B.1.1. Câbles à gaines laminées en remplacement des gaines de plomb pour les câbles MT

SMITH J., BOW K., The Dow Chemical Co., Granville, Etats-Unis

B.1.1. Laminated sheathed cable for replacement of lead sheathed cable in medium voltage applications

SMITH J., BOW K., The Dow Chemical Co., Granville, U.S.A.

Résumé

L'histoire de la performance de cables lamellés au plomb, cable papier isolés a été très bonne. Mais aujord'hui, les soucis sur les issues de l'environnement et santé associés avec le plomb favorisent une recherche alternative pour la construction des cables. L'usage des gaines lamellées est proposé comme alternative à l'usage de l'isolation polymeric. Les gaines lamellées consistent d'une bande métallique enduite de plastique qui est appliquée longitudinallement sur le noyau du cable, scellée sur les endroits qui se surpassent et jointe sur la gaine de couverture. Ce papier fournira les details sur les soucis de environnement en ce qui concerne le plomb, donnera les descriptions de plusieurs formes de cables lamellées qui ont remplacé avec succès les conduits plombes, fournira le data sur l'usage à terme long comme les materiaux des gaines s'usent et decrira les facteurs necessaires dans la grande échele du remplacement des gaines plombées avec les gaines lamellées.

Abstract

The performance history of lead sheathed, paper insulated cable has been very good. Today, however, the concern over the environmental and health issues associated with lead is fostering a search for alternative cable constructions. The use of a laminate sheath over polymeric insulation is proposed as an alternative. The laminate sheath consists of a plastic coated metallic tape or strip that is applied longitudinally over the cable core, sealed at the overlap, and bonded to the oversheath. This paper will provide detail on environmental concerns with lead, describe several laminate sheath designs that have successfully replaced lead sheaths, provide data on the long term aging of the sheathing materials, and describe the factors involved in the large scale replacement of lead sheaths with laminate sheaths.

INTRODUCTION

Much progress has been made in the development of laminate sheaths as chemical/moisture barriers for medium voltage and high voltage cable. Laminate sheaths are being used commercially on medium voltage and high voltage cables [1, 2]. In addition, several papers at JICABLE have followed the development history of laminate sheaths.

A 1984 JICABLE paper reviewed the use of laminate sheaths as a radial moisture barrier for power cable [3]. The design parameters for the successful use of such sheaths on medium and high voltage power cable were discussed. These parameters where 1) a means to accommodate the thermal expansion of the core to insure that thermal stress did not damage the laminate sheath, 2) a means to provide a longitudinal water block to prevent migration of water along the length of the cable, and 3) materials which must withstand the maximum operating temperature of the cable. Materials which could find utility in the moisture barrier sheath were then described. These were: 1) a coated copper which had excellent adhesive characteristics to plastic jackets and a bond resistant to the effects of moisture, and 2) water swellable tapes which could act both as a longitudinal water block and a cushion layer to absorb thermal expansion. The overall conclusions reached were the laminate sheaths as moisture barriers were effective in resisting the radial ingress of moisture, and preventing premature failure due to the treeing phenomena. Furthermore, the materials had been developed to successfully commercialize moisture barrier power cable.

A 1987 JICABLE paper [4] described test results with a prototype cable having moisture barrier sheath. The sheath used coated copper as a combination shield and moisture barrier. The coated copper was bonded to an overall polyethylene jacket. Water swellable tapes were used under the shield to act as a cushion for thermal expansion and to prevent longitudinal water flow. The overlap was sealed using a hot melt adhesive. The moisture barrier sheath passed several key industry tests. Cables were pulled at side wall bearing pressures of 23.4 kN/m (1600 lb $_f$/ft) and 29.2 kN/m (2000 lb $_f$/ft). The moisture barrier sheath did not suffer damage and maintained its integrity. The cable withstood 20 thermo-mechanical cycles to conductor temperatures of 130°C and 90°C without damage to the moisture barrier sheath. These load cycles were conducted with a 1m water column attached to the cable. The water swellable tapes functioned perfectly as a cushion layer and to limit longitudinal water penetration. The bond to the jacket and seal at the overlap were maintained throughout the side wall pressure and load tests. It was concluded that a functional moisture barrier sheath for medium voltage cable had been developed.

A 1991 JICABLE paper [5] described the development of a new class of plastic coated metallic shielding tapes for use in medium or high voltage power cables. These tapes derived their attributes from the use of a semiconducting coating on one or both sides. The semiconducting coating could be used in combination with non-conducting coatings to provide the laminate sheath. The semiconducting coating facing the core can allow for electrical charge transfer between the core and shielding tape. The outer, non-conducting coating can be bonded to the cable jacket to provide a laminate sheath. The coatings on both sides provide a high degree of corrosion resistance to the shielding tape, allowing for the use of aluminum shields in power cable. In case of water penetration in the core-shield interface, or swelling of a water swellable material used in that interface, the shield is protected from corrosion. The use of semiconducting coatings on shielding tapes can lead to simpler and more efficient power cable designs by allowing the moisture/chemical barrier function to be combined with the shielding function.