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Agenda No. C 10

Author's Name F.Wockner

Product V 84 VG 15
Classified
Assignment

# PRE-CATALYZED FURNITURE FINISHES



The Sherwin-Williams Co.
PV&L 2nd Annual Symposium
November 1956
Cleveland, Ohio

Abstract

This is a summary of the development of V 84 VG 15, Water White Precatalyzed Furniture Finish. The formula is based on Urea Formaldehyde Resin, modified with oxidizing and non drying alkyds. The most outstanding properties of this varnish are its light colour, its resistance to many household acids and alkali, and its fast cure.

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## Introduction

The purpose of this program was the development of a Furniture Varnish which could truly be called a Water White Varnish. This meant that the varnish must have a colour of 1 on the Gardner Holdt scale. Furthermore it was felt that in order to really be an outstanding furniture finish the following properties would be required: High gloss and good build, high degree of cold check, chemical and mar resistance, good rubbing and polishing qualities and fast drying or curing properties.

After reviewing the available raw materials which could be used to develop such a finish, it was decided that only a formula based on Urea Formaldehyde Resin would meet all these requirements. This actually meant a compromise as there are other raw materials which would yield films with better mar and chemical resistance, but only UF Resins would enable us to formulate to a colour of 1, and it was felt that a light colour would be a better selling point than for example outstanding chemical resistance.

## Details

### 1) Evaluation of Urea Formaldehyde Resins

The first step was to find the best suitable UF Resin. For this reason, six UF Resins were evaluated for speed of cure, hardness, viscosity, water resistance, stability and formaldehyde release on curing. The resins were reduced to 41% solids with Xylol (323), and catalyzed with 10% - expressed on solids - of (24 G 6), American Cyanamid Catalyst 296-9. This catalyst was found to give the optimum can stability, as compared to for example inorganic acids such as Hydrochloric, Sulfuric or Phosphoric Acids.

The results are recorded below on Chart No. I.

| Name | Code | Viscosity Ford #4 | Drag Free Time* | Hardness o'nite AD ** | Hardness 1 hr. 140°F | Water Resistance of Baked Film Immersed for 12 Hrs. |
|---|---|---|---|---|---|---|
| Ufor. F240N | (48 G 4) | 21" | 10' | -6 | 6 | Turned milky, came off glass |
| Beck. P354 | (48 G 9) | 27" | 5' | 6-9 | 9-12 | " " " " " |
| Ufor. F240 | (48 G 5) | 43" | 7' | 6 | 9 | " " " " " |
| Ufor. F210 | | 59" | 8' | -6 | 6 | " " " " " |
| Ufor. F158 | | 46" | 9' | 6 | 9 | " " " " " |
| Plastopal BT | | 32" | 12' | 3-6 | 9 | " " " " " |

CHART NO. I

* Dragfree: Finger passed across film leaves no mark.
** Relative measure of hardness as determined by the Lacquer Scratch Tester.

