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SUBJECT : Dielectrics - Capacitors

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TO :

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The market for capacitor impregnation fluids in Europe is governed mainly by the requirements for power-factor correction capacitors, which are usually large items of equipment.

Unlike the USA, where 70 % of impregnation fluids are used in smaller ballast and motor-run capacitors, very few ballast capacitors (i. e. fluorescent lamp capacitors) use an impregnation fluid. Technology in Europe has, for many years, favoured metallized plastic (polypropylene) film capacitors for lighting circuits and the phasing out of PCBs in this sector was virtually complete before Monsanto withdrew from the business. For motor-run capacitors, technical opinion was divided between the merits of dry metallized-film capacitors and impregnated paper systems. A number of capacitor manufacturers had already moved towards the use of dry-film before Monsanto withdrew PCBs. In addition, motor-run capacitors form a relatively small proportion of the business in Europe (< 10 %). There may be a specialised business for impregantion fluids for such capacitors, but it is small.

For power-factor correction capacitors the European market was around 8000 tonnes (1976) for PCB fluids. Correcting for density suggests a potential market of around 5800 tonnes for a suitable fluid.

Power factor correction capacitors are normally constructed with a dielectric consisting of polypropylene film plus a layer of paper which is then impregnated to eliminate voids. Although the capacitance of such a capacitor is not as dependent on the dielectric constant (D. K.) as one using only paper, it is still of some advantage to use an impregnant with a relatively high D. K. since this improves the breakdown potential of the capacitor.
High D. K. fluids, however, are more difficult to clean-up to dielectric standards, since ionisation of ionisable impurities is enhanced. In addition, the hydrolytic stability of ester fluids is not ideal and since residual water in the paper layer is difficult to remove completely this can cause problems. Power-factor correction capacitors are expected to have a very long life (> 25 years), whereas motor-run capacitors need only be guaranteed for 5 years. Hence the reason why ester fluids are acceptable for motor-run capacitors, but are not fully approved for P. F. correction.

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Compared with PCB fluids, both esters and hydrocarbon fluids are more difficult to utilise in capacitors. For earlier impregnated paper designs, Aroclor 1242 could be upgraded to dielectric standards fairly readily and was used without additives in the impregnation system. For later mixed dielectric (paper/polypropylene film) designs, where the electrical stress was increased, it became common practice to add an epoxide as an acid scavenger to improve capacitor life.

When esters or hydrocarbons are used, either in paper or mixed dielectric designs, it is necessary to add epoxide and an antioxidant. It is also necessary to upgrade the resulting fluid (+ additives) to dielectric standards. This last step is very difficult with esters, particularly those having a relatively high D. K.

The ideal fluid would be one having a D. K. of about six at room temperature (Santicizer 160 = 6.4 Santicizer 261 = 5.7), but should also possess good chemical and thermal stability to avoid degradation under use conditions. In power-factor correction capacitors the high D. K. is not as important as having good stability - hence the interest in benzylated aromatics of the Santosol 100 type. In Japan, diarylmethane has been used since 1974.

The European market for an impregnation fluid for motor-run capacitors is probably less than 500 tonnes, but this figure needs confirmation. Several manufacturers, however, may still be developing power-factor correction capacitors using ester, especially if they have technical agreements with General Electric.

If benzylated aromatics (Santosol 100/150) can be used in power-factor correction capacitors, it is likely that Malotherm S/Lipanol T may also be exploited. The ability of the fluid to be upgraded to dielectric quality may then be a critical issue.

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