cc - G. R. Seidel, Exp. Sta., Wilm.
H. C. Brill, Newport, Del.
J. B. Bullitt, Wilm. D-7016
J. D. McBurney, " D-7012
J. D. Rode, " D-8033
R. E. Thomas, Newburgh
J. D. Pickens, Flint
O. H. Bullitt, Jr., Exp. Sta., Wilm.
J. W. Iliff, Lab.
Russell Morgan, Lab.
R. B. Davis, Lab.
C. R. E. Merkle, Lab.
Paul Robinson, Lab.
P. B. Evans, Lab.
K. C. Lampert, Lab.
S. L. Godshalk, Lab.
R. L. Selby, Lab.
S. Hochberg, Lab.
J. H. Lowell, Lab.
D. L. Herndon, Lab.
L. P. Hubbuch, Lab.

File: 1810

Marshall Laboratory
March 5, 1953

MEMORANDUM REPORT NO. M-555

Prepared by: J. P. Sermattei

PIGMENTS DEPARTMENT'S TETRAISOPROPYL TITANATE (TPT)

INTRODUCTION

Messrs. G. R. Seidel, J. H. Haslam, and H. C. Brill of Pigments Department visited Marshall Laboratory on March 2 to bring us up to date on the use of tetraisopropyl titanate (TPT) for improving the adhesion of paints to metals, wood, glass and old painted surfaces. Present at the meeting with the visitors were:

P. B. Evans
S. L. Godshalk
K. C. Lampert
O. H. Bullitt, Jr.
R. L. Selby
S. Hochberg
G. L. Evans
R. J. Sheppard
R. W. LaBerge
S. Graves
Miss A. Willard
H. G. Stauffer
J. P. Sermattei

SUMMARY

Dr. H. C. Brill presented the new information on TPT that has been developed since Pigments' previous visit last October 2. Dr. Brill stated that their original recommendations for using TPT as a 2% solution in anhydrous isopropanol had not proven satisfactory for practical use. Two percent TPT in isopropanol hydrolyzes too rapidly at relative humidities above 40%, and this results in powdery, non-adherent films that are of no value for improving the adhesion of the coatings applied over them.

A controlled hydrolysis, despite varying humidity and temperature conditions, is the key to the successful use of TPT as an adhesion promoting interlayer. Dr. Brill has now established that TPT is effective in improving adhesion only when:

(1) the solvent is evaporated and the TPT film is formed before any hydrolysis occurs, and

(2) subsequent hydrolysis of the formed TPT film occurs before the topcoat is applied.

The problem has been to devise a TPT composition that complies with these conditions over a practical range of temperatures and relative humidities. The best composition developed thus far is a solution of 1.8% TPT and 0.2% naphthalene in hexane. The naphthalene acts as a hydrolysis suppressor at high humidities while still permitting hydrolysis to occur at low humidities after evaporation of the hexane. The hexane is a very fast evaporating solvent that leaves the film quickly before hydrolysis starts. This composition is effective from 20% R. H. at room temperature to 92% R. H. at 85°F. However, at 20% R. H., 16 hours at ordinary temperatures are required for hydrolysis to occur to a sufficient extent to produce good adhesion.

The procedure for using the TPT/naphthalene solution is simply to brush or wipe on a thin film of the 2% solution in hexane; allow to air dry 16 hours, and then apply the topcoat paint. Where baking is permissible, as in some industrial applications, a bake of thirty minutes at 250°F. can be substituted with advantage for the overnight dry. When a latex paint is applied over the TPT, one to two hours air drying of the TPT is sufficient even under low relative humidities.

ACTION

1. K. C. Lampert will run preliminary tests on TPT/naphthalene for improving adhesion of trade sales paints to glossy, contaminated paint surfaces.

2. Stuart Graves will test for improving adhesion to wood of new emulsion paints.

3. R. J. Sheppard will re-examine for improving adhesion of OA to undercoats.

4. R. W. LaBerge will spot check for improving adhesion of outside house paints to wood.

5. P. B. Evans will seek clearance for disclosing our OA adhesion problem to Pigments, so as to obtain maximum assistance on the use of TPT.

DISCUSSION

Other materials than naphthalene can be used to protect the TPT from premature hydrolysis, but many of these fail because they stop hydrolysis too completely and thus fail to develop good adhesion. Some hydrolysis of the TPT after the film is formed is essential. A slight clouding of the TPT film may some times occur on hydrolysis under high humidity conditions and this is not harmful as long as the resulting film is adherent. Besides providing the proper degree of control on the hydrolysis of TPT, naphthalene dissolves in TPT and solutions of 10% naphthalene and 90% TPT are stable.

However, with a film former such as OA, it may be advantageous to substitute the OA for the naphthalene and use toluene as the solvent for a 2% TPT/OA solution. In this case, baking the TPT/OA film thirty minutes at 250°F. may overcome the erratic results previously obtained under air drying conditions. In this connection, the Pigments' representatives felt they could be of greater service to us on the OA adhesion problem if we told them what OA was.

Most of Dr. Brill's work has been done over metal and glass and relatively little over wood and old paint. However, he recommended TPT/naphthalene for use over old paint to improve the adhesion of both latex and oil-type paints. We were cautioned to avoid spillage of the TPT solution on white trim areas as this would cause yellowing. Dr. Brill did not know whether TPT would be effective over grease contaminated surfaces. To be of interest to Trade Sales, TPT should be effective over old paint without sanding or washing; otherwise, there would be no real incentive for using it.

Dr. Brill stated that Elchem had successfully used TPT to bond a ceramic coating to aluminum. The TPT bonded ceramic coating withstood a bend around a 1/8" mandrel without cracking.

MARSHALL LABORATORY

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