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Field Ageing of Composite Traction Insulators

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This paper presents composite insulator's field ageing stations set up in coastal climate. Insulators mounted there are exposed to natural ageing factors, such as UV radiation, salt fogs and mists. They are also powered with voltage giving high electrical stress on surface of insulators. Periodically leakage currents are measured. Type of insulator chosen for this research allows to achieve intensive and uniform ageing of the housing material. This material is based on the new type of hardener for epoxy resins, produced in chemical degradation of PET.

Keywords: composite insulator, ageing, epoxy resin, traction insulator, electrical stress.

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Introduction

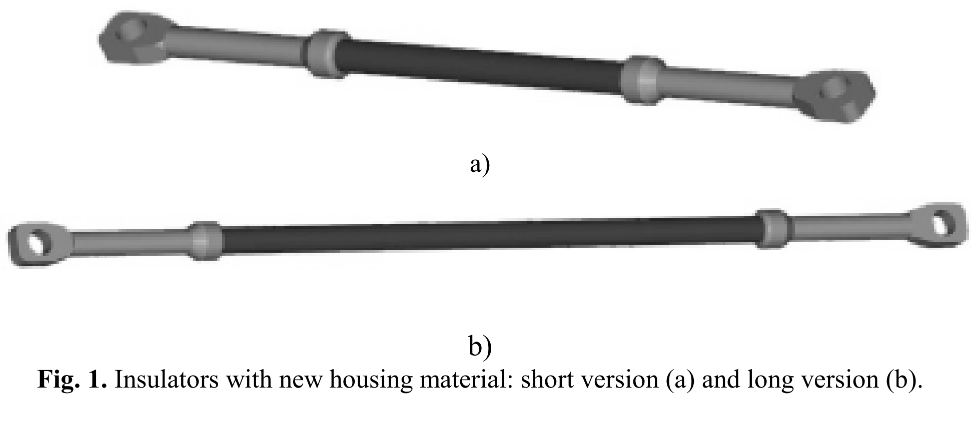
In recent years, at Technical University of Szczecin, new type of hardener for epoxy resins was obtained. This hardener is produced from product of chemical degradation of poly(ethylene terephthalate) – PET. At the beginning, research was started with material samples tests of series of composites, based on new hardener and a few types of fillers, at different ratios. The best composition was used as housing material of traction tension insulators. These were prepared in two length versions and used for ageing tests. Part of them is aged in laboratory in salt fog chamber with high voltage applied and some are exposed to coastal natural climate in two field ageing stations in Poland. In both cases leakage currents are measured during ageing. Analyze of number of current peaks allows to control the ageing process and compare laboratory and field ageing. In this paper ageing on field stations and first results will be presented.

I. Insulator

New material was used for construction of traction tension insulator, which was prepared in two length versions of insulating part: 50 cm – according to Polish standards and 24 cm – shortened version, allowing ageing material under higher electrical stress level at the same voltage as 50 cm version. Both versions are presented at pictures below.

II. Field ageing stations

Both types of insulators were mounted at two field



a)

b)

Fig. 1. Insulators with new housing material: short version (a) and long version (b).

ageing stations. First is placed in Świnoujście-Karsibórz, approx. 3000 meters from sea shore, where terrain is rather damp (river, swamp). Second one is placed approx. 300 meters from sea shore in Dźwirzyno, near dusty road. Both of them are under direct influence of coastal climate, characterized in large amount of rains and strong winds transporting evaporated sea water. Salt particles and other dust is covering insulators with thin conductive layer, leading to deterioration of housing material of the insulators. Insulators are mounted at 15 kV AC power lines, with one side powered and the other one connected to ground potential which gives voltage of 8.67 kV, 24 hours per day. Electrical stress values are 0.17 kV/cm for long version of insulator and 0.37 kV/cm for short one. It is important to emphasize that this voltage is only an ageing factor and is higher than the nominal voltage value for long insulator, which is 3 kV DC, therefore these conditions cannot be considered as normal service parameters.

Table below presents values of conductivity from water reservoirs in Western Pomerania which have influence on these two field ageing stations.

For one set of insulators, mounted at Świnoujście-Karsibórz station, after six months of natural ageing, leakage currents were recorded (in natural ageing conditions at field ageing stations). Measured values of leakage currents at 8.67 kV are: for short insulators (24 cm) – about 40 μA and for long ones (50 cm) about

