LCA FOR TELECOMMUNICATION CABLES

Markus Terho
Nokia Research Center
P.O. Box 45
FIN-00211 Helsinki, FINLAND

Abstract—This LCA for telecommunication cables has been carried out in accordance with the SETAC "Code of Practice" for conducting an LCA. The study was defined to comprise of all manufacturing processes from raw material acquisition to the final disposal including transportation phases and the use of the product. The LCA made showed clearly the domination of the cable raw materials manufacturing when considering the environmental burdens and impacts caused during the whole life cycle of the product. The improvement assessment made, as part of the LCA, also clearly demonstrated that by changing materials and disposal ways of the product significant improvements in the environmental impacts could be achieved.

I. THE MOTIVATION

The motivation for conducting an LCA for telecommunication cables was primarily to gain basic knowledge of Nokia Cables' own products and processes by studying the life cycle of a typical fibre optic cable, and secondly to compare different options within the studied process with the objective of minimizing environmental impacts. Of course, the study results can be used for many other applications in the future e.g.: comparing different processes, products and materials; supporting R&D and long-range material planning; identifying worst materials or processes; providing guidance in long-term strategic planning concerning trends in product design; providing customer information; and using the results in marketing to enhance market competitiveness. This paper is based on a master thesis made for the Helsinki University of Technology [1].

II. THE PRODUCT

The studied product was a typical home market 12 fibre Spiral Space optical cable. A commercial picture of the studied cable is presented in Fig. 1. and the structure of the cable is shown in Fig. 2.

III. THE METHOD

The method used in the study is based on the SETAC guidelines for life cycle assessment with the exception of substituting human and ecological health with more precisely defined impact categories.

The primary data (i.e., information directly obtained from individual companies) for the inventory was gathered with a questionnaire which was sent to all material suppliers of the cable. Secondary data was obtained from different published sources and all data, both primary and secondary, was cross-checked from several sources to identify data quality.

After the inventory a preliminary LCA was conducted and based on its results only the four environmentally significant materials - PBT, steel sheath, steel wire and PELD - were assessed in more detail. Following this the
study was divided into two modules: the first module covered the cable life cycle from cradle to gate and the second module covered the full life cycle from cradle to grave.

IV. THE TOOL

The LCA-software used in the study was an updated copy of the SimaPro3 analyst version. It is build with a number of methods to classify and weight or characterize impacts. In classification and characterization emissions are divided into nine different categories: greenhouse effect, ozone layer depletion, acidification, eutrophication, summer smog, heavy metals, winter smog, carcinogenic substances and pesticides [2]. These categories are based on the most prominent environmental problems we are facing today.

Pollution and extraction are forms of impact on the environment. In SimaPro, there are four main categories of impact: airborne emissions, waterborne emissions, solid emissions and raw materials. Within these categories, each kind of impact is identified as the exchange of a particular substance with the environment. This "substance" can be a pollutant like dioxin, a waste product, or a raw material or energy source like coal. Emissions involve the release of a substance into the environment, while the use of raw materials involves the extraction of substances from the environment [2].

V. THE RESULTS

The results of the study can be presented in various ways: in an inventory table, in a process tree, and in different charts of the impact assessment. In this paper the results are presented in a nutshell.

The process tree of the studied modules - extremely simplified - is presented in Fig. 3. In the figure the first module is drawn with a dash line to bring it out from the second module.

A. First module

The impact assessment results for the first module, which includes all production and transportation phases from raw material extraction to cable manufacturing, is presented in Fig. 4.

Fig. 4. Environmental effects per phase.

From the picture it is clear that PELD is the dominant material followed by the two steel parts and PBT. The manufacturing of an optical cable seems to have environmental effects of little importance.

In the above figure the magnitude and the order of importance comes especially clear. Therefore the process of selecting the targets for improvement assessment for the first module becomes quite simple.

B. Second module

The full life cycle, which includes the first module and the later phases of the cable life cycle: transportation of the cable, installation, energy use of 30 years, and the disposal - at present to a dumping-ground, is shown in Fig. 5.

Fig. 5. Environmental effects of different life cycle phases.
The full life cycle is dominated by three factors: the first module (referred as optical cable in Fig.5.), installation and disposal (waste). The consumption of energy during 30 years of use and transportation of the cable - in Finland - seem to have very little effects on the environment.

C. Scenarios

Based on the LCA results two different improvement assessment scenarios were carried out. The first one studied the impacts of different sheathing material choices and the second concentrated on differences between two feasible disposal options.

In the first scenario the environmental impacts of PELLD and PEHD were compared to the current sheathing material - PELD. The comparison results are presented in Fig. 6 and 7.

![Fig. 6. Comparison of PELLD and PELD](image)

From the above picture we can see that all impact categories are smaller with PELLD when compared to PELD. This is mostly due to the fact that manufacturing of PELLD is more energy efficient than the manufacturing of PELD.

![Fig. 7. Comparison of PEHD and PELD](image)

Also changing the seating material from PELD to PEHD seems to improve the overall environmental impacts.

In the second scenario the differences between two feasible disposal options - landfilling and incineration - for fibre optic cables were assessed. The result of the comparison are presented in Fig. 8.

![Fig. 8. Comparison of landfilling and incineration](image)

Disposal by incineration seems to lessen the total environmental impacts of the whole life cycle of the cable. Naturally this means that the incineration has to be done in such a way, that energy is recovered and the flue gases are treated properly. Otherwise incineration increases the overall emissions released.

The improvement assessment - based on the studied scenarios - suggests that by changing both the sheathing material from PELD to PELLD and, at the same time, the disposal method from landfilling to incineration the environmental impacts - in ecopoints calculated with SimaPro - of the cable will decrease significantly.

VI. THE CONCLUSIONS

Based on the LCA results it is quite evident that the first module and waste disposal are the most dominant factors, and the first module is dominated by PELD. The most significant environmental improvements can be found in changing the sheathing material and the way of disposing of the used cable.

REFERENCES