Environmentally Friendly Non-crosslinked Insulated Power Cable

1. Outline

Recently, people around the world have become intensely aware of the problem of global warming and the issue is seriously being discussed in various countries, especially in Europe. For example, the European Commission gives top priority to climate change strategy and aims to reduce greenhouse gas (GHG) emissions by 55% compared to 1990 levels by 2030. The Paris Agreement was adopted at COP21 in 2015 and Japan declared that it aims to achieve a decarbonized society (carbon neutrality) by 2050.

There is ever-increasing demand for power cables because the market has been expanding with a combination of the expansion of the renewable energy business, such as offshore wind and solar photovoltaic power generation, and the need for renewal of power cables laid in the high-growth period.

Currently, most power cables are XLPE cables, which use crosslinked polyethylene (XLPE) for insulation. XLPE has excellent heat resistance due to its crosslinks, but it shows no fluidity with heat and its material recovery is difficult. In addition, the longer the cable to be produced, the longer the lead time may be, because manufacturing XLPE cables requires a crosslinking reaction process to form a network structure and a drying process to exhaust by-product gases from the reaction.

Against this backdrop, we have developed environmentally friendly non-crosslinked insulated power cables (Photo 1) that can contribute to improving productivity.

2. Features

Features of the non-crosslinked insulated power cables are shown in Table 1.

2-1 Excellent environmental friendliness

Since the insulation is non-crosslinked, the insulation can be remelted and remolded, enabling material recovery (Fig. 1). The developed non-crosslinked material also has higher dielectric withstanding voltage than XLPE, technically enabling the production of thinner insulation. This

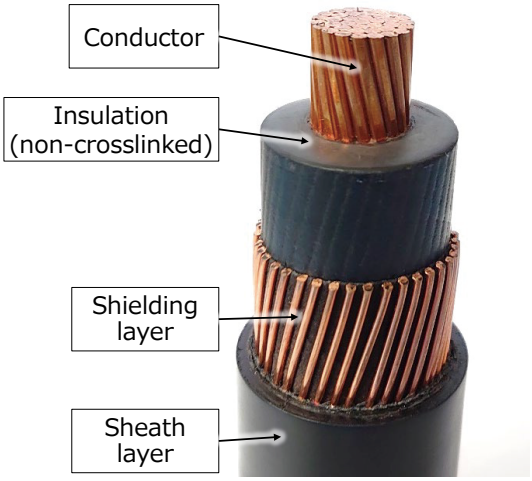


Photo 1. 22 kV class non-crosslinked insulated power cable

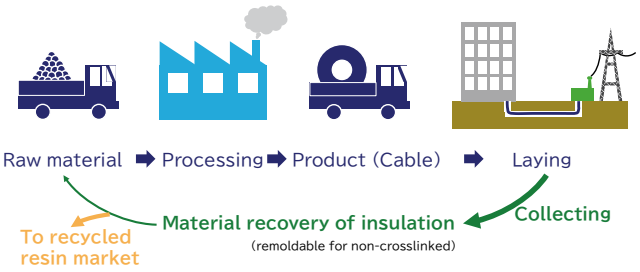
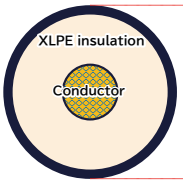
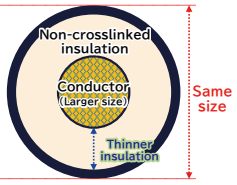


Fig. 1. Recycle flow of non-crosslinked insulated power cable

Table 1. Features of non-crosslinked insulated power cable

Item	XLPE	Non-crosslinked material
Structure image		
Manufacturing Precess	Extruding, crosslinking, drying	Only extruding (shorter leadtime)
Recycling	Mainly thermal recovery	Matrial recovery
GHG emissions	1.0	0.7 (Same part number and size)
Allowable temperature	1.0	>1.1 (Continuous, overload, instantaneous)
Bending property	1.0	1.0 (Samepart number and size)
Transmission cabacity	1.0	1.1 (When continuous allowable temper-atureis increased)
Withstanding voltage	1.0	1.1~1.2 (Initialelectric preperty)
Transmission loss	1.0	0.8 (When the insulation is thinned, the cable diameter does not change, and the conductor is enlarged)

can prevent the enlargement of the diameters of cables based on the environmental and economical conductor size optimization (ECSO*1) approach, which has been vigorously standardized by International Electrotechnical Commission, Japanese Industrial Standards, and other organizations in recent years.