Table

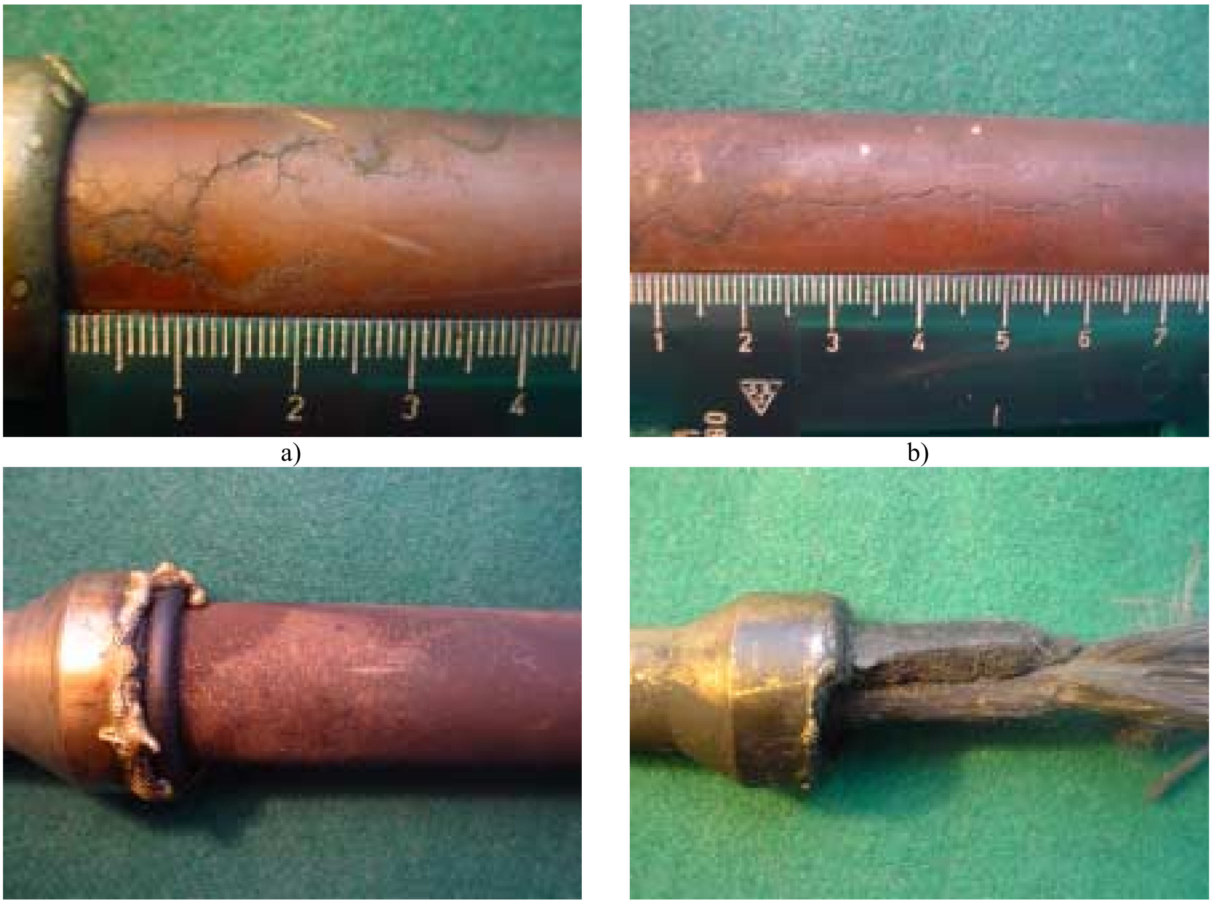
Water conductivity in Western Pomerania in Poland

#	Location	Water reservoir	Conductivity (mS/cm)
1	Pobierowo	Baltic Sea	7.7
2	Dźwirzyno	Baltic Sea	8.9
3	Trzebież	Zalew Szczeciński Lake	0.5
4	Nowe Warpno	Zalew Szczeciński Lake	1.4
5	Ustowo	Odra River	0.4

Pictures below present ageing stations and insulators mounted to lines.

Fig. 2. Insulators mounted in Dźwirzyno at two sites (lower side powered).

Fig. 3. Insulators mounted in Kołobrzeg-Karsibórz (upper side powered) and connecting measuring equipment.



a) b) c) d)

Fig. 4. Insulators heavily damaged during natural ageing. (a), (b) – eroded tracks on the surface, (c) – damaged fitting and the whole surface, (d) – insulator completely burned out.

20 µA. To compare data measured at field ageing station to insulators aged at laboratory, the same conditions were set at laboratory: 8.7 kV without salt fog. Leakage currents measured at long insulators (50 cm) which had been aged for 80 hours in laboratory (in salt fog chamber under 20 kV voltage) were approximately at level of 40 µA which is twice as high as for insulators aged in natural conditions.

III. Insulator failure

At the beginning of the December 2004, after approx. 5 months of exposition, some insulators from Dźwirzyno were heavily damaged and demounted. It was caused by first snow, which was very dense and wet and covered the whole surface of insulator dissolving dust and salt particles gathered on it during preceding moths. Constant currents of high values appeared leading to destruction of insulators.

This failure wasn't planned and some results of natural ageing for longer time are lost, but from the other hand, very good example of intensive natural ageing was achieved in short period of time. Pictures below present surface and interior of damaged insulators. For one of them only surface of housing material was damaged, but for other one housing material was completely burned out.

Summary

Example of insulators presented above showed that natural ageing could be unpredictable and very intensive, too. These insulators cannot be compared to laboratory ageing. But rest of them with measurements taken every few months is controlled and compared to laboratory ageing constantly. This allows to estimate intensity of laboratory ageing (salt fog method) and in future to predict lifetime of insulator.

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Ш. Банашак

Експлуатаційні випробування тягових композитних ізоляторів

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У статті описані місцеві дослідницькі станції для випробування композитних ізоляторів, що знаходяться в приморському районі. Ці композитні ізолятори схильні до дії природних чинників старіння, таких як ультрафіолетове випромінювання, солоні тумани і мряка, а також дії високої напруги. Періодично проводяться вимірювання струму витоку з поверхні ізолятора. Тип ізолятора, підібраний для такого роду дослідження, дозволяє досягнути інтенсивного і рівномірного процесу старіння поверхні його ізоляційної оболонки, яка виконана з нового матеріалу. Цим матеріалом є епоксидна смола з затверджувачем, який одержують з хімічного рециклінгу PET.