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Studies in Shellac Etch Primer: Part III — Replacement of Zinc Chromate by Barium Potassium Chromate

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Zinc chromate, an imported chemical, is a common ingredient of the conventional shellac etch primers. The possibility of replacing it by indigenously available chemicals has been investigated. Barium potassium chromate has been found to be a satisfactory substitute for zinc chromate in the preparation of shellac single pack etch primers. The optimum proportions of different constituents for preparing a satisfactory primer are: Dewaxed shellac, 100; methylated spirit, 100; *n*-butanol, 82; phosphoric acid, 30; barium potassium chromate, 50; and talc 5 parts. The primer obtained using barium chromate has poor shelf life.

SHELLAC is a satisfactory binder for the formulation of single pack etch primers and a number of compositions have been developed both at this Institute and elsewhere[1-5]. An etch primer based on dewaxed shellac, zinc chrome, phosphoric acid and solvents, produced on a commercial scale, is already on the market.

The steps to overcome the gelling of shellac varnishes which occurs when they are ground with certain grades of zinc chrome were described in an earlier communication[6]. In a subsequent communication[7], an etch primer based on the use of the more anti-corrosive zinc tetroxychromate and avoiding the use of phosphoric acid was described. Zinc being an imported item, it was considered desirable to investigate other chromate pigments produced from indigenous raw materials, such as barium potassium chromate and barium chromate for possible use in such compositions in place or at least in partial substitution of the zinc pigments. The present paper describes the results of studies in this direction.

Preparation of etch primers

As a result of the earlier studies, the most suitable composition standardized for the conventional etch primer was: Dewaxed shellac, 100; spirit, 100; *n*-butyl alcohol, 82; zinc chrome, 95; talc, 5; and phosphoric acid (85%), 30 parts. In the present study, etch primers of this standard composition were prepared replacing zinc chromate, weight for weight by barium potassium chromate. It was found that the films (on aluminium) were extremely slow drying and needed about a week to attain maximum hardness. Even then, elasticity was poor and the films cracked readily on bending the panel over a conical mandrel of minimum diameter 0·32 cm.

Attempts were then made to see if the pigment concentration could be altered to achieve more rapid hardening of the film. When the proportion of the pigment was reduced by half, i.e. when it was 50% on the wt of lac, the film acquired maximum hardness and that too within 24 hr, as happens in the case of the standardized zinc chrome primer (Table 1). This film also possessed adequate elasticity and showed no cracks on bending over the same mandrel. In the case of barium chromate, however, the optimum proportion was 100 parts of the pigment per 100 parts of lac. The optimum composition for the new primer would thus be as follows: Dewaxed shellac, 100; methylated spirit,

Table 1 — Properties of air-dried films (on aluminium) of shellac etch primer

Pigment No.	Barium potassium chromate				Barium chromate			
	Pigment parts/ 100 parts dewaxed shellac	Scratch hardness kg	Elasticity	Falling block impact test	Pigment parts/ 100 parts dewaxed shellac	Scratch hardness kg	Elasticity	Falling block impact test
1	90	0·3	Cracks	Failed	180	>2·0	No crack	Failed
2	80	0·3	do	do	160	>2·0	do	do
3	70	0·3	do	do	140	>2·0	do	do
4	60	1·9	No crack	Passed	120	>2·0	do	do
5	50	2·0	do	do	100	>2·0	do	Passed
6	40	1·5	Cracks	do	80	>2·0	do	do
7	30	1·4	do	Failed	60	>2·0	do	Failed
8	20	1·4	do	do	40	>2·0	Cracks	do
9	10	1·3	do	do	20	1·9	do	do

100; barium chromate, 100 (or barium potassium chromate, 50); talc, 5; *n*-butyl alcohol, 82; and phosphoric acid (85%), 30 parts.

These compositions were further investigated with regard to their performance on metallic surfaces, shelf life, adhesion to finishing coat, etc.

Performance of the primers

The scratch hardness of air-dried film (dry weight 0·21-0·25 g on 5×3 in panels) on aluminium, brass, galvanized iron and mild steel was of the order of 2 kg and over. The films did not show any tendency to crack on bending over the conical mandrel. Films of compositions prepared using barium potassium chromate showed similar hardness even after storage of the primer. There was no deterioration at the end of the test period (5 months). There was no caking or thickening of the primer. Adhesion to finishing coats of synthetic enamels and nitrocellulose lacquers was of the same order as of the zinc chromate based primers. However, the film properties of primer prepared using barium chromate were found to be extremely poor after storage for a month and a half, indicating poor shelf life.

The ageing characteristics of the films on various substrates (viz. mild steel, G.I. sheet, brass and aluminium) with and without finishing coats were examined. All the films withstood exposure in a humidity cabinet for 25 days and salt droplet test for 10 days, except that in the case of uncoated barium chromate primer film on mild steel, rust spot started developing after 10 and 4 days respectively. On exposure to natural weathering over the laboratory roof, bare films of the same primer on mild steel were seen to develop rust spots within 4 months. The rest of the samples remained unaffected at the end of 5 months.

It is thus seen that barium potassium chromate is suitable for use in the preparation of shellac etch primers as a substitute for zinc chromate. The proportion to be used is 50% on the weight of lac as against 95% in the case of zinc chromate. Barium chromate, however, is not suitable because of the poor shelf life of the primer.

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