

## DEVELOPMENT OF NEW RECYCLABLE INSULATION MATERIAL FOR POWER CABLE

Kwang Hoi **KU**, Kyu Cheol **Cho**, Seung Bum **Kwon**, Jae Soon **Lee**, SK Innovation (SKI), (R.O. Korea), [kkh78@sk.com](mailto:kkh78@sk.com), Kwang jun **Park**, Bong soo **Han**, Young jun **Kim**, ILJIN Electric Co., Ltd.(ILJIN), (R.O. Korea), [jedi1030@iljin.co.kr](mailto:jedi1030@iljin.co.kr), Dong Myung **Kim**, Jong Man **Joung**, Tae Ho **Kwon**, KEPCO Facility Diagnosis Center (KEPCO), (R.O. Korea), [jimany@kepri.re.kr](mailto:jimany@kepri.re.kr),

### ABSTRACT

The conventional XLPE has superior thermal and mechanical properties from the chemical cross-linking. Truly, this material can damage on our environmental. On the other hand, the new-PE we've developed recently doesn't have chemical cross-linking bonding therefore this new material can be recyclable.

In this article, we mainly focus on the development for power cable using the new-PE keeping its electrical property for insulator. Insulation properties and reliabilities are investigated throughout physical and electrical test.

### KEYWORDS

Recyclable material, Environmental friendly, thermal stability, non-cross-linking, new-PE, AWTT

### 1. Introduction

In the past, the XLPE has been widely used for insulation material due to its high thermal stability which might be originated from cross-linking structure. In this case, the product can't be recycled. So the cables after use have to be burnt and buried causing the contamination of air and soil.

However, the new-PE we've developed doesn't have chemical cross-linking bonding. That's why it can be re-molten for recycling.

The polymer is composed of two phases crystalline and amorphous. new-PE, a kind of PE, also has crystalline and amorphous phase. The reason new-PE shows superior properties compared to XLPE is Tie-molecules which play a role of physical cross-linking. Tie-molecules are entangled each other in amorphous phase. And these tethered molecules can act as chemical cross-linking and add excellent endurance to mechanical properties.

So, we would like to suggest replace XLPE with new insulation material. It has many advantages not only in a view point of environment but in one of thermal stability. The advantages we could get are shown below

- Environmental friendly by recyclable material
- Better properties of insulation compared to XLPE (Thermal resistance, insulation properties, dielectric constant, and so on)
- From the simple manufacturing process, it would be more economical

Insulation properties and reliabilities for new-PE are investigated throughout physical and electrical test.

### 2. Development of insulating material

#### 2.1 Difference of materials

Basically, there is difference between XLPE and new-PE in structure.

The XLPE have a cross-linking point from the chemicals (DCP or silane). On the other hand, the materials in this article don't have any point from chemical reaction as shown in Fig 1.

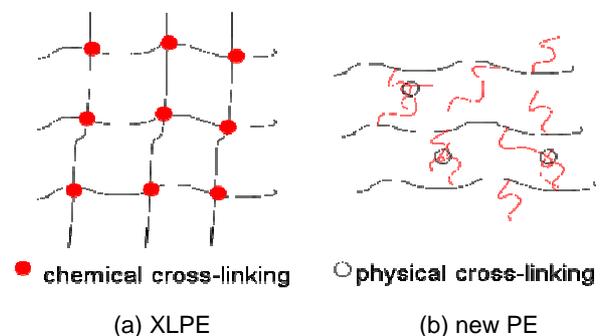


Fig 1. The structure of XLPE and new PE

Due to the chemical cross-linking point, the XLPE can't be molten and recycled again. However, the physical cross-linking point in new-PE material, when heated, will become untied and fluid again. So, this non cross-linked PE can be recycled again and can reduce the environmental pollution.

The basic properties of XLPE and new-PE used in this study were summarized in Table 1.

Table 1: Basic properties of base resin

| Item   | MFR (190°C) (g/10min) | Gel Fraction (%) | TS@B (MPa) | E@B (MPa) |
|--------|-----------------------|------------------|------------|-----------|
| XLPE   | -                     | 82               | 24.7       | 560       |
| New-PE | 1.7                   | -                | 31.3       | 830       |

The mechanical and electrical properties of the above two materials were estimated throughout this study. And the real cables were also manufactured by two different properties.

#### 2.2 Basic Properties of insulating material

Electrical properties were summarized in Table2 with standard. And the mechanical properties before and after aging also were shown. The result of tensile strength and elongation at break before and after ageing are good in accordance with standard.