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Waterproof structure of long-distance communication

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ABSTRACT

The development of electricity-related industries increased the quantity demanded of long-distance cable. But due to the environmental complexity of long-distance cable's pavement and the arduousness of detection and maintenance, so it is valuable to make research on long-distance cable's waterproof structure devise, and introduce the waterproof performance of long-distance cable, in order to analyze the principle and structure designing of waterproof cable, and deepen the detailed research on long-distance cable communication.

KEYWORDS

Long-distance communication; Cable; Waterproof performance; XLPE cable.

INTRODUCTION

The rapid development of the electricity industry pushes forward the long-distance technological development and increases the quantity demanded of long-distance cable. Long-distance cables are mostly paved district central offices, provincial central offices and between district and county central offices. But due to the complex structure, long-distance communication cable's detection and maintenance are both of considerable difficulties, in addition, long-distance communication cables' transmission generally use carrier frequency and shoulder the essential communication works, so in case break down, social production and people's lives would be largely influenced. Therefore improving the long-distance cables' performances is essential for domestic electricity industry.

THE IMPORTANCE OF WATERPROOF PERFORMANCE TO LONG-DISTANCE COMMUNICATION CABLE

The environment of long-distance communication cable is complex. No matter paved in the air, in soil or in water, the long-distance cable would be surrounded by moisture. After prolonged usage of long-distance cable, surrounded moisture would penetrate inside, and increase communication depletion, deduce service efficiency and in turn cause communication failure. As shown in the following diagram (as in Figure 1).

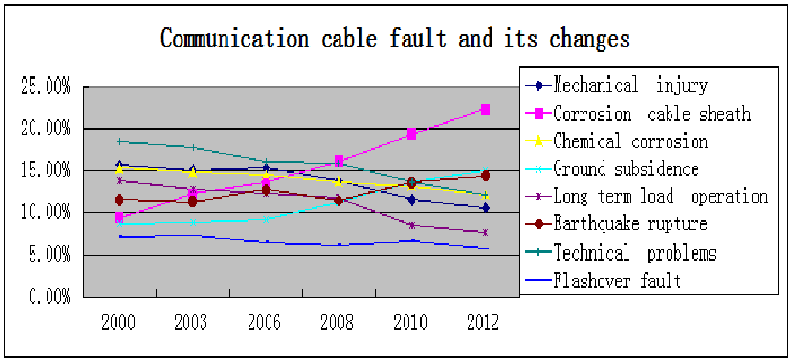

Figure 1 : Communication cable fault and its changes

In the common communication cable faults in China, the proportion that mechanical injury, earth rupture, long term load operation, technical problem and flashover faults account for deduce chronologically, because of the executive development of the construction process and the improvement of construction technique. The proportion of ground subsidence rises because the environment deteriorates. Corrosion cable sheath also occupies larger proportion. In corrosion cable sheath, moisture penetration is important. Buried cable can be easily penetrated, and the sufficient moisture in soil would corrode the cable sheath and cause moisture penetration. Therefore communication cable's capacitance increases, energy loss increases and service efficiency decreases. Overhead lines outdoors also encounter the same during to the moisture in the air. Moisture penetration intensifies the long-distance communication cable failures, and the detection and maintenance are difficult, therefore we should improve the waterproof performance of long-distance cable. We should proceed with structure design of long-distance cables and add necessary waterproof measures, to guarantee the stable operation of long-distance communication cables.

CATEGORIES AND FUNDAMENTAL STRUCTURE OF LONG-DISTANCE COMMUNICATION WATERPROOF CABLES

According to the different working principle, long-distance waterproof cables can be categorized as impregnated paper cable, self-contained oil filled cable, XLPE cable, polyethylene cable, ethylene propylene rubber cable and gas filled cable. Self-contained oil filled cable can be divided into single core self-contained oil filled cable and three core self-contained oil filled cable. As shown in Figure 2.

