Optimization of High Voltage electrodes and HV cable accessories design by using MATLAB and FEMM

Enis **TUNA**,
Demirer Kablo Accessories Design**,** 4 Eylül Mah. İsmet İnönü Cad. No:279 BİLECİK / TURKEY
enis.tuna@masscable.com

ABSTRACT

In this study an essential approach to electrical geometric field control is done by defining / introducing the over stresses in parallel electrode edges and similarities in real applications in AC HV cable accessories. After understanding the necessity of electrical field control, special mathematical equations based on Borda and Rogowski profile are introduced, optimized and compared under the perspective of success to control field strength in a limited area.

Fınally a computer aided "profile design method" is introduced to design a field control part with an iterative process based on known Borda and Rogowski equations and product design parameters without using the physical drawing of the final product by using MATLAB, FEMM, VB Aided Software and SOLIDWORKS.

KEYWORDS

High voltage cable accessories, MATLAB, FEM, Borda profile, Non-uniform field, Weibull distribution, Llifetime

Enis **TUNA**, Demirer Cable-HV Cable Accessories Design- R&D ,Bilecik/TURKEY

INTRODUCTION

Prefabricated high voltage and extra high voltage cable accessories which are used at state of the art HV transmission lines requires stress control elements/ systems to provide continues stress control to limit the electrical stress at the cut end of cables to a value to guarantee, by using available insulating materials, an expected life time of the cable system of at least 40 years.

In all type of HV cables screen/shield layer around the insulation layer (XLPE, Paper insulation, PE, EPR etc.) provides a ground potential around the cable insulation which is helping to ensure a uniform electrical field distribution in the cable dielectric insulation.

This outer sheath is also preventing surface electrical activity and possible discharges which would reduce the lifetime of cable significantly.**[1]**

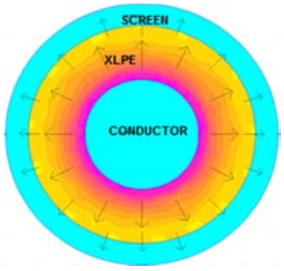

Fig.1: Electrical Field Distribution on Screened Cable

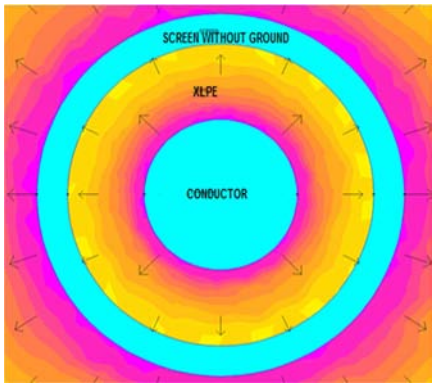

Fig.2: Field Distribution on Non-Screened Cable

In HV cables electrical field lines distributed homogenously around the cable axis and electrical stress is decreasing proportionally with increasing thickness of insulation layer.

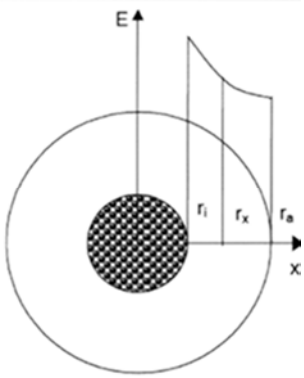

Fig.3: Field Strength Distribution on Cylinder System

$$E_x = \frac{V}{r_x * ln(\frac{r_a}{r_i})} \qquad [1]$$

During the assembling of terminations and joints because of the nature reasons; screen layer of the cable must be removed to a certain point from HV potential (cable conductor).Distance in-between High Voltage potential and screen layer depends on the operating voltage level and insulation ambiance in cable assembling.(air,oil,SF6 etc.)

Removal of the screen layer results to non-homogenous field distribution which means that the electrical field is no longer uniform along the cable axis.