

Development of stoving enamel paint using alkyd resin and urea formaldehyde suitable for use on domestic appliances.

A THESIS PRESENTED BY

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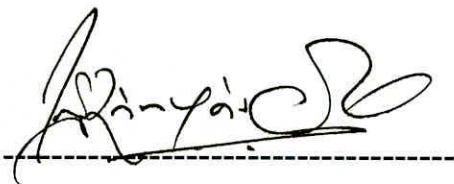
DECLARATION.

I do hereby declare the work described in this thesis was carried out by me under the supervision of Dr. Sudantha Liyanage and Mr. Ranjit Ganemulla and a report on this has not been submitted to any University for another degree.


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Thushari Kolonnage.

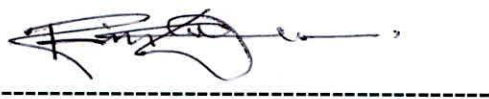
I certify that the above statement made by the candidate is true and that thesis is suitable for submission to the University for the purpose of evaluation.



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Director Operations/Technical

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To

My

Mother & Father

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ABSTRACT

Stoving enamels are paints, which are designed to cure a film possessing optimum properties at a pre-determined temperature. Stoving enamels are applicable on metal finishes. Main components used in manufacturing Stoving enamels are alkyd resins and amino resins.

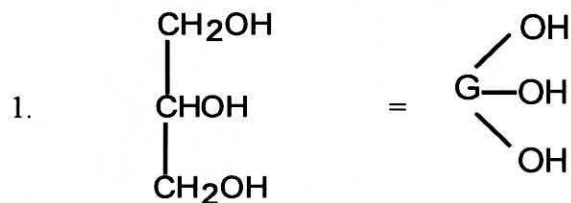
This thesis explains the development of Stoving enamel paint using alkyd resins and Urea formaldehyde as the amino resin, that is suitable for domestic appliances.

Four types of short oil alkyd resins were used *i.e.*: two types of Coconut oil modified alkyds, Soya bean oil modified alkyd and Cadura modified alkyd type. The Urea formaldehyde resin used was an imported resin with a solid content of $56 \pm 2\%$. TiO_2 (Titanium dioxide) was used as the pigment to obtain the opacity of the paint and also for the Whiteness (if the required paint is of white). The main solvents used were xylol and butanol. Each alkyd type was reacted separately with other ingredients using relevant equipment and machinery and made Stoving enamel samples. Paint was sprayed on metal panels and dried in an oven for 30 minutes at 127°C . Panels were tested to obtain results.

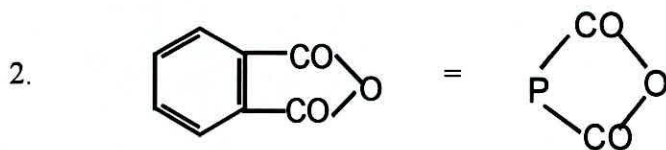
This study has clearly shown that, the Stoving enamel made by using alkyd resin modified with synthetic Cadura oil gave the best physical & chemical properties when compared to other four types of resins. It has shown good hardness, gloss, surface adherence and resistant to stains.

The hardness of Stoving enamel made by using soya oil modified alkyd resin was better than coconut oil modified alkyd.

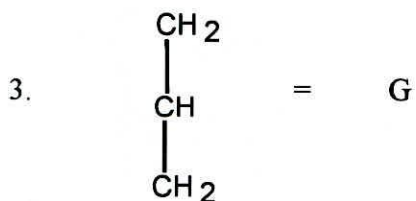
LIST OF ABBREVIATIONS



Glycerol



Phthalic anhydride



4. U/F - Urea formaldehyde.
5. M/F - Melamine formaldehyde.
6. R - Organic group.
7. R¹ - Different organic group.

1. Introduction.

Organic surface coatings cover a wide range of materials. It refers to varnishes, enamels, emulsions, lacquers, stoving finishes and printing inks; in fact, all these organic products which are applied as liquids in thin films, either to decorate or protect a surface. Some of these materials are clear coatings and the others contain pigments.

These organic surface coatings fall into two classes³, *Convertible* and *Non-Convertible*. A film-forming material, whatever its nature, is usually applied in the form of a solution or emulsion. In the case of a solution, for example, the purpose of the solvent is to reduce the viscosity so that the coating may be easily applied to the surface by brushing, spraying, dipping, roller-coating or etc. The solvent then evaporates leaving a film of the coating material. Some film formers, such as shellac, bitumen and nitrocellulose, after being deposited from solution dry to give a film that can be re-dissolved in the solvent from which it was originally deposited. Such materials are called *Non-Convertible Coatings*. This is purely a physical process and there is no chemical reaction involved.

The film deposited after evaporation of the solvent changes comparatively quickly into a form which is unlike the original film-forming material, and moreover it is insoluble in the solvent from which it was deposited. Such materials are called *Convertible Coatings*. This time the physical process of solvent loss is followed by a chemical reaction within the film. This reaction is essential in order to achieve the desired properties and performance of the paint.

This reactivity can be arranged depending on the end use intended for the paint and this provide a useful way of sub dividing the convertible coatings into two main groups.

- 1) Those which cure by absorbing and reacting with atmospheric oxygen.
- 2) Those which cure by interaction of two or more constituents of the film.

Curing of coatings by reaction with atmospheric Oxygen :-

These paints are based on resins which contain the so called drying oils, which when suitably catalyzed will oxidise to form progressively more complex polymers until full curing of the film is achieved. The film will be then hard and tough and completely insoluble in its original solvents. Whilst these paints are ideal for the general decorative market, the main disadvantage when considering the industrial market, is that the paint takes a long period *i.e.* about one day to dry and harden sufficiently to be handled during the flowline production.

Curing of coatings by interaction between two or more constituents: -

The film constituents must possess a fairly high order of reactivity under specified conditions but is negligible under normal conditions of storage for practical reasons. Two ways which the reactivity upon storage could be avoided are

(1) By keeping the reactive components apart until the coating is to be applied.

e.g. All the two pack systems. (Not discussed in details)

(2) By using components, which are only reactive under conditions of elevated temperatures.

e.g. Industrial Stoving enamels. (Discussed in details)

Industrial Stoving enamels:-

The largest single group of Stoving enamels is that combining alkyd resins and amino resins. They are designed to cure to a film possessing optimum properties at a pre-determined time and temperature.

The Stoving enamels are generally used in original equipment manufacture applications, because factories are the main establishments with the facilities to cope with the high curing temperatures required. The rapid attainment of full cure and handling properties of these coatings are also significant advantages in mass production systems of factories.

Articles coated with these Stoving systems typically include vehicles, washing machines, metal decorating applications etc. In general the uses for these finishes are where good durability, chemical resistance and the quality of finish are important.