A.9.5 Influence des changements de structure du PR sur les propriétés diélectriques de l'isolation des câbles.

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A.9.5 Influence of structural changes of XLPE on dielectric properties of cable insulation.

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RESUME

Les études effectuées concernaient l'isolation de câble en polyéthylène dont le degré de la réticulation était différent. On a fait des mesures de temps de claquage avec la méthode de l'aiguille pour déterminer la résistance du materériau étudié aux décharges partielles. On a également calculé la résistance électrique du polyéthylène réticulé et le facteur de pertes diélectriques. On a observé des changements de structure pendant l'analyse en spectrophotométrie l'infrarouge et les études microscopiques.

ABSTRACT

The investigations were carried out on XLPE cable insulation with a different crosslinking degree. The measurements of time to breakdown of insulation were performed by the needle test to determine the resistance to partial discharges of tested material. It also determined electric strength of crosslinked polyethylene and the dielectric loss factor. Structural changes were observed by means of IR spectrophotometric analysis and the scanning microscope.

1. INTRODUCTION

Good dielectric properties and relatively easy processing have caused that insulation polyethylene is widely used in cable industry. However, this kind of insulation is relatively little resistant against partial discharges, which can be concluded from power cable exploitation [1].

Partial discharges take place in cavities created in the solid dielectric both during manufacturing and cable exploitation. Insulating system degradation is a consequence of electrical and water treeing [2]. In order to prolong cable insulation life, among other methods, polyethylene structure modification by crosslinking is used. Polyethylene crosslinking causes an increase of its resistance against water treeing which is one of the main reasons of insulation failure [3,4].

In the present research, we took into concideration the influence of polyethylene crosslinking degree on its dielectric properties. We investigated polyethylene resistance against electrical treeing, electric strength and tgδ of samples characterized by different degrees of crosslinking. Electrical treeing resistance can be determined on the basis of comparative needle test. We can determine tree incubation time, voltage at which treeing is initiated or tree growth time until breakdown. Time-to-breakdown of polyethylene insulation determined by means of the needle test was selected as a fundamental criterion of electrical treeing resistance in our research.

2. RESEARCH METHOD

The research was conducted on six kinds of polyethylene. Samples were made in the shape of slabs and polyethylene foil. The following symbols were used:

A - basic material, thermoplastic polyethylene used for manufacturing medium - voltage cables suitable for chemical crosslinking,

A_{x1}- polyethylene A with a crosslinking agent, crosslinking degree equal to 54%,

A_{x2}- polyethylene A, crosslinking degree equal to 77%,

A_{x3}- polyethylene A, crosslinking degree equal to 80%,

A_{x4}- polyethylene A, crosslinking degree equal to 90%,

B_{x5}- crosslinked polyethylene, based on variety B of basic polyethylene, crosslinking degree equal to 87%.

Another part of the research was made on 15 kV power cable sections. The following kinds of insulating polyethylene were investigated:

- thermoplastic polyethylene, uncrosslinked, taken from a new cable section,
- 80,5% crosslinked polyethylene, taken from a new cable section,
- 80,5% crosslinked polyethylene, taken from a cable which had been exploited in a waterlogged area for up to 3000 hours,
- 80,5% crosslinked polyetylene aged in laboratory conditions.

The research included:

- determining electrical treeing resistance of polyetylene,
- determining the dielectric loss factor,
- determining electric strength,
- material structure evaluation by means of the scanning microscope,
- IR spectrophotometric analysis.