The effect of PMMA on physical properties of dammar for coating paint application

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Abstract
Purpose – The aim of this paper is to describe the preparation and characterisation of poly(methyl methacrylate) (PMMA) (Mw: 996,000) and dammar mixtures to obtain a new series of natural coating materials for application on mild steel substrates. Dammar is a natural resin extracted from Dipterocarpus Grandiflorus sp., or kruing trees, which grow mainly in the tropical Asia Pacific forest.

Design/methodology/approach – Natural dammar resin was mixed with PMMA at different weight percentages in xylene as a solvent and dammar as dominant component. The mixtures were applied on mild steel Q-panels to form dry coating films. The coating films were investigated under Attenuated Total Reflection-Fourier Transforms Infrared (ATR-FTIR) technique to observe the presence of functional groups from PMMA and dammar. Resistivity of coating films against corrosive agents from electrolytes was measured by using potential time measurement (PTM) technique. ASTM D3359 (cross-hatch) technique was used to measure the coating film adhesion strength on the substrate. The entire tests were conducted at 28°C.

Findings – Natural dammar resins is potentially applicable for coating on cold rolled mild steel Q-panel when mixed with PMMA. Blended dammar resin with PMMA in 5:5 ratio (coded as DP50) was found to give the highest energy of rapid impact indenter. Cross-hatch test under ASTM D3359 revealed that 50 percent w/w of dammar in PMMA had increased the adhesion strength of the coating film where there was no coating area peeling off from the substrate after the test. DP50 also had the longest time to resist penetration of electrolytes through the coating film when immersed in salt water.

Research limitations/implications – Decreasing the amount of dammar lower than 50 percent weight ratio with PMMA will cause high viscosity and inhomogeneous mixtures.

Originality/value – Natural dammar resin mixed with PMMA (behaviour naturally in free standing film) for coating paint application was formulated.

Keywords PMMA, Xylene, Dipterocarpus Grandiflorus, PTM, Cross-hatch, ATR-FTIR, DSC, Resins, Plants

Paper type Research paper

Introduction
Most organic binders for paints application have been developed from synthetic resins. Nowadays, the cost of synthetic materials in coating industry has increased due to the costly manufacturing processes and shortage of raw materials. In the work reported in this paper, we developed a new coating composition where one of the components (dammar) was affordably extracted from plants. Hence, this will lower the cost of the raw materials.

Poly(methyl methacrylate) (PMMA) (Figure 1) is well-known for its fast self-cure amorphous polymer. It has glass-like property. In previous studies, it had been shown that PMMA exhibits excellent transparency, photo stability, good mechanical strength, hydrolytic stability, and it is inert to many chemicals. It also has been applied in optical data storage systems, packaging, automobile industries, cosmetics (Lalande et al., 2006), and medicine (Weam et al., 2000).

PMMA is, however, brittle (Wu, 1976; Yamashita and Nabeshima, 2000) and has low adhesion property due to its low surface energy. Modifiers or blends with other polymers have been added to improve its flexibility. For an example, the use of epoxy or hydroxyl functional monomers such as 2-hydroxyethylmethacrylate or glycidylmethacrylate (Wang et al., 2006) and tetramethylammonium formate (Alemdar et al., 2007) has enhanced the property of PMMA in coating paint application.