Fermilab

TM-228
0321.000
March 1970

VACUUM CHARACTERISTICS OF SOME EPOXY RESINS FOR MAGNET AND COIL IMPREGNATION

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Various potential epoxy resins for magnet impregnation are investigated from the standpoint of superior outgassing characteristics under vacuum. In general, the performance of epoxy systems requiring high temperature curing cycle (anhydride curing agent) was found to be better than R.T. cured epoxy systems. Some of the epoxy formulations tested were R.T. cured Hysol (H9-2039 Resin + H2-3561 curing agent), B-stage sterling epoxy system (Y-663) for precoating laminations, H.T. cured sterling epoxy system (E-250-24 Resin + C-24 catalyst), H.T. cured NMA system (Shell-826 or CIBA-6005 Resin 100 pbw + Nadic Methyl Anhydride curing agent 90 pbw + DMP-30 accelerator approximately 1 pbw). Among all the systems mentioned above, the H.T. cured NMA system showed the lowest outgassing rate.

The effect of final curing temperature on the outgassing rate was studied by curing the NMA epoxy at three different temperatures of 200° F, 240° F, and 300° F. A significant improvement was noticed between 200° F and 240° F cured systems; thus, indicating an optimisation of outgassing rate at about 240° F cure temperature. A lower cure temperature was, however, selected for NAL Booster magnets' impregnation, as a compromise to keep the thermal stresses within control.

The tests to study the effect of different filler materials on vacuum properties indicate that they could be arranged in the following order of improving outgassing rates - NMA system with liquid filler (Carowax 20 pbw), without filler, and with solid alumina filler.

A typical outgassing rate of the NMA epoxy system with solid alumina filler cured at 300° F using ½" x ½" x 6" test sample was found to be about 1.6×10^{-7} Torr-liter/sec-cm^2. Mass spectrum of similar epoxy systems did not show any significant traces of heavy hydrocarbons. Only, the usual residual gases like water vapor, nitrogen, hydrogen, and argon were detected.