

**C6.5****The study of on-line relaxation effect on internal mechanical stresses and dielectric strength of HV cable insulation**

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ABSTRACT

On-line relaxation (ROL) was originally developed in order to minimize insulation shrinkage in joints and terminations [1]. It has been expected to have some positive influence on cable Dielectric strength as well. This influence and its possible physical mechanism are the subjects of the present paper. The comparative study of internal mechanical stresses and electrical treeing resistance was carried out for insulation samples of relaxed and non-relaxed cables. The dielectric strength was also measured for full-scale samples of cables. Tests were carried out with impulse and AC voltage.

RÉSUMÉ

La relaxation linéaire est une méthode qui initialement a été mise au point pour diminuer le retrait de l'isolation dans des manchons de jonction et d'extrémité [1]. On attendait aussi qu'elle devait exercer une certaine influence positive sur la rigidité diélectrique du câble. Cette influence et ses mécanismes physiques possibles sont des objets de cet article. On a effectué des recherches comparatives des contraintes mécaniques internes et de la résistance à la formation d'arborescences électriques des échantillons de l'isolation des câbles relaxés et non relaxés. On a mesuré aussi la rigidité diélectrique sur des câbles en grandes longueurs; les essais ont été effectués sur la tension de choc et sur la tension alternative.

1. On-line Relaxation

The CV-line for XLPE insulating consists of a heating section followed by cooling of the cross-linked core. Cooling always creates mechanical stresses in insulation due to volumetric shrinkage. The surface core solidifies on large diameters, because the inner part, still hot and expanded, prevents shrinkage. At the end of the cooling section the inner part is also cooled down and solidified. However, the shrinkage of the inner part is partly prevented by the surface, which tends to keep its large diameter. As a result there remains some unfavourable stresses. On-line relaxation is a method for releasing such stresses.

The principle of on-line relaxation [1] is very simple. An additional heating section is added in the middle of cooling thus re-melting the core surface and letting it shrink on the smaller diameter when the inner part is already partly shrunken. Technically on-line relaxation used with gas cooling is based on the same solutions as normal heating zones.

2. The study of internal mechanical stresses

The whole study was carried out on two 66 kV cables (table 1) produced during one run and under the same conditions (table 2). Only relaxation was switched on for the other cable.

Table 1 Tested cable AHXAMK 1x70 mm² 66 kV

	Material	Thickness	Diameter
Conductor	Aluminium		9.6 mm
Cond.Screen	HFDA 0800	0.64 mm	10.9 mm
Insulation	LE 4201 S	9.2 mm	29.2
Ins. screen	LE 0592	0.62 mm	30.5
Foil	Aluminium	0.2 mm	
Sheath		2.6 mm	37.2

Table 2 Production conditions

	non-relaxed	relaxed
Production line	NK Cables VCV-line (CDCC method)	
Line speed	3.9 m/min	
Heating method	radiant curing	
Heating zone temperatures (6x5 m)	350, 350, 350, 350 330 and 320 °C	
Relaxation zone temperatures (2x6 m)	-	380 °C
	-	350 °C
Cooling method	gas cooling	
Production length	770 m	740 m