CROSSLINKING BY IRRADIATION (ELECTRON BEAM) TECHNOLOGY

Crosslinking is the process of creating strong bondings between the molecules in a material. It transforms the material from one that can melt and reshape (thermoplastic) to a rigid, non-melting state (thermoset). Crosslinking is used in cable manufacturing for several vital reasons. It significantly improves the cable's resistance to environmental factors, enhances electrical properties, and boosts flame resistance, ensuring the cables meet the high demands of modern technology and infrastructure, providing reliability, safety, and durability.

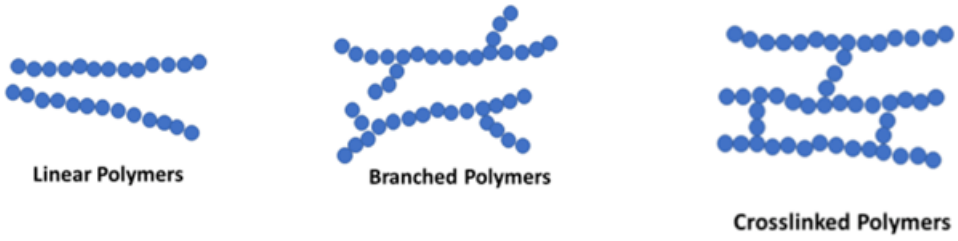

Figure 1 - Type of Polymers

CrossLinking (XL) Methods

Crosslinking can take place through both chemical and pyhsical (irradiation) processes.

Chemical crosslinking process must have the corresponding chemical crosslinking agent, that is, must have peroxide, sulphur or silane crosslinking agent; Irradiation crosslinking does not require chemical crosslinkers and is relatively efficient. Chemical crosslinking reaction must be carried out at the corresponding temperature, scientific and rigorous control of the extrusion temperature during the reaction process, otherwise in the early crosslinking is likely to occur coke, while the equipment also occupies a lot of space, consumes a lot of energy, production efficiency is not high, so it also limits the wide use of chemical crosslinking in wire and cable to a certain extent.

Irradiation (E-beam) crosslinking generally, does not need to be carried out under a range of high temperature and high pressure conditions, and the energy consumption required for irradiation crosslinking is also very low. The temperature rise of the polymer due to the absorption of beam energy is generally not greater than 70 ° C, and the metal hydroxide flame retardant added to the cable during the reaction process will not decompose due to high temperature during crosslinking. Therefore, irradiation(E-beam) crosslinking is generally very widely used for processing **flame-retardant cables**. Under normal circumstances, irradiation crosslinking can make the material obtain a high temperature resistance level, and there will be no residue after a series of processing, and long-term contact with acid usually does not appear swelling phenomenon. Irradiation(E-beam) crosslinking has a high production efficiency and is easier to control the crosslinking degree.

	Chemical Crosslinking	**Irradiation Crosslinking**
XL Conditions	High Temperature	Room Temperature
Performance	Difficult to Control	Controllable & Uniformity
Application Range	Narrow	Wide
Product Efficiency	Low	High

Solen Kablo will utilize electron accelerator to achieve crosslinking through irradiation.

Electron beams are generated by heating a filament to activate electrons and then directing them through a vacuum tube onto a target material. As these high-speed electrons penetrate the material, they interact with its molecular structure, forming precise crosslinks between polymer chains. This process, known as e-beam crosslinking, enhances the material's properties compared to conventional methods, making it ideal for applications such as solar cables. Electron Beam Accelerator is a device to accelerate electrons in a tube to create scanned beams to give energy to cross link insulation or sheath compound. This technology like the cathode ray tube system of televisions.