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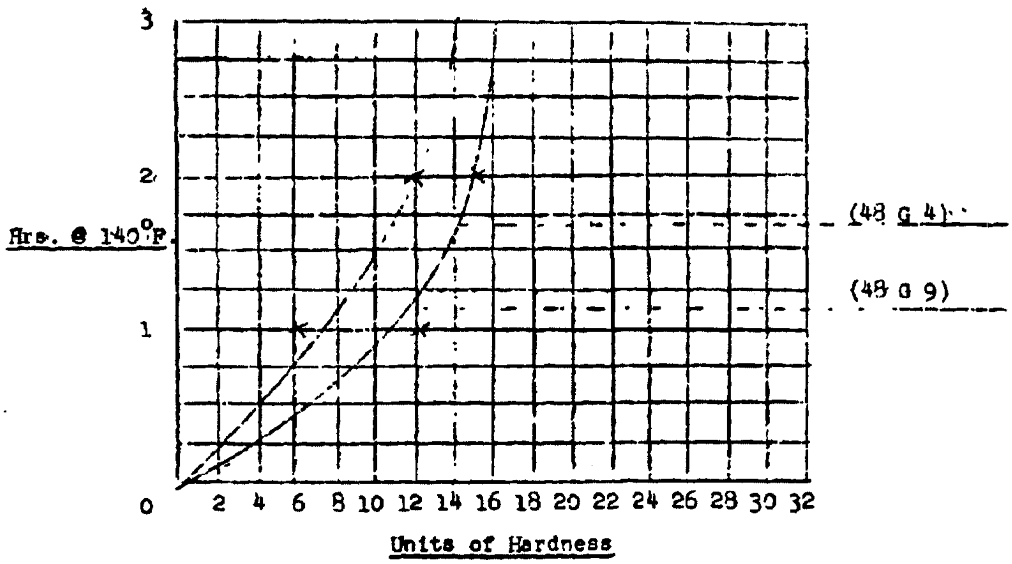
Reichhold's Beckamine P354, (48 G 9) was found to yield the hardest film. Rohm & Haas Uformite F240, (48 G 4) gave the least odor on curing. These two resin formulations were then baked for three hours to ensure complete cure, and the hardness of the film was recorded after each hour of bake.

For results see Chart No. II.

CHART NO. II




Indications were that

a) A varnish formulated with Uformite F240 (48 G 4), would have the least odour on curing, but some sacrifice would have to be made on the ultimate film hardness.

b) Uformite F210 would likely give a varnish with the desired viscosity and build but the film would be too soft.

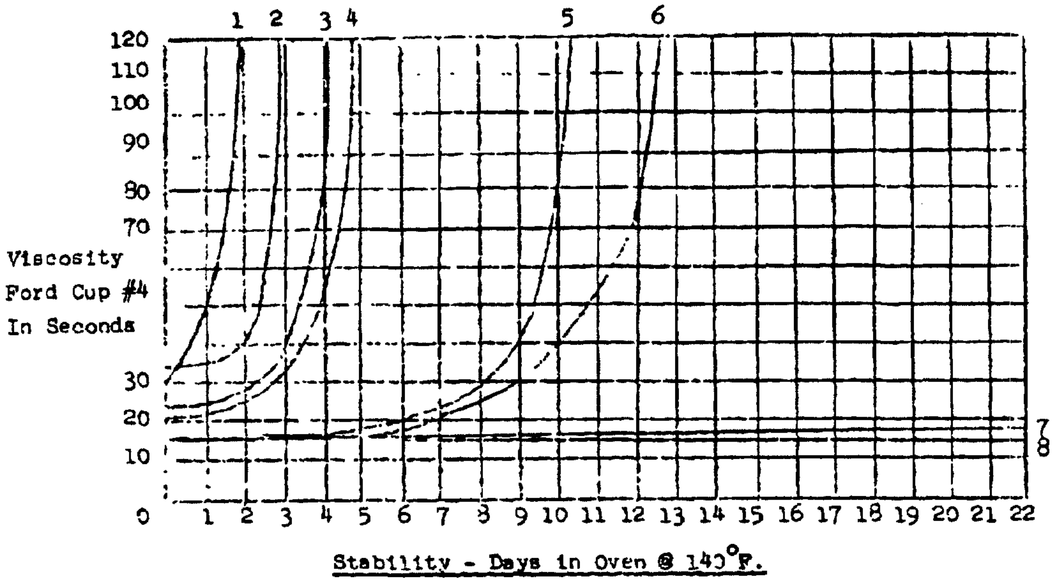
c) Reichhold's Beckamine P354 (48 G 9), would have the desirable qualities of rapid cure and film hardness. The advantages of this particular resin would probably outnumber its deficiencies, such as low viscosity.

2) Investigating the Influence of Various Solvents on Can Stability

Since the solvents used in a precatalyzed UF Resin formulation determine the stability to a large extent, Beckamine P354 (48 G 9) was reduced with eight different solvents to 41% solids. These blends were tested for stability at a constant temperature of 140°F.

