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NOTE

A Study on Curing between Shellac and Polyamide Resin by Dielectric Measurements

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A study was done to investigate the curing between shellac and polyamide resin, in solution stage by the measurement of dissipation factor (tan δ) at 100 kHz. It was found that the measurement of dissipation factor with time can be conveniently used for the determination of cure time of shellac polyamide resin blend.

Key Words: Shellac, Polyamide resin, Dielectric measurements.

Shellac is the only known commercial resin of animal origin with outstanding properties[1]. Studies were made on the different physico-chemical properties of solution blends of shellac with butylated melamine formaldehyde (BMF), butylated urea formaldehyde (BUF), epoxy and phenolic resins[2–12]. The dissipation factor is a measure of as such electrical inefficiency of the insulating material. The dissipation factor indicates the amount of energy dissipated by the insulating material when the voltage is applied to the circuit[13].

Chemical determination of cure time is difficult and time consuming. A number of methods based on the measurements of various physical and mechanical properties such as dynamic mechanical measurements[14,15], differential thermal analysis[16], ultrasonic wave propagation[17], infrared spectroscopy in reflected light[18], etc. were previously used for determination of cure time of different synthetic resins. Measurements of electrical properties such as dielectric constant and dissipation factors etc. are also found to be a good indicator of cure time determination for some synthetic resins as described by many researchers[8,9,19,20]. The present study was done to investigate the possibility for the measurement of the dissipation factor (tan δ) as a parameter for the determination of cure time of shellac- polyamide resin blend in solution stage.

Commercial variety of shellac with flow value not less than 50 obtained either from Tajna Shellac, Khunti or Gupta Brothers, Bundu and polyamide resin obtained from Synth. & Pol. Ind. was used in the study. A solvent mixture of *n*-butanol (AnalaR grade) and xylene (AnalaR grade) in equal weight ratio 1 : 1

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was prepared. Now both shellac and polyamide resins were dissolved (25% w/w) in the prepared solvent mixture. Equal amount of prepared shellac solution was mixed with the resin solution with vigorous shaking to prepare the shellac-polyamide solution blend in the ratio of 50 : 50.

Measurements of the dissipation factor were carried out at 100 kHz. With the help of a General Radio (USA) capacitance bridge (Model 715C). The excitation of the bridge was done with a RADART (India) R.C. oscillator (Model 929) and the detector was (Type 1212-A) of General Radio. The dielectric cell of Leeds and Northrup Co. had the platinized electrodes.

The dissipation factor of the varnish sample was measured within 1 h of blending and the measurement was continued for 10 days. The variation of dissipation factor with time at 30°C of the blend is shown in Fig. 1. The dissipation factor was found to decrease rapidly up to 4 days of mixing. No marked change in the value of dissipation factor was observed after that.

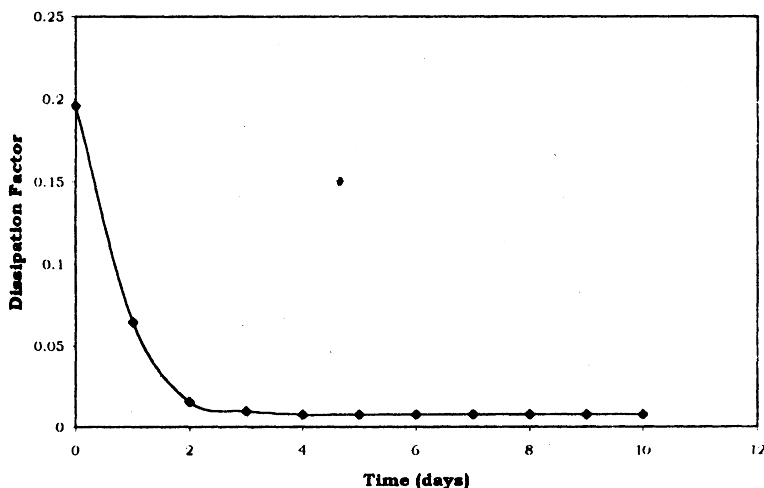

Fig. 1. Variation of D.F. (tan δ) of shellac-polyamide resin blend with time

The relaxation of hydroxyl group[4] is the main cause behind the dielectric behaviour of shellac and also its hard fraction (its main constituent). A sharp decrease in the dissipation factor suggests that there exists a decrease in the number of hydroxyl groups which arises due to curing reaction between reactive groups of shellac and polyamide resins. The chemical changes can also be monitored by precipitation of prepared varnish by a non-solvent. The precipitate obtained is not soluble in the number of solvents indicating that some chemical bonding is taking place between the reactive groups of the resins.

A previous study also shows similar decrease in dissipation factor and also in the dielectric constant for polyester resin and the behaviour is well correlated with the curing of the resin[19]. Some other workers also studied this behaviour with some other resins[8, 9] and well correlated their curing behaviour using dielectric properties.

The result of the present study shows that the cure time of shellac and

polyamide resin blend can be well investigated by the measurement of dissipation factor with time and it also suggests that the prepared blend must be kept for about 4 days before its use for the optimum performance for its electrical insulation uses.

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