkamines due to high molecular weight
- Significantly improved pencil hardness and thermal stability of the cured films.
- The phenalkamines-cured epoxy coatings exhibit superior chemical and solvent resistance, with no signs of damage during water, acid and alkali immersion tests.
- Anticorrosive properties were observed to be at par when compared with the commercial phenalkamine

Applications

Phenalkamine epoxy hardeners are best suited for applications in the marine industry, construction coatings and adhesives, owing to theri excellent corrosion resistance and improved performance properties

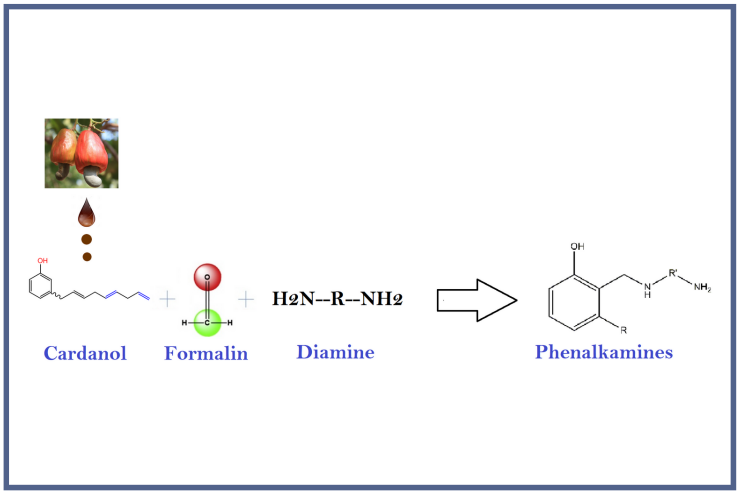
Technology Status

- Demonstrated at bench scale (~100 gm)
- Cured epoxy coatings tested as per ASTM standards
- Sample available ~ 5 kg
- Seeking interested industry partners

References

https://www.marketsandmarkets.com/Market-Reports/epoxy-curing-agent-market-91475650.html

https://www.academia.edu/26059360/Effect_of_molecular_weight_of_phenalkamines_on_the_curing_mechanical_thermal_and_anticorrosive_properties_of_epoxy_based_coatings



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