The results are recorded in Chart No. III.

CHART NO. III




1. (416)Diacetone Alc.
2. (145)Min.Spir.
3. (125)VM&P Naph.
4. (1 G 14)Rubber Solvent
5. (323)Xylol
6. (317)Toluol
7. (4G21)Ipa/Mibc 60/40
8. (4G24)CCS 1000 Alcohol

a) In general aliphatic hydrocarbons such as (125), (145) and (1 G 14) give increased viscosity but diminished pot life.

b) The lower type alcohols such as (4 G 24) and (4 G 21) give solutions of low viscosity but greatly increased pot life.

c) Aromatic hydrocarbons such as (317), (323) give results which lie somewhere between the two extremes of aliphatic and alcoholic solvents.

d) Ketones give solutions of low viscosity but the catalytic effect of the ketonic group C = O diminishes the pot life of the varnish to almost zero.

3) Attempts to Improve the Build

Improved build could be obtained by increasing the viscosity of the varnish. The only means - besides using thickening agents - would be to use solvents with a low solvency power. It was hoped - and realized - that a compromise could be made between the solvents effecting the highest viscosities and the ones giving the best stability. The main film forming ingredients were reduced to 41% solids with the same 8 solvents that were previously used in the stability tests.

The materials and the viscosities obtained are recorded in Chart No. IV.

| Name | Code | (317) | (323) | (1 G 14) | (125) | (145) | (4G24) | (4G21) | (416) |
|---|---|---|---|---|---|---|---|---|---|
| D.C.O.Alkyd | (39 G 74) | 97 | 135 | Syrup | Syrup | Syrup | 21 | 27 | 34 |
| Polyester | (40 G 53) | 19 | 22 | Incomp. | Incomp. | Incomp. | 19 | 21 | 26 |
| Uformite F240N | (48 G 4) | 20 | 21 | 31 | 33 | 50 | 20 | 23 | 37 |
| Pelargonic Alkyd | (40 G 51) | 41 | 67 | Incomp. | Incomp. | Incomp. | 20 | 25 | 33 |

CHART NO. IV

4) Evaluation of Short Oil Alkyds Against Medium Oil Alkyds

Replacement of (39 G 74) 30% D.C.O. Alkyd with A1247 50% D.C.O. Alkyd and purchased alkyds of similar oil lengths led to three discoveries.

1. A considerable increase in gloss was noticed.

2. The longer oil alkyds increased the rubbing and polishing qualities.

3. Against these improvements stands a marked decrease in resistance properties. Some films could not be sanded with Mineral Spirits because of excessive softening, whilst in other cases intercoat adhesion was adversely affected. Also noteworthy is the fact that with some of the shorter oil alkyds incompatability was present, resulting in the formation of milky films when observed against a dark background. In conclusion we may say that in no case were suitable properties realized with alkyds of an oil length of 50% or higher. It has been our experience that the oil length of the alkyd must be around 40%.

5) Effectiveness of Driers

In order to determine the effectiveness of metallic driers on oxidizing alkyds in catalyzed urea formaldehyde finishes, the following driers were evaluated in various percentages in formulations containing short and medium oil alkyds:

| | | |
|---|---|---|
| (9 G 3) | Lead Naphthenate | 24% |
| (9 G 53) | Cobalt Naphthenate | 6% |
| (9 G 43) | Manganese Naphthenate | 6% |
| (9 G 41) | Calcium Octoate | 5% |
| (9 G 61) | Iron Naphthenate | 6% |

The samples were poured on glass against a comparable formulation without driers and tested for hardness after baking for 1 hour at 140°F., after over-night air drying and after 24 hours air drying. Films were also tested for speed of dry and resistance to softening under (145). In no instance could any improvement be noticed with those formulations containing driers.

