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EFFECTIVENESS OF A SILICONE RUBBER PROTECTIVE COATING ON H. V. INSULATOR MODELS

1. Introduction

A new technology for increasing the surface break-down resistance of polymers used in polimeric outdoor h.v. insulators involves covering the materials of a poor surface properties with other materials exhibiting better such properties. A tendency to use such technologies becomes more and more common [1,5]. A basic problem in layered insulating constructions is the effectiveness and optimisation of the external layer thickness. To evaluate the surface break-down resistance of various materials, mass losses (ΔM) were measured. The results obtained allow to suppose that the magnitude of mass losses may be a useful source of information on the surface break-down resistance of insulating polymers subject to surface partial discharge (spd) in the salt fog atmosphere.

2. Method and subject of study

Mass losses ΔM were measured in typical insulating materials used for high voltage outdoor insulators. The composition of materials is given in Table 1.

Table 1

Composition of materials tested

Symbol	Material composition
K1	Epidian-2 epoxy resin (Polish made); 100:200 SiO_2 (p/w)
K2	Araldit CY 185 cycloaliphatic epoxy resin (CIBA-GEIGY); 100:320 SiO_2 (p/w)
K3	Silicone rubber RTV 590 A
K4	K1 with a 0,25 mm K3 layer
K5	K1 with a 0,50 mm K3 layer

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20 x 50 mm samples of materials tested were placed in a salt fog chamber (30 g NaCl/1 concentration; 4 mm/h fog settling). The samples were subsequently subject to long-term surface partial discharges at a mean stress voltage E. Mass losses ΔM were measured periodically during the study.

3. Results

As a result of long-lasting surface partial discharges (spd's), mass losses ΔM occurred, their magnitude depending on time and kind of materials. Two phase of the relationship may be discerned in model $\Delta M(t)$ relationships at E = 0,9 kV/cm (Fig.1); phase I (initial): presumedly foreign layers remaining from the manufacture process are of some importance here (e.g. silicone lubricant); phase II: proper destruction of the material tested.

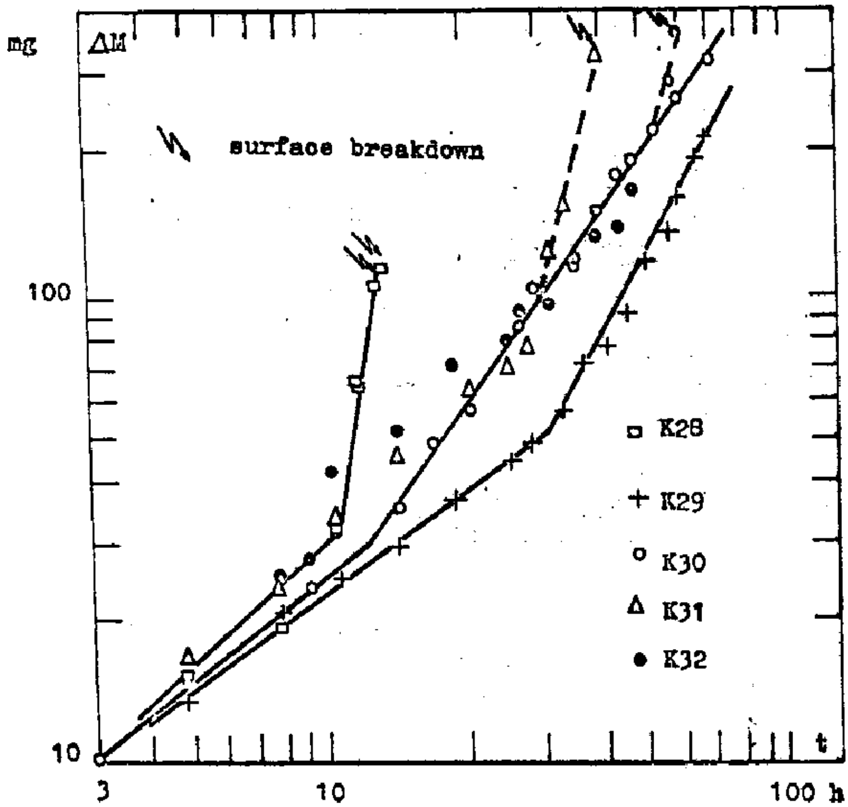

Fig 1. M(t), E = 0,9 kV/cm d.c.

At both phases, the $\Delta M(t)$ relationship may be described as

$$\Delta M = A \cdot t^n \quad (1)$$

where A and n - material constants,

ΔM - mass loss,

t - duration of spd.