2-2 High productivity

There is no necessity for crosslinking and drying processes in the manufacture of the cables, thereby shortening the lead time. Moreover, since the manufacturing process uses less electric power, GHG emissions will be reduced by 10 to 30% compared to those for XLPE.

2-3 Excellent heat resisting property and flexibility

This product uses material with a non-crosslinked structure but with excellent heat resisting property and flexibility for insulation by applying our original compounding technique. The developed non-crosslinked material suggests that the cables can be used at higher temperatures than conventional XLPE cables. The short-circuit cable tests (Photos 2 and 3) revealed that even when the temperature of the conductor at a short circuit was raised to 110% of Japanese standard for XLPE cables, the insulation was not deformed.

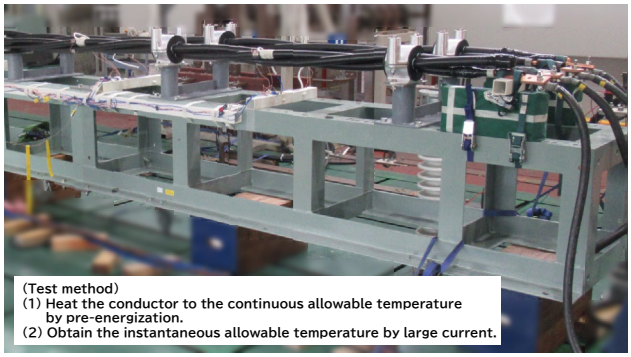


Photo 2. Short-circuit test of non-crosslinked insulated power cable

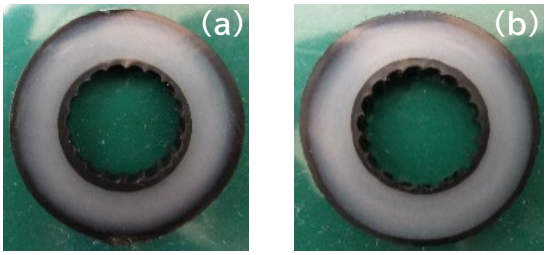


Photo 3. Cross-section of non-crosslinked insulated power cable
(a) Before short-circuit test, (b) After test

The elasticity of the cables is the same as that of XLPE cables at room temperature and the bending stiffness is also the same as that of XLPE at room temperature, thereby achieving good wiring (Fig. 2).

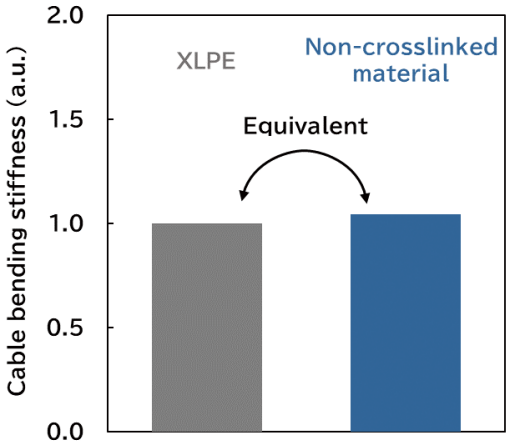


Fig. 2. Bending stiffness of each insulating material
(66 kV class cable, at room temperature)

3. Future Developments

Offshore wind power generation, a pillar of the renewable energy business, has a limited capacity to manually control the output power. The use of the non-crosslinked insulated power cables, which are operable at higher temperatures, will allow more flexibility for operational conditions of power transmission lines against output fluctuations. We will search for applications of the non-crosslinked insulated cables through communication with customers and build wider recognition of the non-crosslinked insulated cables through the replacement of conventional cables and other activities.

* 1 Environmental and Economical Conductor Size Optimization (ECSO): An approach to selecting the most appropriate conductor size to make the life cycle cost as low as possible, taking into account the cable's running costs as well as initial costs.