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Study Committee B1

Insulated Cables

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Towards Sustainability: A Power Cable Industry Supplier´s Perspective

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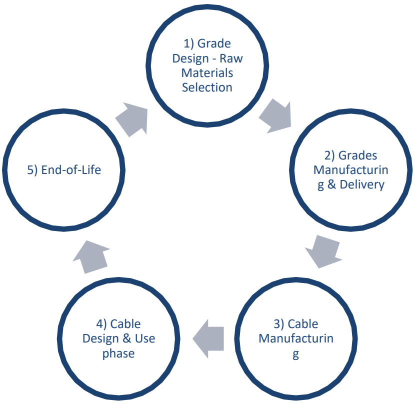
Motivation

Polyolefins (PO) are an important component of power cables. This paper presents various contributions of polyolefins along their lifecycle and how they can contribute to sustainability in the wire and cable industry.

Approach

Levers that can be employed to progress towards net-zero emissions and pathways to minimise impact on the environment and health are explored in this paper. It considers how polyolefin products can be manufactured, handled, used and disposed of, in order to contribute to an improved sustainability specifically in power cables.



Objects of investigation

1) Decoupling the polyolefin industry from using virgin fossil fuels as a raw material. Three major options are available: (i) *mechanical recycling*; (ii) *chemical recycling*; and (iii) *use of renewable feedstock*.

2) Polyolefin manufacturing typically includes hydrocarbon cracking followed by polymerisation into polyolefins. The emissions can be reduced via several actions and can be measured and reported as described in the green house gas protocol initiative (scope 1-3).

3) Properties of polyolefins can be optimised to enable a more efficient cable manufacturing. For example, solutions have been developed to have a lower degassing burden.

4) When the cable has been produced it will operate for decades. An LCA study showed that high thermal losses during the use phase is the main contributor to CO2 emissions during the lifetime of a cable. This makes cable design and material selections important parameters.

5) XLPE insulated cables can be recycled. Whe<<<<<n mixed with HDPE or PP, a new polymer material with improved impact resistance is obtained.

Discussion

Power cables are 'enablers' in the transformation of our energy system from fossil-based to renewables-based, through the integration of renewables from onshore and offshore wind and solar.

Key is that materials used in power cables are designed with circularity in mind without compromise on performance or reliability of these critical assets

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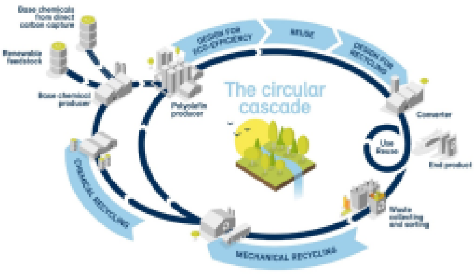

Given the scale and complexity of the polymerisation process and associated assets, an 'overnight' transition from fossil–based feedstock materials to a fully circular economy is not realistic. It also has to be kept in mind that a sustainable power cable polyolefin solution cannot compromise other key aspects such as quality and reliability. The authors believe that an analysis that covers the whole value chain will provide the required holistic view to make the best and most efficient choices to achieve sustainability while maintaining performance and reliability for the future.

Conclusion

- Power cable applications and its need for long lifetime and reliable energy supply as well as improved sustainability requires close cooperation across industry stakeholders.

- Several steps in the process have been introduced, evaluated and discussed. There are several aspects to sustainability of polyolefins in power cables. It includes the selection of raw material to the disposal at end-of-life, through a use phase that is one of the longest for a polyolefin application which has a substantial impact on the energy consumption and therefore sustainability.

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continued

Summary overview of circular options for polyolefins

	Emissions reduction	Plastic waste use	Virgin-like Quality	Perspective/further improvement efforts
Mechanical recycling	++	Yes	No	Improved collection/ sorting/cleaning for better output quality
Chemical recycling	+	Yes	Yes	Energy efficiency and CO2 balance in chemical reaction
Bio-based feedstock	++	No	Yes	3rd generation bio-feedstock from e.g. algae [11]

i) Mechanical recycling (1)

- Mechanical recycling means that the plastic parts are milled or shredded to finer parts/particles. These “flakes” can then be molten and compounded into new pellets.
- Consistent quality and right quantity is demanding and thus sorting and cleaning is essential
- Attractive from a carbon footprint perspective

ii) Chemical recycling (1)

- In this process low quality mixed plastic waste not suitable for mechanical recycling could be used
- Technology breaking down the plastic waste into chemical building blocks
- Several technologies are technically ready and proven at first industrial scale
- With this technology, recycled plastics could be used in high quality applications

iii) Renewables or bio-based feedstock (1)

- To avoid competition with the food industry, the state-of-the-art consists of renewable feedstock coming from biogenic waste and residues from e.g. vegetable oil refining
- The CO_2 absorbed by the plant during its growth is “captured” in the biomass used as feedstock. This captured carbon is considered a carbon storage in a lifecycle analysis (LCA). In the “cradle-to-gate” LCA for polyethylene (PE) production, it is evaluated that using bio-based feedstock instead of fossil feedstock reduces the carbon footprint by 1.9 tons of CO_2-eq per 1 ton of PE.

Grade manufacturing process (2)

- Scope 1: Own operation: Power and electricity source and electrification
- Scope 2: Indirect: Efficiency in machines and operations as well as clean energy using renewable energy
- Scope 3: Choice of raw materials, logistics and packaging, recycling.

Cable Manufacturing (3)

- Properties of polyolefins can be optimised to enable more efficient cable manufacturing. For instance, a material enabling cable extrusion at lower temperatures while delivering the same performance will positively impact the sustainability profile of said cable.
- XLPE is currently the material of choice for power cable insulation since it offers an attractive combination of thermal, mechanical and electrical properties that deliver both performance and reliability.
- Suppliers need to assist the cable industry to achieve compliance with regulations by e.g. supplying relevant data/information for safe handling. This requires good organisation at the polyolefin manufacturer to monitor constantly evolving regulations and provide reliable and accurate data.

Cable Design & Use phase (4)

- Operating a cable at higher voltage would typically involve more polyolefin materials, but would also result in lower conductor size, reducing the amount of metal required and therefore contribute to a more sustainable cable
- The cable design phase is thus probably the most important key phase to determine the performance capability that the new cable will release over the life cycle.
- The cable once produced will operate for decades, and the sheer duration of this “use phase” shows the criticality of the sustainability profile of the power cable.

End-of-Life (5)

- Grinded XLPE waste could be blended with HDPE and PP with improved properties like impact strength, giving an added value as a "new" raw material
- There are other methods to improve the mechanical recycling of cable materials, such as stripping the different layers of the cable