

New pollution preventing paints

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Environmental concerns have set the bells ringing for the chemical and allied industries to improve their manufacturing practices and also take care of their effluents. The paint industry uses many volatile organic ingredients, which can cause fatal diseases. Research is going on to make products that would cause less harm to the ecosystem and do not release any harmful vapours into the atmosphere.

The reduction of volatile organic compound (VOC) emissions has become a major environmental concern, especially in the paint industry, where the VOCs are widely used to aid the drying of paints and in the cleanup operations. Most conventional paints contain 200 to 400 gms/litre of VOCs. The volatile vehicle of the paint lowers the viscosity, improves the ease of application and facilitates drying of the paint. VOCs are also used in the removal of paint during cleanup.

These VOCs, when released into the air, react with oxides of nitrogen in the presence of sunlight to form tropospheric or ground level ozone, which significantly contributes to the formation of smog. The fatal effects due to prolonged exposure to ozone could be - permanent damage to lung tissue and functioning of the immune system.

Low VOC-content paints

In view of these problems, many low VOC-content paints have been developed such as water-based coatings, low-VOC latex paints, paints using high solids loading and powder coatings. Further reduction in VOC levels can be achieved through the development of zero-VOC content paints. This article briefly describes a new paint formulation that eliminates the need for volatile organic compounds.

The new formulation involves a functional modification of alkyd resin, a drying oil and a suitable pigment. The alkyd resin and the modified alkyd resin have both been synthesised first. The modified resin being acid sensitive, imparts this property to the paint. During cleanup, the paint gets emulsified in aqueous acidic wash solution. The drying of paint is a result of cross-linking of the molecular chains of drying oil. Thus, VOCs have been eliminated from both the paint and the wash solutions.

Paint properties

The paints formulated were tested for various properties such as ease of application, drying time and quality of the dry coating. The paints using castor oil had a drying time of 30 minutes for an hour on concrete, a few days on wood and more than a week on metal. Problems such as poor consistency, insufficient dispersion stability and particle flocculation (leading to formation of hard lumps) were however overcome using an

appropriate drying oil. Consistency and dispersion stability was found to be excellent along with a good retention of acid sensitivity.

Washing kinetics

The washing kinetics of the paint was tested by subjecting its samples to gentle shear while keeping them immersed in an acid solution of known concentration. The washing of the resin upon contact with an acid solution is assumed to take place in three steps:

- The resin reacts with the acid, producing soap, which accumulates at the surface.
- The resin or acid diffuses to the soap layer to react further, producing a thicker layer.
- When the soap reaches a critical thickness, it is peeled away by shear.

A straightforward theoretical analysis of mass transfer involved in the washing kinetics, leads to mass transfer coefficient varying directly with the applied relative velocity or shear, and inversely with paint viscosity. The experiments confirm these expectations. The mass transfer coefficients vary with the resin concentration for the case of excess resin, and with the acid concentration for the case of excess acid. Some deviations have been observed experimentally with regard to the latter predictions, indicating the need for a deeper theoretical analysis of these newer products.

The best washing kinetics have been achieved with a pH between 4 and 5, suggesting the usefulness of the product formulation. The resin concentrations ranged from 14-17 per cent by weight and the pigment concentration was about 45 per cent by weight.

Conclusion

In a nutshell, this new formulation is completely free of volatile organic compounds and also, the paint is washable with dilute acidic aqueous solutions. The major washed components of the paint or their resultant products in the effluent are also biodegradable. ♦

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