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Study on Semi Conductive Layer during EHV XLPE Cable Joint Procedure

[1]Sachin Kumar Gupta, [2]Arun Pachori

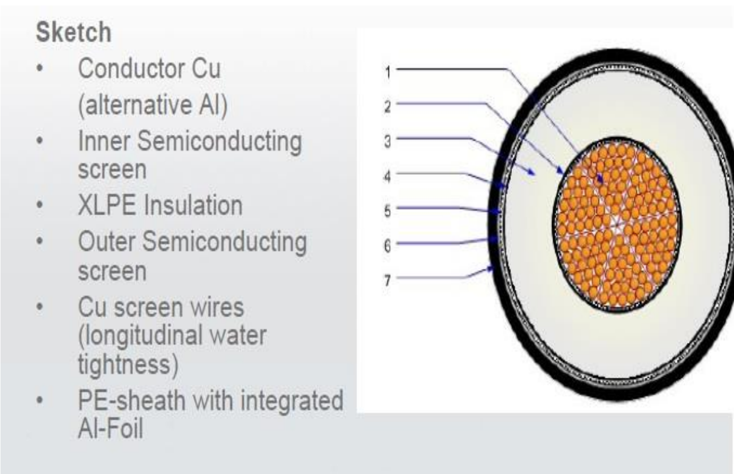
[1]PG student, [2]Associate Professor, Dept of EE, Government Engineering College, Jabalpur, India

Abstract: **Modern XLPE cable consist of a solid cable core, a metallic sheath and a non-metallic outer covering . The cable core consists of the conductor, wrapped with Semi-conducting tapes, The inner Semi-conductive layer , The solid main insulation and the outer semi-conducting layer. These three insulation layers are extruded in one process. Without Semi-conducting layer E and H fields are not uniformly concentrated in insulation material. During the process of cable joint the cable core peeled off. In the above process the Semi-conductive layer plays vital role. It is discovered that voids and contamination combined with ionic contamination in the Semi conducting shields led to voltage stress concentrations within the cable. These elevated voltage stresses combined with moisture ingress into cable structure created what are known today as cable trees. These dendritic growth of microscopic cavities degraded the insulation over time ultimately causing the cable to fail.**

Keywords: **Cable, Semi conductive layer, peeling device, insulation screen contours.**

1. INTRODUCTION

The material described in the paper is not Semiconductor material in the sense we understand in electronics field. The material is a polymer base mixed with a conductivity imparting agents such as carbon black. As we know semiconductor behaves as conductors when temperature rises so when the HT cables is on load , Its conductor temperature rises due to this the semicon layer which is on conductor behaves like conductor as a result overall cross-section area is increased now. The second silicon layer which is over XLPE on temperature rise behaves a conductor and used for dissipating heat out of conductor as the cable heat due to load. The semi-conductive layer also serves to even out the stresses associated with partial discharge which would otherwise attack the insulation at specific points. Semi-conducting compounds also have the effect of fillings in the interstices of the conductor giving a smooth surface for insulation. Without semiconducting layer E and it fields are not uniformly concentrated in insulation material.



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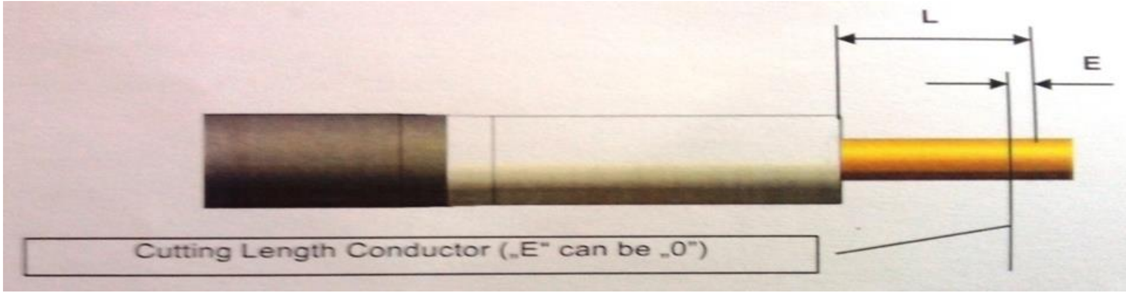
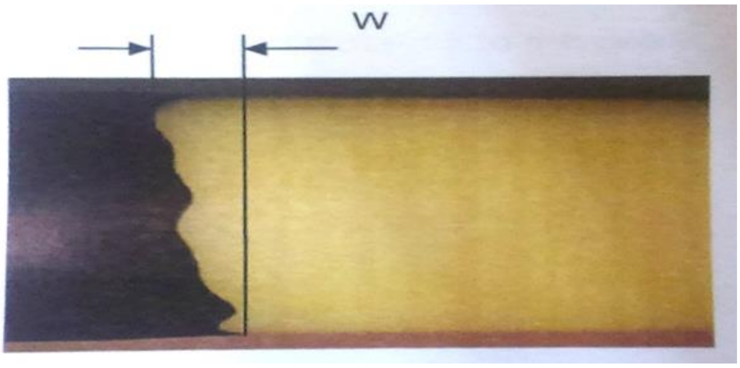
2. DURING CABLE JOINT PROCEDURE

Ends of the cable cut with an additional length of about 100 mm to have enough lengths to adjust the peeling device. Cable is cut at the determined cutting length exactly vertically. If any remove the graphite coating on the whole jointing area. Mark the reference line on both plastic cable sheaths remove the cable sheaths of both sides of the joint according to the different dimensions. Melt the plastic sheaths at the cutting position using a cord up to the surface of the metal cable sheath. Heat and remove the plastic cable sheath. Remove the corrugated aluminum sheath.



