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APPLICATION OF THE THERMAL ANALYSIS FOR DETECTION OF THE RESINOID BOND INFLUENCE ON QUALITY OF THE COMPOSITIONS

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Abstract

The hardening process of bond compositions is very important technological operation from the point of view of quality and reliability of high-voltage insulation systems. The thermal analysis TMA, DTMA and DTA were used and compared for detection of the bond compositions.

Keywords: bond compositions, thermooxidation

Introduction

As the hardening process belongs to the most important technological processes from the view of the quality and reliability of bond compositions. The cure process is influenced by several factors e.g. by the temperature, by the time of the prehardening process, by the magnitude and viscosity of the bond in the composition, etc.

The hardening of the bonds of composites can be taken as a complicated technological process where at the increased temperature the chemical reaction (network reaction) and the change of its structure occurs. The properties of the composition are determined during the network reaction. The temperature and the time of hardening are given by the used bond. At the described compositions containing epoxy bond the hardening passes at the temperature from 160 to 170°C for 6–8 h.

Experimental

The two samples of compositions having the different resinoid bond were exposured termooxidation process with temperature 200°C and were compared by thermal analysis TMA, DTMA and DTA.

By carrying out these analyses the epoxy compositions were proved to be difficulty characterizable by TMA because during measurements different coef-

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ficients of the length temperature expansiveness of individual parts of the composition showed to be unfavorable. Also preparation of samples due to stratification of the temperature stressing of the composition is very complicated. On the contrary the advantage of TMA consisted in the direct detection of the physical constant of the composition – the glassy transition temperature T_g (Fig. 1).

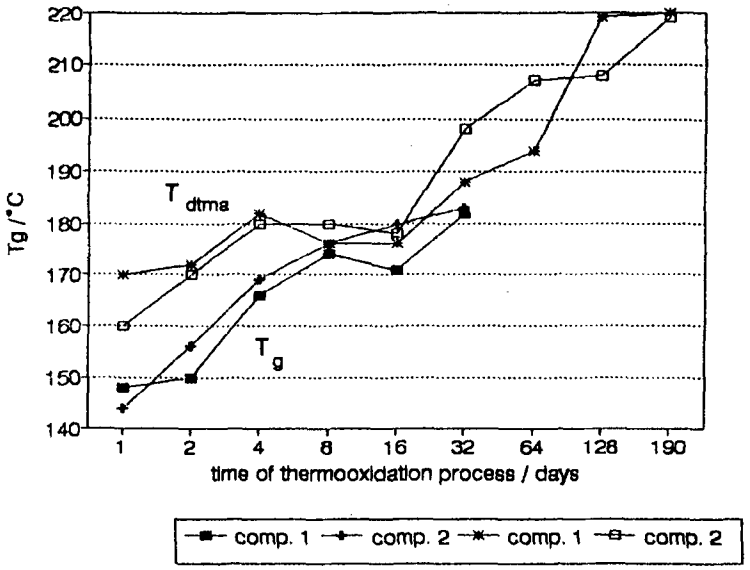

Fig. 1 The glassy transition temperature T_g (TMA) and the temperature of the penetration maximum T_{DTMA} (DTMA)

By measuring of the temperature T_{DTMA} (temperature of penetration maximum) is not possible to eliminate, that some rigid particle is in contact place of detecting element and the one of large rigid particle influences whole measuring. In spite of the fact that some compositions contain the large rigid particles which are comparisonable with size of the DTMA detecting element, the analysis DTMA prove that the changes T_{DTMA} correspond (Fig. 1) to changes of the glassy transition temperature T_g (TMA).

The DTA was proved better than TMA and DTMA for the evaluation of the level of resinoid bond degradation. By pulverizing of composition (max. 160 mesh), the taking to pieces of the rigid particles was eliminated and especially the influence of the individual layers of composition.

The samples for DTA with diameter $d=5$ mm, weight 23 g were sequentially taken from the individual measured insulants. DTA was done in the temperature range 25 to 250°C at the heating rate 5 deg·min^{-1}. Al_2O_3 was used as inert standard for all DTA (annealed by temperature 500°C). For increasing the

thermooxidation process DTA was made in dynamic oxygen atmosphere – rate of flow 20 $ml \cdot min^{-1}$.

Results

The result of DTA in the temperature range 20 to 400°C are two exoeffects. The first peak area is the most important for evaluation of composition containing the resinoid bond, because the first peak area corresponds to the structural changes in composition, the state of curing and the degradate level of composition. By analysing the epoxy composition, the first peak area depends on curing temperature and time of the resinoid bond. By increasing curing temperature and time, the first peak area decreases as well as the temperature of the reaction starting point (Fig. 2).

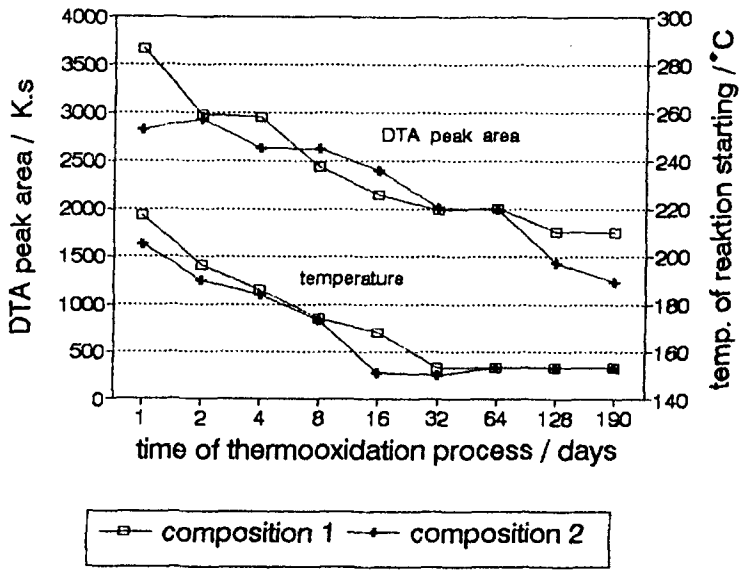

Fig. 2 The enthalpy of the epoxy compositions by DTA during the thermooxidation process

Zusammenfassung — Hinsichtlich der Güte und Zuverlässigkeit von Hochspannungsisolatorsystemen ist das Aushärten von Bindemittelkombinationen ein sehr wichtiger verfahrenstechnischer Vorgang. TMA, DTMA und DTA wurden zur Detektion von Bindemittelkombinationen benutzt und miteinander verglichen.