Nature of Cure of Shellac-Amino Resin Blends

INTRODUCTION

The nature of cure of the reactive groups of shellac-amino resin blends is discussed in this note using data reported earlier[1–5] on dielectric strengths and some related properties of these blends.

It has been reported earlier that the breakdown strength (BDS) of shellac varnish (when tested in the form of air dried or baked films) increases with the addition of an amino resin, viz., melamine or urea formaldehyde resin. This is evidently due to improved cure behaviour of these blends. Lusk[6] has shown that the increased degree of cure of a phenoplast resin increases the BDS which reaches maximum value only if the cure is complete. The increase in BDS can be attributed to one or more of the following reasons: (i) less ions are available for conduction, (ii) presence of less number of voids in dielectric, (iii) uniformity of coating (Kozumplik[7] has reported that a relationship exists between the uniformity of enamel insulation and its BDS), and (iv) higher thermal conductivity.

In this note, results of a similar study on an amino resin cured with a para toluene sulfonic (PTS) acid is reported and compared with the shellac-amino resin blend regarding their BDS, acid value, etc.

EXPERIMENTAL

Butylated melamine formaldehyde resin (25% solid content in methylated spirit) as obtained from Hardcastle Waud and Co., Bombay, was mixed with 0.5%, 1%, 2.5%, and 5% paratoluene sulphonic acid. BDS of varnish film[1] and acid value were determined using standard methods.

RESULTS AND DISCUSSION

BDS of films of Melamine resin—PTS acid blends is as shown in Figure 1. It is seen that even at 2% acid content, crosslinking is complete resulting in BDS reaching a maximum. This BDS, viz., 2.25 kV/mil is the same as the BDS maximum obtained with shellac-amino resin blends.[1] Further addition of acid decreases the dielectric strength of the varnish.

It is also seen that while a sharp peak is observed in Figure 1 (BDS of PTS acid cured melamine

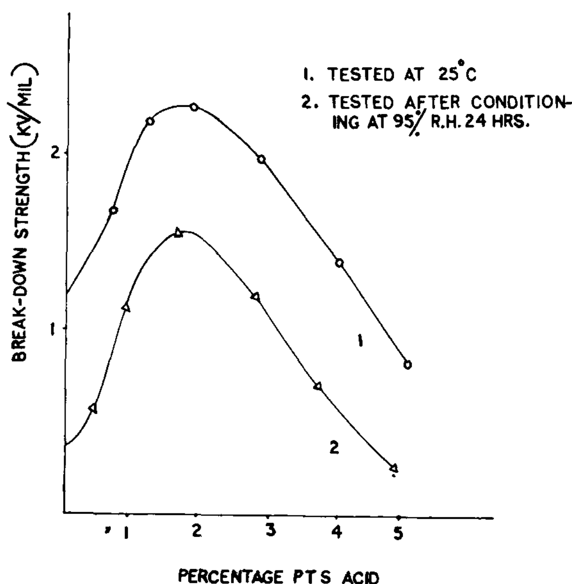

Fig. 1. Variation of BDS of PTS acid cured melamine resin.

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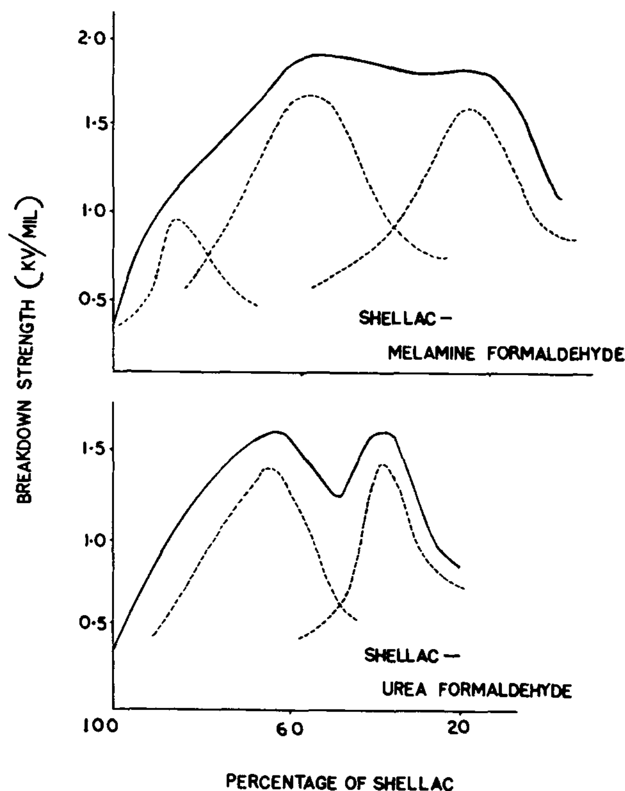

Fig. 2. Effect of curing on BDS of shellac amino resin blends.

resin), a plateau is observed in Figure 2 (BDS of shellac cured melamine resin). Thus, a single cure reaction is not the sole reason for the observed improved BDS in shellac-melamine resin blends.

The carboxyl values (acid values) show a drop (Fig. 3) only if small percentages of shellac are added. If more shellac is added, i.e., above 70% shellac content, there is no drop in acid value. Kumar[8] has, on the basis of surface coating and other chemical properties of shellac-urea formaldehyde (SUF) resin blends, indicated that on curing (baking) ester reaction predominate and then ether type reactions predominate.

Infrared spectra[8] of air dried as well as baked compositions of shellac-melamine resin blend (SMF

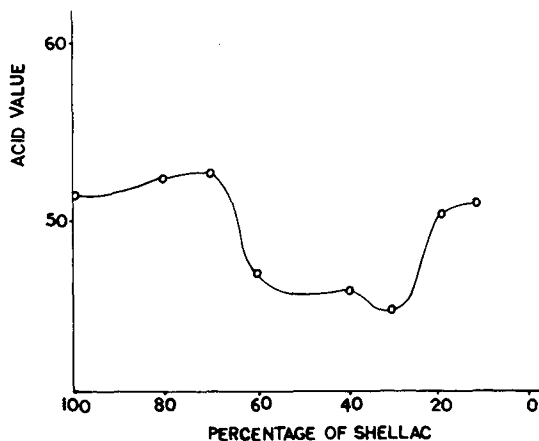

Fig. 3. Variation of acid value of shellac/melamine resin blend with percentage of shellac.

64) indicate no appreciable reduction in intensity or shift in the peak at 1724 cm^{-1} assigned to carboxyl groups while the peak at 3450 cm^{-1} assigned to hydroxyls disappears with increasing cure.

In Figure 2, the plateau in the BDS-phr of shellac curve is divided into three peaks in the case of SMF blend and into two peaks in the case of SUF blend. On the basis of the above studies, it seems that the peak at low shellac level is due to ester linkages between carboxyl groups of shellac and methylol groups of SMF, while the larger peak around 70% shellac level is due to the ether linkages between the two resins. The third peak at the extreme left may be due to carboxyl group linkages with the methylol group. It is also seen that while the minima for SUF are distinct, the minima for SMF are not so mainly owing to the overlapping of ester and ether reactions in SMF blends than in SUF blends at different resin-shellac levels.

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