3. PEELING THE CABLE CORE

Carry out a peeling test on an additional cable to determine the relationship between turns of peeling device / angle of a rotations of the knife adjustment .Use this relationship on the original cable core to realise a wave " W" not longer than 15mm.



Apply a mark with insulating tape on the outer semiconductor layer in the direction to the cable so that the cable core can be peeled with the peeling device up to 10 mm before the cone. The cable core must be coated with gliding grease if the device doesn't use rolls. The round peeling device must be firmly placed at the cable end whereby the peeling knife must not rest on.

The peeling knife must be adjusted at the beginning in the deepest possible cutting position. The knife must be adjusted step by step so that the semi-conducting layer is completely removed. During the peeling process no trace of external semi-conducting layer may remain. Put the sliced semi-conductive layer through the guidance which wraps the material around the cable core with some distance to the knife and carry out the peeling process up to the mark.

4. EXAMINTION OF THE CABLE CORE

Now the prepared the cable core may not show any unclean faults life coarse, abrasion channels or marks of the rasp etc. Badly visible spots must be controlled by means of a mirror. Reconditioning is allowed only with 400er sand paper. After finishing of this work no semi conductive particle may remain on the insulation. The longitudinal wave at the end of insulation screen must be checked the max allowed length w=15 mm. The measured length "W" has to be written to the protocol.

The phenomenon of water treeing can reduce the service life of XLPE cables. Many actions can be taken to reduce water tree growth, but the approach that has been most widely adopted is the use of specially engineered Insulating materials

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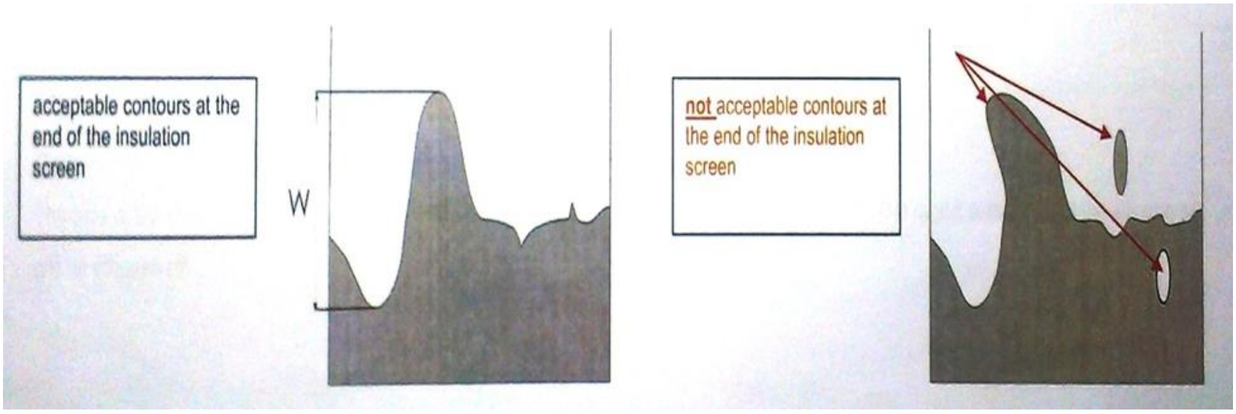
designed to limit water tree growth. These insulation materials, combined with the use of clean silicon shields and sound manufacturing processes have dispelled the concerns that many utilities had regarding the use of cables with a polymeric insulation.

The critical importance of cleanliness (of both the insulation and the semiconducting screens) and smoothness (insulation screen interface) has been a hard learned lesson Improved cleanliness and interface smoothness increases operating stresses (important for HV& EHV) and delivered life. The cleanliness of all cable materials has improved significantly over the last 15 years. Cleaner raw materials, improved manufacturing technology, and handling techniques have all contributed to enhanced cleanliness.



In The cable core dimension must be checked using a calliper gauge. The result has to be written in to the fitting protocol. The oval shape of the core max value – min value in the same level may not exceed 0.5 mm whereby the core is to be investigated in circular. The support plates of the peeling device will cause shallow grooves on the surface of the extruded insulation screen . These grooves are acceptable as long as they will end some millimeters before the transition to the insulation. The grooves are too deep if they extend to the Transition zone in this case they have penetrated the insulation and this is not acceptable. In the transition zone to the insulation the extruded screen may have different shapes. The above shown diagram present example of acceptable and non acceptable contours of the end of the insulation screen.

5. CONCLUSION

As the study shows that water trees grow relatively slowly over a period of months or years. Semiconducting screens or semiconducting shields are extruded over the conductor and the insulation outer surface to maintain a uniformly divergent electric field with in the cable core. As water tree grow the electrical stress can increase at the tip of water tree. Once initiated electrical trees grow rapidly until the insulation is weakened to the point that it no longer with stand the applied voltage and an electrical faults occurs. So during the cable joint procedure above stated precautions should be taken that are based on field experiences so that the life of EHV XLPE cable can be increased.

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