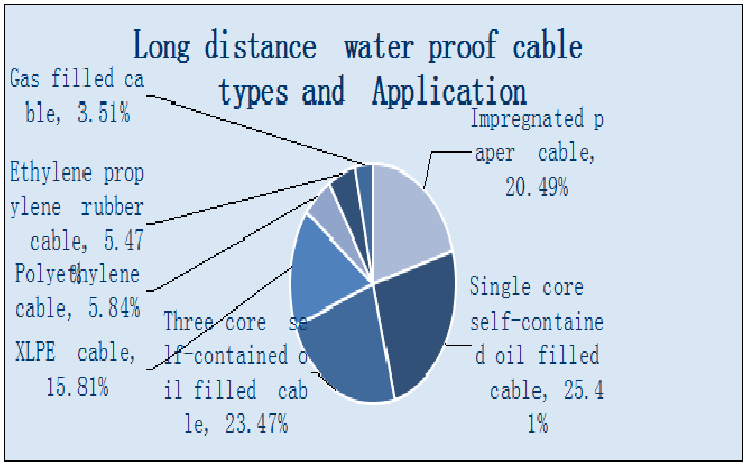

Figure 2 : The following diagram

In practical application, the most widely used in China is self-contained oil filled cables, followed by impregnated paper cables. To analyze the service condition of long-distance communication waterproof cable would strengthen our understanding of it, and thereby deepen the structure research on it.

Self-contained oil filled cable

In the field of long-distance communication, self-contained oil filled cables are most widely used. self-contained oil filled cables structured with waterproof oil among the cables to achieve water blocking, comparing to other waterproof cables, self-contained oil filled cables have higher working field intensity, and can be used in larger message capacity and higher electric tension. In practical application, self-contained oil filled cable can be divided into single core self-contained oil filled cable and three core self-contained oil filled cable according to the quantity of cable cores.

The typical structure of self-contained oil cable consists of exterior wire armoring for cable's mechanic protection and tensile property, polypropylene plastics as lining, vermiproof protective layer, polypropylene external branch pipes, external protective reinforcement, lead alloy protective jacket as insulating layer, and semi-conductive electronic and magnetic shielding layer inside, from outside to inside. single core self-contained oil filled cable could use wire as oil passage, while three core self-contained oil filled cable's oil passage is the space among the three cores.

Impregnated paper cable

Impregnated paper cables are frequently used in practical application, following the self-contained oil filled cable. This type of cable can be divided into non-draining impregnated paper cable and mass-impregnated paper cable according to the difference of impregnated papers. Non-draining impregnated paper cable can become plastic solid state under the working temperature, and would not be influenced by installation drop. But mass-impregnated paper cable would have fluxion problem when installed in terrains with great dropping variance. So mass-impregnated paper cables are not suitable for circuits with larger than 30m altitude difference. To guarantee better waterproof effect, the outside impregnated paper should be 50um thick. But the outside impregnated paper shouldn't be too thick, or it will influence the practical application effect for communication cable. To see it from practical level,

impregnated paper should not thicker than 180um, and in practical production, alkylbenzene is often used as impregnant.

The typical structure of Impregnated paper cable consists of exterior wire armoring for cable's mechanic protection and tensile property, polypropylene plastics as lining, vermiproof protective layer, polypropylene external branch pipes, external protective reinforcement, lead alloy protective jacket as insulating layer, and semi-conductive electronic and magnetic shielding layer inside, from outside to inside. The insulating layer of impregnated paper cable make up with impregnated materials with waterproof performance, therefore at the same time guarantee the insulation of long-distance cables, it strengthen the water performance, furthermore promote the service efficiency of long-distance cables.

XLPE cable

With science and technique development, XLPE cable, as a research hotspot of contemporary communication cable, are used wider and wider. Compared with former two kinds of cables, XLPE cable has more advantages. Such as using solid insulating material to replace filling oil or impregnated papers, in this way, on the one hand, lead protective jackets would be discarded, cable weight would reduce, the production of XLPE cable would be simpler, and transportation would be more convenient. On the other hand, installation of XLPE cables is simplified, making long-distance pavement much easier. In addition, the new materials applied in hinge XLPE cable promote its mechanical capacity and electricity capacity, without the support of detection, controlling or adjustment of oil filled level and other related devices.

Other cables

Polyethylene cable, ethylene propylene rubber cable and gas filled cable can also guarantee favorable long-distance waterproof performance and related communication functions. However in practical application, polyethylene cable, ethylene propylene rubber cable and gas filled cable are of limitation, so their ranges of application are smaller than impregnated paper cable, self-contained oil filled cable and XLPE cable.

