COMPARISON OF METHODS FOR THE DISSIPATION FACTOR MEASUREMENT AT PRACTICAL EXAMPLES

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INTRODUCTION

The proper procedures are dielectrical measurement, partial discharge measurement, determination of system behavior, chemical analysis, optical and acoustic procedures and insulation material tests. The dielectrical measurement consists of the dissipation factor, capacitance, insulation resistance and the dielectrical diagnostics (measurement of current and voltage in the time and frequency domain). In this paper the methods of dissipation factor and capacitance measurement will be described and compared in practical test measurements.

Dissipation factor and capacitance are material and equipment depending values. By measurements the limits of values will be proven and tested. Trends could give hints for changes in the equipment or insulation material. For example an increasing capacitance of bushings or capacitors could be a result of the discharge between partial capacitances inside the equipment. An increasing dissipation factor could come from increasing humidity or structural changes caused by aging. Also the inception of high partial discharge could recognize by an increasing dissipation factor. The determination of the inception of the partial discharge by evaluation of the knee in the trend of the dissipation factor is relatively inexact und was only used in the beginning of high voltage diagnostic measurement.

INFLUENCES AND DIMENSIONS OF TAN DELTA

- Stray capacitance between earth and measuring object as well as earth and standard capacitor (assembling condition, type of fitting). The stray capacitances present the most important source of troubles, for this reason doubled shielded measuring cables were used.
- Surface currents (condition of surface) and leakage currents: to prevent these problems guard rings were applied if possible.
- Environmental conditions: The dissipation factor is dependant from temperature and the moisture content of the test object and the humidity of air. It is almost a exponential connection and with a correction factor the measuring result can be rectified
- Magnetic fields could influence an additional current in the circuit
- Influences of the power supply, filters and non linear elements could influence the null instrument.

SCHERING BRIDGE

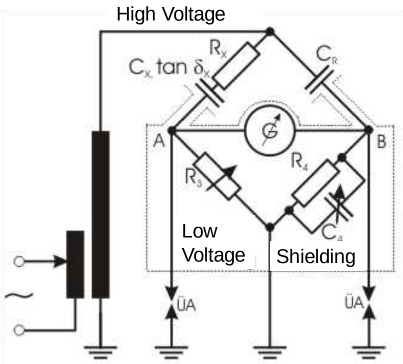

Fig. 1 Principle circuit of the Schering Bridge

DIRECT CURRENT MEASUREMENT

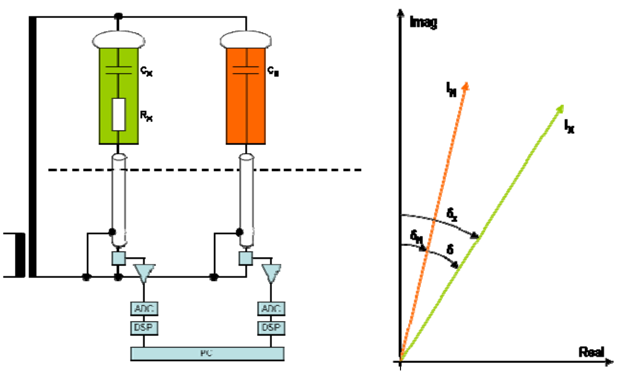

Fig. 2 Principle circuit and the vector diagram of the current components of a digital dissipation factor measurement instrument

TEST RESULTS

For the comparison measurements six machine bars, which are insulated with resin rich technology were tested. The terminal corona protection was guarded at the Schering bridges or directly grounded at the digital measuring systems.

Three different types of Schering Bridges and three different digital dissipation factor measuring systems are used. The three Schering Bridges are chosen according to their null instrument. So at this comparison measurement a needle null instrument (SB1), a null instrument which shows separated the real and the imaginary part (SB2) and a oscilloscope as null instrument (SB3) are used. The digital systems had following distinguishing features: capacitive measuring impedance (MD1), resistive measuring impedance (MD2), resistive measuring impedance (MD3).

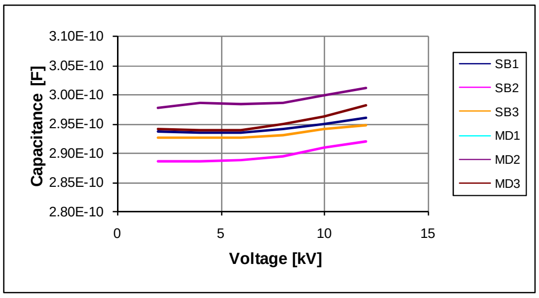

Fig. 3 Capacitance results of the first test object

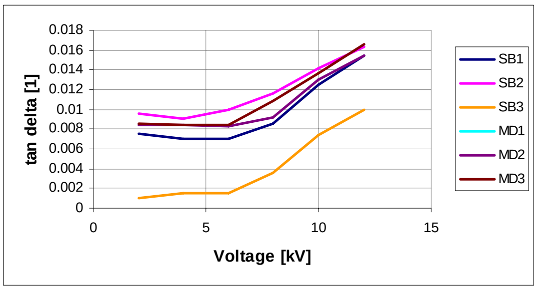

Fig. 4 Dissipation factor results of the first test object

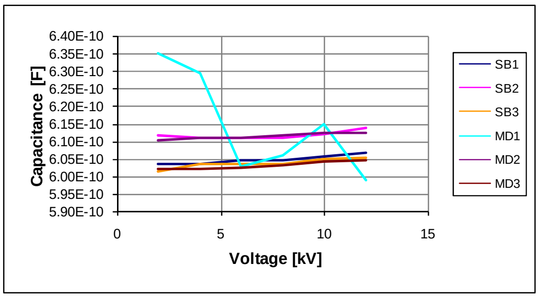

Fig. 5 Capacitance results of the second test object

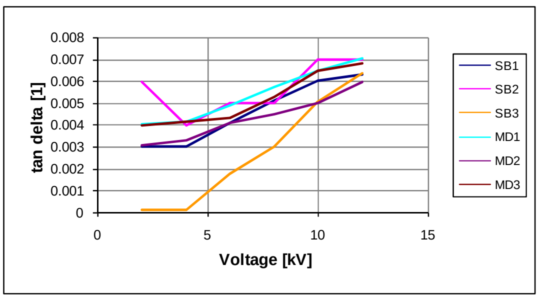

Fig. 6 Dissipation factor results of the second test object

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