0007-SWP-043971

6) Evaluation of U Resin B

This resin was added to a catalyzed UF Resin solution and was found to improve gloss, rubbing qualities and water resistance provided it was used in relatively large amounts (30% on UF solids). The price of 65¢ per pound however makes it economically unfeasible to use at the present time.

7) Determination of Minimum Amount of Catalysts (24 G 6) Necessary to Obtain A Satisfactory Degree of Hardness

We had previously determined that a direct correlation exists between speed of cure and hardness on the one hand and stability on the other. Increased amounts of catalysts will increase the speed of cure while decreasing the stability. It is also known that every UF Resin reacts differently to a given catalyst. Therefore an attempt was made to determine the minimum percentage of catalyst (24 G 6) required to obtain a satisfactory cure. An experimental formulation, consisting of (39 G 74) DCO Alkyd, (48 G 9) Beckamine P354, (40 G 53) Polyester and (323) Xylol, was catalyzed with (24 G 6) Cyanamid Catalyst 296-9 in the following proportions: 3-5-8 and 10%, expressed on UF solids. Pour outs on glass were baked at 140°F. for 1 hour and after a cooling period of 1 hour tested for hardness.

3% produced a soft and tacky film; 5% caused a fair degree of hardness (3 units on the Lacquer Scratch Tester); 8% measured 6 units and 10% 9 units. (9 units are equivalent to approximately 75% on the Sward Hardness Rocker). These results confirm our previous experimental work that 10-12% catalyst is required to obtain a satisfactory degree of hardness.

Conclusions

1. The urea resin giving best results was Beckamine P354 (48 G 9). This resin was found to give the fastest cure and relatively good pot life.

2. Oxidizing alkyds must be kept at a minimum in order that maximum cure takes place during the short baking cycle.

3. Alkyds with oil lengths of 40% or more must be kept at a minimum, otherwise incompatibility might result. A small amount however has been found very helpful in increasing the gloss and rubbing qualities.

4. Of the various resins tried, (48 G 53) Polyester was found to produce the highest gloss. However this material has a tendency to embrittle on ageing.

5. At least 25% of the solvent portion must be alcohols and the formula should not contain any ketones or aliphatic hydrocarbons.

6. The amount of catalyst should be 10-12% on UF resin solids.

Summary

The result of this investigation is V 84 VG 15, Water White Low Bake Furniture Finish. The formula is as follows:

0007-SWP-043972

| Lbs. | Name | Code |
|---|---|---|
| 374 1/2 | Beckamine P354 | (48 G 9) |
| 56 3/4 | Dibutyl Phthalate | (1304) |
| 73 3/4 | Pelargonic Alkyd | (40 G 51) |
| 23 3/4 | Glyptal G2480 | (39 G 9) |
| 75 | Polyester | (40 G 53) |
| 125 | Lauric Alkyd | (40 G 52) |
| 196 | Xylol | (323) |
| 50 | Butyl Alcohol | (4 G 21) |
| 22 1/2 | n-Butyl Acid Phosphate | (24 G 6) |
| 1000 | | |

This varnish possesses the following properties; It has a high gloss, can be rubbed and polished to any desired sheen, is mar resistant (unpolished), does not soften under Acetone or most other Lacquer solvents, withstands household acids and alkali, resists 40 cold check cycles at 4 mils, is WW, and has excellent colour retention. V 84 VG 15 is available both pre and post catalyzed, in gloss and rubbed effect. The precatalyzed finish cures to a hard film in 1 hour at 140°F., or overnight at 90-100°F.; it also can be rubbed and polished after overnight air dry. The post catalyzed version takes the 2 psi print test after 2 hours air drying and yet has a pot life of 48 hours. The stability of V 84 VG 15 is 3 months or better.

Despite all these outstanding characteristics, however, more work has to be done to improve it still further. For example we would like to increase the viscosity from the present 22 seconds on the Ford #4 Cup to approximately 35 seconds so as to obtain better build, and also to increase the stability to 1 year.

Oct. 3, 1956

0007-SWP-043973