WATERPROOF CABLE STRUCTURE DEVICE AND WATER BLOCKING MECHANISM

Long-distance communication cable's water penetration problems mainly appear as longitudinal and radial penetration and water blocking structure are mainly designed based on these two modes. In order to guarantee the radial waterproof performance of long-distance communication cables, we can change the material of protective jacket from polyethylene material to metallic sheath made by stainless steel, copper or aluminum, or synthetically protective layer made by composite material to construct radial water-blocking protective system. In addition, to improve the radial waterproof function of long-distance communication cable, we can use lead plastic composite layer or metallic jacket inside the protective jacket. The lead plastic composite layer can be used in structural design of heavy load cable, and the metallic jacket can be used in high tension cable.

In order to ensure favorable longitudinal waterproof performance of the communication cable, waterproof material should be filled between the stand cables when designing the cable structure. To achieve the longitudinal waterproof performance of the cable structure, we should proceed with two levels, the first is during the stranding and compressing, waterproof material should be added as conductor hinder water; the second is during the production of cable core, waterproof material should added into the cable production to guarantee the longitudinal waterproof performance of long-distance communication cable.

SEVERAL COMMON CABLE WATERPROOF STRUCTURES

Commonly used long-distance communication waterproof cable structures in China including following several (as in TABLE 1):

TABLE 1: The first is XLPE cable longitudinal waterproof structure, mainly achieved by using initiative waterproof material to stuff the cable core

XLPE cable structure							
Single core medium voltage radial water blocking structure	Water blocking conductor conductor screen XLPE insulation Insulated shield In the semi conducting water-resistant tape The metal shielding layer Water resistance of the outer semi conduction Longitudinal coated aluminum plastic composite bag Protective sleeve	Single core high pressure water blocking structure	Water blocking conductor conductor screen XLPE insulation Insulated shield Inner semi conductive water expansion buffer layer Metal protective sleeve bamboo Protective sleeve	Three core cable radial water blocking structure	Water blocking conductor conductor screen XLPE insulation Insulated shield Semiconductor waterstop The metal shielding layer Water blocking filling material Semiconductor waterstop Al plastic composite tape Protective sleeve	Three core armored radial water blocking structure	Water blocking conductor conductor screen XLPE insulation Insulated shield The water resistance of semiconductor buffer zone Tubular metal shielding layer Ordinary filling material The inner sheath Armor layer Protective sleeve

CONCLUSION

Along with the unceasing development of electricity related industries, the range of application of long-distance communication cable would become wider and wider, this essay analyzes the designing and achieving principles of long-distance cable's water blocking structure, and compares two commonly used devises of waterproof cable structure, longitudinal and radial waterproof on aspects of devise and structure, in order to deepen the structure researcher on long-distance cable waterproof performance.

REFERENCES

[1] Liu Rui; Maintenance and solutions to faults of the inflated segments of railway communication cable filing [J]. Technology and Market, **05**, 57-58 **(2013)**.

[2] Wang Yonghong, Lu Zhonghui, Li Yingzhi; Research on Environmental Test of Telecommunication Cable and Materials [J]. Equipment Environmental Engineering, **03**, **(2004)**.

[3] Wang Zheng; Waterproof Structure Design of Long-Distance Communication Cables [J]. Telecom Power Technologies, **01**, 67-69 **(2014)**.

[4] Wang Juan; Long distance transmission technology in communication engineering[J]. Journal of Henan Science and Technology, **23**, 08 **(2013)**.

[5] Guo Ran; The comparison and selection of long distance communication engineering technology [J]. Silicon Valley, **03**, **(2009)**.
[6] Huang Xiaoming; Waterproof Structure Design of Long-Distance Communication Cables [J]. Optical fiber and cable and its application technology, **05**, 45-47 **(1989)**.
[7] Zou Jun, Yuan Jiansheng, Zhou Yukun, Ma Xinshan; Pipeline To Its Internal Communication Cables And Metallic Mitigation Line To Its Nearby Underground Communication Cables [J]. Power System Technology, **04**, **(2000)**.
[8] Li Yuanpeng; Technological Development and Consideration regarding Optical Fiber and Cable, and Communication Cable [J]. Telecommunications Technology, **11**, **(2002)**.