N.S. Starikova
National Research Tomsk Polytechnic University
Tomsk, Russia

Increasing the quality of cable insulation control

Introduction

Insulation is an essential component of cables and wires used to prevent the electrical contact between conducting parts of cables, to ensure the transfer characteristics of cables, to shield the cable core from mechanical and other negative impacts. Thus, the qualitative control of insulation over the entire cable length is required to provide the reliable transmission path.

The two methods to control the cable insulation are stated in the current regulatory documentation: electrical discharge method [1, p. 4] and capacitance method [3, p. 1; 5, p. 1].

The electrical discharge method provides a high voltage to the cable insulation surface. The controlled cable is moved through the bead chain electrode. Breakdown occurs when the defect of insulation is moved through the control area. When using the other method, the controlled cable is moved through a metallic cylinder filled with water. The metallic cylinder has a relatively small length and is connected to a high frequency voltage source [5, p. 1]. The methods and their drawbacks were considered in the papers [6, p. 1]. The stated drawbacks can be removed by using both methods, and, thus, it allows us to increase the efficiency of control [6, p. 1].

Description of the control method

The observed method provides the test voltage application to the cable insulation surface using the bead chain electrode (fig. 1) and the concurrent continuous control of the linear capacitance.

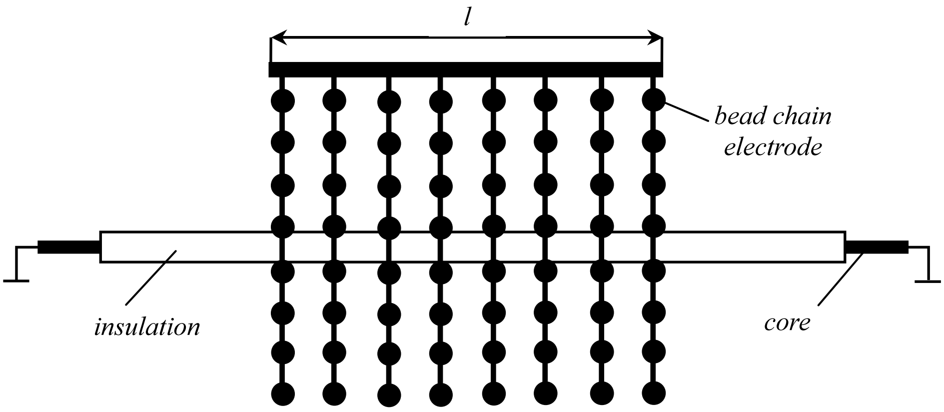

Fig. 1. The model of the bead chain electrode and a cable

The test voltage value is chosen depending on the insulation thickness and material [2, p. 4] as ET-2 testing (spark testing). Thus, the change of capacitance per length and the breakdown occurrence indicate the defect moving through the control area.

The purpose of research

The accuracy of capacitance measuring with this method depends on different factors. The aim of the research is to analyze the effect of the test voltage parameters on the accuracy of measurement. And the method to decrease the effect of the test voltage parameters is proposed.

Theoretical model of the control implementation

The method provides the application of test voltage to the controlled cable surface (fig. 2). The area under control can be presented as a cylindrical capacitor. So, their capacity can be calculated by the known formulae [4, p. 118].

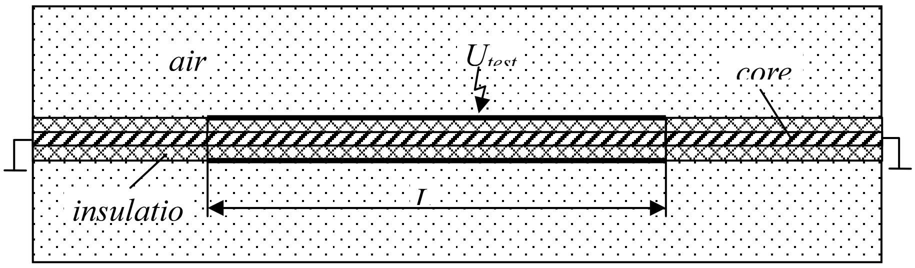

Fig. 2. Theoretical cable model with the area under control

In practice, the measured capacity of the controlled area differs from the calculated one because of the test voltage spreading on the controlled cable surface. The test voltage spreading occurs due to the partial discharges which propagate along the insulation surface. Thus, the length of control area *L* is more than the length of bead chain electrode *l* (fig. 1) with high test voltage.

The length of the test voltage spreading depends on the test voltage parameters such as value and frequency.

Test voltage parameters

The value of spark test voltage is considerably greater than the operating voltage. The test voltage value is regulated by the national standard [2, p. 4] and it is chosen depending on the insulation material and thickness. Fig. 3 illustrates the dependence of the test voltage spreading length on the test voltage value for different frequencies. According to fig. 3, the length of the test voltage spreading increases when the test voltage value grows. The comparison of dependencies for the same test voltage value proves that the spreading length is greater for higher frequency. To decrease the effect of test voltage parameters (value and frequency), it is necessary to consider these parameters in software of the device when the cable capacity per length is measured.

Conclusion

The effect of test voltage parameters on the length of test voltage spreading has been considered and the method to decrease this effect has been proposed. It allows us to obtain useful signal for providing high quality of cable insulation control. The considered method is software-based and do not complicate the device construction. The advantages of the proposed method are obvious.

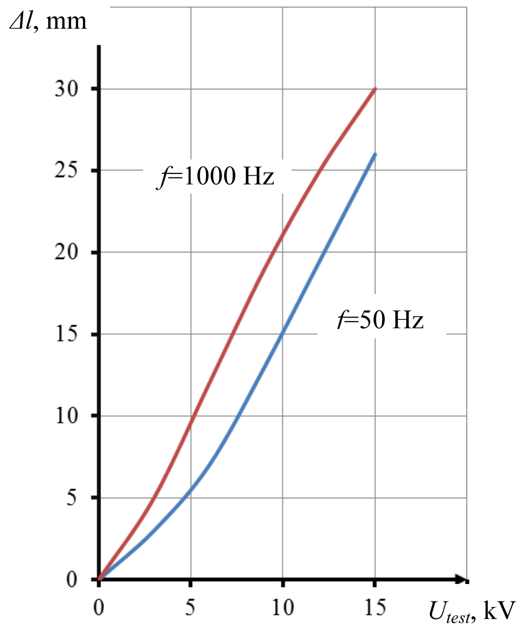

Fig. 3. The dependence of the test voltage spreading length on the test voltage value

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Scientific supervisor: V.V. Red'ko, TPU, Russia
Llinguistic adviser: M.A. Yuzhakova, TPU, Russia