

Study on Degassing Process of the World's First 500kV XLPE Insulated AC Submarine Cable

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ABSTRACT

The world's first 500kV XLPE insulated AC submarine cable line has a length of 18.5 km. This paper verifies rationality of design and process control of large-length EHV XLPE insulation structure, and proposes a "heat convection" degassing method to enhance degassing effect for XLPE insulated cores, which was verified by simulation and test methods. Some results show that: 1) Surface quality and extrusion stability of 500kV XLPE insulation core can be effectively guaranteed by reasonable process control. This process is suitable for continuous extrusion of EHV and large-length cable insulation. 2) Degassing simulation results show that degassing temperature, pressure and flow velocity can be basically uniform and constant, and air can pass through gaps between insulation cores and take away gas by-product inside cable to ensure degassing effect to be stable. 3) Combined with actual process verification and test results, it can be seen that degassing method and effect for large length thick insulation are reliable. The new degassing method can significantly enhance degassing efficiency to 50%. It is hoped that research results mentioned in this paper can provide some technical references for large-length EHV XLPE insulation production.

KEYWORDS

500kV;AC submarine cable;XLPE;Degassing;TGA

0 INTRODUCTION

In recent years, product development and performance research for large-length EHV insulated submarine cables has been one of the most important topics for experts and scholars in power industry. And many key technical researches have been carried out^[1-6]. Among them, 500kV large-length EHV AC submarine cable has technical difficulties recognized by the submarine cable industry including complex system design, harsh and changeable application environment, high requirements for product manufacturing equipment and technology and has been one of most important technologies in the field of ocean development. It can be applied to power transmission between mainland and island, offshore oil exploitation, offshore wind power generation and so on.

Zhoushan interconnection Transmission 500kV Submarine Cable Project invested by China Zhejiang

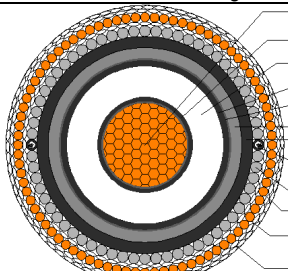
Electric Power Company of State Grid starting at Zhenhai submarine cable terminal station and ending at Zhoushan submarine cable terminal station, is the world's first 500kV EHV XLPE insulated AC submarine cable project, which has drawn wide attention of scholars at home and abroad since its implementation.

Based on this project underground, 500kV submarine cable is designed and developed. This paper mainly introduces researches on XLPE insulation extrusion process control for 500kV submarine cable and a new insulation degassing method adopted in this project. And degassing effects are verified by simulation and experimental analysis methods. This purpose is to provide reference and guidance for future research on large-length and EHV AC submarine cables.

1 DEVELOPMENT PRODUCT PARAMETERS

In this paper, 500kV AC submarine cable is of a single core structure with a length of 18.5km and the company designation code of HYJQ71-F 290/500 1x1800+2x(10B1+2B4). The product structure schematic diagram and main performance parameters are shown in Table1. This product has passed type test and pre-qualification test of China Electric Power Industry Electrical Equipment Quality Inspection and Testing Center, which demonstrates that product performances can meet operation requirements and 1100MW power transmission capacity can be guaranteed.

Tab.1: Product Basic Parameters

| Schematic diagram of product structure | |
|--|--------------------------------|
|  | |
| Nominal voltage of a system | 500kV |
| Maximum operating voltage | 550kV |
| System frequency | 50Hz |
| System grounding | Neutral point solidly grounded |
| Rated transmission capacity | 1100MW |
| Maximum rated continuous operation current | 1411A |
| Long-term operation temperature of conductor | 90 |
| Conductor short circuit temperature | 250 |
| Lightning impulse voltage peak value | 1550 |
| Switching impulse voltage peak value | 1175 |
| Copper conductor crosssection | 1800mm ² |