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MEMORANDUM REPORT NO. M-541

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SYSTEMS FOR FLOOR PAINTS

The present 631 line porch and floor enamels are based upon various alkyds as vehicles. These have a pigment-to-binder ratio varying from about 70/100 to 95/100, and they are brushed at a total solids of approximately 57%. There are many disadvantages associated with this system, such as, softness, long dry time, poor abrasion resistance, poor alkali resistance, thin films, etc.

If a thick film of high solids could be laid down on a floor in a single coat, and if this film could be dried by some mechanism other than oxidation or solvent evaporation, then a more durable type of system would result provided the proper balance of physical properties could be imparted to such a system. Thick, single-coat films of the alkyd-based 631 line enamels would never dry hard, since their drying depends on a combination of oxidation and solvent evaporation. The type of system that we have investigated is an air-dry, catalyzed system. This system depends on a chemical reaction between a linear polymer and a catalyst which results in a cross-linked polymer. The film dries because it forms a dense network which is resistant to most chemical agents.

The purpose of this report is to present the systems that were investigated and to examine their properties.

(1) Shell Epon 1001, which is diamine catalyzed, will be discussed in a separate report.

(2) Shell Epon 828 is a liquid, 100% solids Epon which has a lower molecular weight and higher epoxy equivalent than Epon 1001. The ethylene diamine catalysis is strongly exothermic, and the pot-life of a small pot of catalyzed product is about 1/2 hour at 77°F. Hard films are obtained which exhibit good soap resistance. However, they yellow quickly and are quite brittle. The present price of Epon 828 is $1.25 per pound. This, together with the short pot-life and poor flexibility, is sufficient to remove Epon 828 from further consideration as a floor finish.

(3) Phenoline 300 is a modified phenolic resin, produced by the Carboline Company, which has been analyzed to be an oil-modified Epon, probably catalyzed by a diamine. The films have good soap resistance and excellent hardness, but they yellow badly, are very brittle, and have a milky appearance (possibly a catalyst exudation) which will not wash off. These disadvantages plus the cost of catalyzed resin of $25.00 per gallon make this unpromising as a floor finish.

(4) Araldite E-133 is an epoxy compound made by the Ciba Company. It has fair hardness and good soap resistance. However, it is brittle, yellows badly, and has a milky appearance. Price information is not yet available, but its overall properties give no promise for a good floor finish, and it will be eliminated from further consideration.

(5) Paraplex P-43, produced by Rohm and Haas, is a polyester dissolved in styrene (70% solids). It can be catalyzed by an accelerator-catalyst system consisting of 3% cobalt naphthenate and 3% cumene hydroperoxide. The resulting films are hard and give good color stability but poor soap resistance. If the resin is catalyzed to give a clear film, the top surface remains tacky for an indefinite period. This is due to an inhibition of the styrene polymerization by the oxygen of the air. Pigmentation with W-88 to a pigment-to-binder ratio of 50/100 overcomes this top tack and gives a viscous material which can be applied only by troweling. The major disadvantage, however, is the odor of styrene. Although the cost of this resin is low ($0.42 per pound), the bad odor would restrict its use as a floor finish to specific places where odor is not a problem.

(6) BCM containing 15% nitrocellulose (total solids of the solution of 93%) can be catalyzed by 4% cobalt nitrate or by 3% cobalt naphthenate and 3% cumene hydroperoxide to give hard films (drying time 48 hours). Soap resistance and bump-bend are poor. The BCM/PX system is unstable and gels on standing. Substitution of polyvinyl chloride or an alkyd for the nitrocellulose does not improve the stability. Pigmentation of BCM to a high pigment volume concentration causes flocculation. An

estimate of $0.87 per pound is given for making 100% solids BCM. An overall appraisal of this system forces one to conclude that BCM would not make a good floor paint.

(7) Two furfuryl alcohol resins were investigated, one produced by Durez, and the other by the Irvington Varnish and Insulator Company. The Durez resin was black and viscous. It could be pigmented with W-50 to a light brown color and catalyzed with 2% HCl (drying time 18 hours). The other product consisted of a low viscosity vehicle and a solid extender containing the catalyst. The two were mixed together, and the mixture also dried in about 18 hours. It was found in both cases that the cross-linked product became brittle on aging several weeks and turned completely black regardless of the original pigmentation. The odor of the vehicle in both cases was objectionable. For these reasons further work on this type of material was discontinued.

(8) The Desmophen-Desmodur system will be discussed in a separate report.

(9) A soya bean oil alcohol modified urea-formaldehyde resin was catalyzed with various concentrations of hydrochloric acid. The alcohol was used to obtain flexibility. These films dried tack-free, but were very cheesy.

(10) At present no high solids phenolics are specifically produced for room temperature catalysis. Bakelite BVQ-12201 is a phenolic of 50% solids that can be acid catalyzed. The catalyzed film has a milky appearance which can be wiped off leaving a glossy film. The pigmented films were yellowish in color, but they exhibited good mar resistance. The resin could not be used for floor finishes of the type we are investigating because of the low solids.

The physical properties of some of the above mentioned systems are given in Table I.

From a consideration of the function of floor paints, it would appear that the most importent properties are hardness, abrasion resistance and soap resistance. It is these properties that should be improved to the greatest possible degree.

ACTION TAKEN:

The systems discussed in this report will be eliminated from further consideration as floor finishes.

Paraplex P-43 polyester will be considered for other uses as an air-dried product.

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TABLE I. PHYSICAL PROPERTIES OF FILMS FROM TWO COMPONENT SYSTEM

System *	Hard-ness** (Knoop)	Film Thick-ness (mils)	Tensile Strength (lbs./in.^{2})	Elongation (%)	So (Da
Epon 828/8% Ethylene diamine catalyst.	4.3	3.9	2,490±110	3.4 ± 0.3	
Paraplex P-43/3% cobalt naphthenate accelerator/3% cumene hydroperoxide catalyst. (1)	5.1	5	-	-	
Phenoline 300/17% Phenoline 300 catalyst.	12.8	6.9	4,860±687	2.4 ± 0.3	
Araldite E-133/10% Araldite Hardnener HN-951.	3.4	3.1	-	--	
85% BCM-15% PX/3% cobalt naphthenate accelerator/2% cumene hydroperoxide catalyst.	4.1	9.9	3,045±190	11.9+± 1.4	
Alkyd	0.7	1.5	748±38	27.2 ± 2.1	
631-927 (2)	1.5	1.7	1,171±12	22.1 ± 0.4	

* All systems are pigmented with W-50 to a pigment-to-binder ratio of 5
except

(1) Paraplex P-43 which is pigmented with W-88 to a pigment-to-binde
of 50/100.

(2) 631-927 which is red Porch and Floor Enamel having a pigment-to-
ratio of 69/100.

** Hardness was measured seven days after catalysis.