Investigation of the PD behaviour of boundary surfaces with alternative PD-detection methods for AC and DC application

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ABSTRACT

This paper describes a test arrangement for investigating the discharge behaviour at interfaces, in particular of silicone rubber and XLPE insulating materials. First test results can be presented for different surface roughness and for greases of different quality in the interface. The corresponding tests were performed with alternating voltage and direct voltage. Since the silicone rubber is transparent, visual observation and PD detection with optical sensors is also possible.

KEYWORDS

Interface, XLPE, silicone rubber, PD detection, optical PD detection,

INTRODUCTION

Test arrangements for the investigation of materials under high electrical load are usually configurations with a needle electrode for high voltage potential and a plate for ground potential. With this new test configuration, XLPE, silicone rubber or other relevant insulation materials were tested for treeing behavior or time to breakdown.

Most of the failures in service occur in accessories. The critical area in accessories is the interface between the peeled XLPE insulation and the silicone rubber or ethylene-propylene rubber stress cone. For proper installation, the peeled XLPE insulation is covered with a thin layer of grease. To study this critical arrangement, a layout must be created for a test object in which we have the option of changing relevant parameters without completely redesigning the test arrangement.

THE TEST SAMPLE

For this study, we opted for a cubic transparent silicone rubber test body with integrated fluorescent fiber for optical PD detection. On the upper side of this cubic test specimen there is a recess for an XLPE body. The cross-section of this XLPE rod is slightly oversized, so that after the integration of the rod into the silicone rubber, the silicone exerts a pressure on the surface of the XLPE rod. The pressure of the silicone rubber is relevant for the dielectric strength of the interface. By varying the cross-section, it is possible to vary the contact pressure at the interface between silicone rubber and XLPE.

For correct installation it is also necessary to use grease on the surface of the XLPE rod. The amount of grease in the interface and its distribution can hardly be influenced. It depends on the roughness of the surface of the XLPE and the pressure of the silicone rubber on the XLPE rod.

The earth-ground-electrode is a round brass electrode with rounded edges. The high voltage electrode is an Ogoura needle which is integrated in the interface of XLPE rod and silicone rubber.

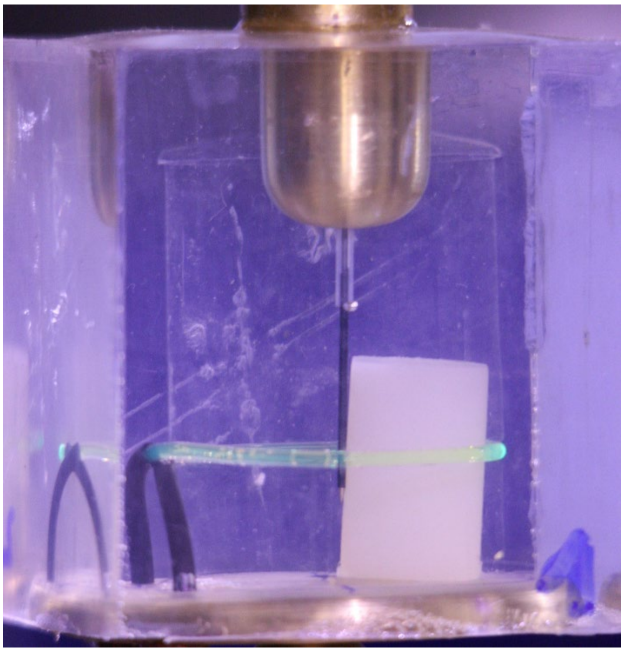

Fig. 1: Test object with integrated optical PD-sensor

PD-DETECTION SYSTEM

A multi-channel MPD600 measurement system from Omicron was used to detect PD pulses. For electrical PD detection an HFCT-sensor was installed in the earth-ground connection of the test sample. For the AC measurements an additional coupling capacitor with 2nF was used. In the DC test circuit a smoothing capacitor of 50nF was integrated into the DC-Greinacher-cascade. Therefore it was not necessary to use an additional coupling capacitor.

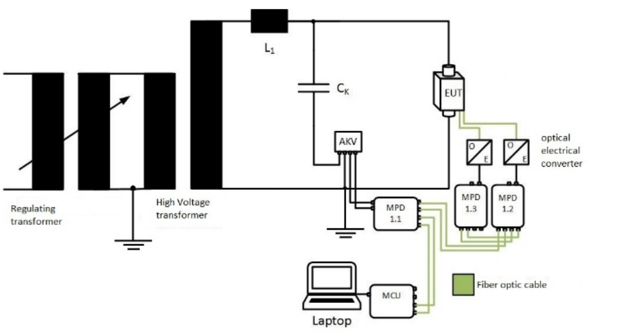

Fig. 2: AC-Testcircuit with optical PD-detection