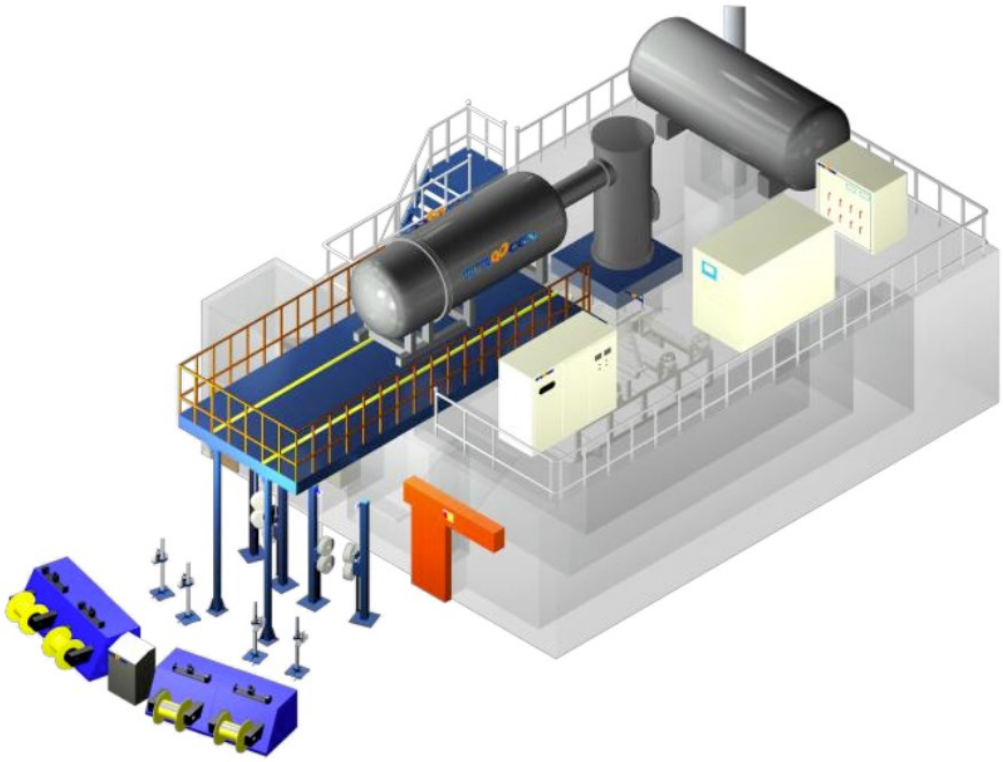

Figure 2 - E-Beam Facility

Wire and cable due to the use of irradiation crosslinking process, should be designed according to product performance product structure and process route, like double-layer structure, three-layer structure, product shielding mode as the design content.

The cable industry always has been developing with the development of the materials and machinery industry. This development brought irradiation (E-beam) crosslinking technology to cable industry, having a significant effect on polymer materials like improving insulation resistance, voltage level, flame retardancy performance

E-BEAM CROSSLINKING ADVANTAGES & BENEFITS compared to CHEMICALLY CROSS-LINKING for XL - CABLES

- No Silane – chemical additives used gives **environmentally friendly characteristics.**
- **No more side defects and unwanted chemical reactions** because of usage of chemical additives e.g., Silane, Peroxide
- **Degree of crosslinking** can be easily controlled by the arranging amount of e-beam dose.
- Higher **current carrying** capacities and better **short circuit** characteristics.
- Higher **insulation resistance** allowing higher voltage level.
- Increased **Tensile** strength.
- More **Abrasion** resistant
- Higher **Melting Points** and **higher Thermal resistance.**
- Resistant to **Higher Temperature** that gives long life 30 years instead of 25 years.
- More resistant to **Chemicals, Oils, Acids and Fluids.**
- More **Flame Retardant** and very **less dripping** in case of fire.
- More resistant to **Mechanical Forces, Stress Cracks, Crush resistant**
- E-beam solution provides **much better insulation & jacketing crosslinking homogeneity.**
- Advantages for cable costing due to **less cost of insulation & sheath compound.**
- Short crosslinking - curing time allow better delivery time.

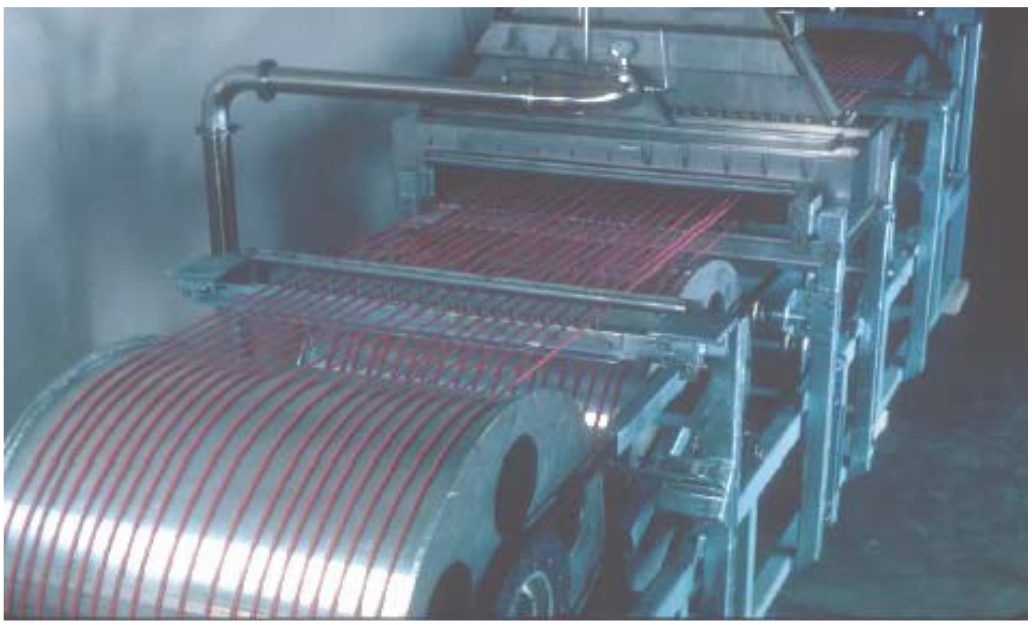

Figure 3 – Cables under electron beam