

Development of the method of determining the moisture content of paper-oil insulation of transformers on the basis of DC resistance measurements

Abstract

The Ph.D. dissertation presents the results of research on the dependence of DC conductance of paper-oil insulation as a function of temperature, electric field intensity, moisture content and, on this basis, the method of determining the moisture content of power transformers insulation.

Cellulose in the form of paper and electrotechnical pressboard impregnated with insulating oil is a widely used insulating material in high voltage power transformers. During many years of exploitation, in the solid part of the liquid-solid insulation, the moisture content increases from 0.8% by weight to 5% by weight. It is therefore important to determine the moisture content in paper-oil insulation of power transformers using non-invasive electrical methods.

The samples of electrotechnical pressboard with moisture from 1.4% to 5.8% of weight were tested. The moisture content of the pressboard samples was determined using the KFT (Karl Fischer Titration) method. The basic research method used during the Ph.D. dissertation was the PDC (Polarization Depolarization Current) electrical method, which enabled the study of the impact of factors such as moisture content, temperature and electric field intensity on the DC conductance of the electrotechnical pressboard. Electrical parameters were measured for electric field intensity in the range of 20 kV/m to 1000 kV/m at the temperature of 20°C to 70°C with 10°C step.

The analysis of the obtained results was performed on the basis of quantum mechanical phenomenon of electron tunnelling (hopping), on the basis of which it was established that DC conductivity of moist pressboard is carried out by the electron tunneling between the nearest of potential wells produced by water molecules. The analysis shows that the moisture in the impregnated with insulating oil pressboard is in the form of nano-drops. The influence of water content and electric field intensity on the value of activation energy of conductivity impregnated with insulating oil cellulose were determined. The average energy activation value of DC conductance was determined for all tested moisture contents and electric field intensity values.

A measurable effect is obtaining a patent on a new method of determining the moisture content in solid elements of the liquid-solid insulation system of power transformers.

Keywords: *oil-paper insulation, power transformers, moisture estimation, DC measurements.*