The relationship (1) is similar to typical "life curves" of insulating materials; the constant A should involve mean surface stress voltages E and surface conditions for partial discharges (e.g. surface conduction χ). When the above assumptions are included, ΔM will be

$$\Delta M = B \cdot f_1(E) \cdot f_2(\chi)\ t^n \quad (2)$$

It is a very tedious task to determine $f_1(E)$ and $f_2(\chi)$ for various materials; nevertheless, changes in $\Delta M(t)$ may be a criterion with which to evaluate and select materials for outdoor insulating constructions [3,4].

The relationships shown in Fig.1 prove that when a low spd resistance material (K1) is covered by a high resistance one (K3), the time necessary to form a conductor track is considerably eloganted. The elogation increase with the protective coating thickness. One can, however, suppose that at stress voltages lower and close to the working values the protective coating effectiveness will increase even more. The effectiveness is also affected by the manner in which the protective coating is applied. Observations made during the study shown that even a slight damage to the outer layer results in a further destruction proceeding basically in the inner layer, the one of poorer properities. It is thus necessary to provide a proper contact between the protective coating and its base. A chemical binding would be the best solution. It is very difficult to obtain such a bindings between silicon rubber and Epidian-2 epoxy resin. On the other hand, such a possibility seems to exist when the CY 185 resin is used as a protective coating, its resistance to spd's Fig 1: K2 being similar to that of silicon rubber Fig 1 : K3. When studying mass losses during spd's d.c. may be used instead of a.c. The d.c. surface partial discharges are more destructive to materials. Mass losses occur at the cathode (they occur in the sample centre when a.c. is applied). Similar effects were observed by [2] . Examples of $\Delta M(t)$ in K3 samples exposed to d.c. spd's are given in Fig.2.

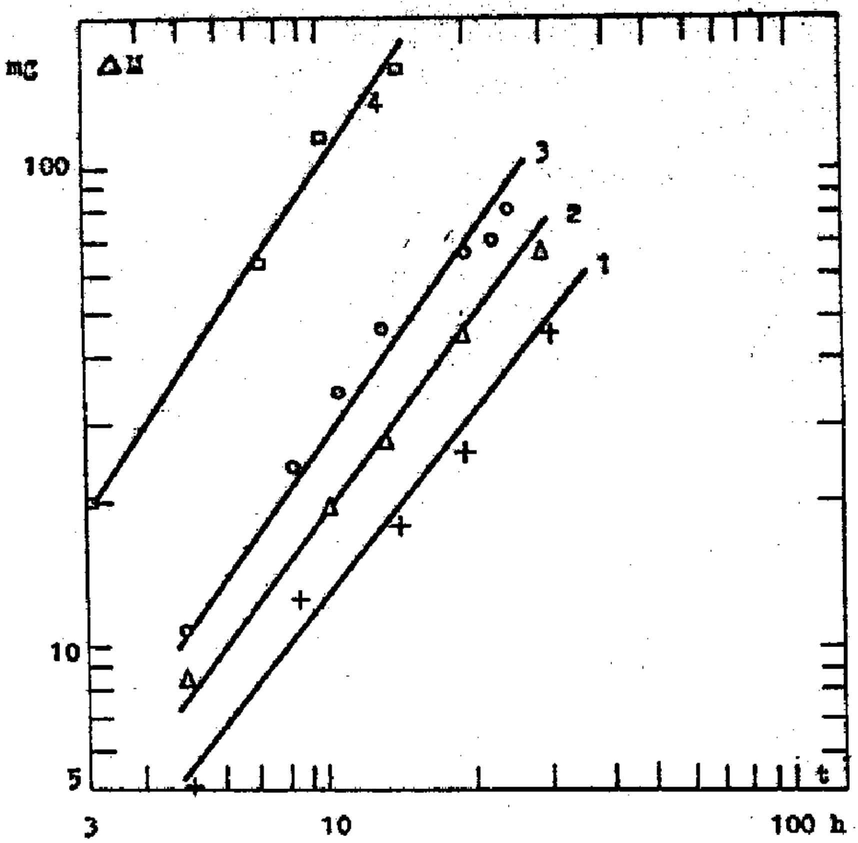

Fig.2. ΔM/t/, E = 0,9 kV/cm a.c. -1, 0,5 kV/cm d.c. -2, 0,9 kV/cm d.c. -3, 2,0 kV/cm d.c. -4.

4. Conclusions

As shown by the results obtained, the magnitude of mass losses ΔM resulting from spd's in insulating materials can be a useful criterion in evaluating the latter.

It is possible to increase the outdoor insulation surface break-down resistance through application of external protective coatings of high resistance materials. The way the coating holds to its base is then important; chemical binding would be the best solution.

D.c. surface partial discharges are more destructive to polymeric insulators than the a.c. ones.

R e f e r e n c e s

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