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SUSTAINABILITY AT TEIJIN ARAMID: PROVIDING AND INCREASING CUSTOMER VALUE THROUGHOUT THE LIFE CYCLE

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ABSTRACT

Since 2008 Teijin Aramid used Eco Efficiency Analysis as a method to compare ecological and economic impacts over the full value chain. Since 2011 Teijin Aramid and Ecomatters developed the Customer Benefit Model (CBM). This model compares specific solutions over the full value chain from the perspective of the user – and is modeled together with the relevant chain partners. All kind of variables can be built into the CBM to adapt to changing circumstances. This way, customer and situational specific calculations can be made for current and future situations. The CBM has proven to be an effective tool in providing the edge in convincing customers and other chain partners of the financial and ecological benefits of our products.

INTRODUCTION

In general, lightweight and long-lasting solutions (so called smart solutions) can lead to resource savings, lower CO_2 emission and a smaller ecological footprint along the whole value chain. In many applications this can be achieved by the use and reuse of Twaron® (an Aramid fiber produced by Teijin Aramid). The comparative impact of smart solutions can be calculated by using the Teijin Aramid Customer Benefit Model.

METHODS

To analyze, quantify and present the performance of our products compared to mainstream in the areas of environmental and economic impact, Teijin Aramid has in co-partnership with Ecomatters, developed a model that uses the principles of an Eco-Efficiency Analysis (EEA). The model shows the added value for every actor throughout the whole life cycle. This identifies potential competitive advantages of our products for every partner in the value chain.

Our model is called the "Customer Benefit Model" or CBM. It is used to support a business case by comparing mainstream products with Twaron® based solutions (products) for the same functional unit. The CBM starts with a mutual qualitative assessment. By using a stage gate process it will potentially result in a quantitative model with three main components:

1) Environmental assessment based on Life Cycle Assessment (LCA), which comprises basic environmental impact data: energy and CO_2 emissions throughout the whole product life cycle.
2) Financial assessment based on the Total Cost of Ownership (TCO). By using the TCO, we analyze the costs structure of the product life cycle and we calculate the payback time, the Net Present Value (NPV) and Internal Rate of Return (IRR)
3) Current and future scenarios can be quantified by changing values of variables.

By building cases together with value chain partners via an interactive and iterative process, the outcomes of the process are shared and accepted by all participants.

RESULTS FROM CASE STUDIES

Two case studies are described below: Steel reinforced conveyor belts in comparison with Twaron® reinforced conveyor belts used in mining operations, and steel gas cylinders compared to Twaron® reinforced composite gas cylinders.

Case study: Conveyor belts

Conveyor belts are used in mining operations to transport ore. These belts can measure up to 10 km in length. As basis for this study, we used the results of Lodewijks (2012) for mines in South Africa as input for our model.

By replacing the steel reinforcement by Twaron® fabric, a weight reduction of the empty belt of 40% is achieved. This is caused by two major drivers; the lower weight of the Twaron® fabric, and less rubber per square meter.

Twaron® reinforcements in conveyor belts can be combined with adding Sulfron® to the rubber. Sulfron®, a Twaron® based product reduces hysteresis in rubber, leading to a reduction in rolling resistance (Van den Hondel, 2012). The reduction in cumulative energy demand for the replacement of steel is 13,5%. Additionally, adding Sulfron® gives another 11,5% reduction. The total effect of lower weight and less rolling resistance leads to a 25% reduction in energy use

Some figures:

Weight reduction	**40%**
Energy savings:	**25%**
CO_2 emissions savings:	**depends on grid**
Payback time:	**some months**

Figure 1: Picture of South African Conveyor belt, with some results of the calculations.

In this case study with the Customer Benefit Model, the variables were the type and price of energy, the energy source (e.g. coal, wind etc.), rubber price and carbon pricing. Energy prices and the type of energy differ per region. Additionally, rubber and energy prices often fluctuate over time. We provided for every customer a tailor-made calculation of the energy and CO_2 emission savings and the yearly financial benefit. The latter was expressed as NPV, IRR and pay-back time, in order to give an easy and understandable evaluation of the results. Financial effects strongly depend on local prices of energy and rubber. Payback time is a few months, and the IRR is far above 200% (Bosman et. al, 2012).

Case study: Gas cylinders

For gas cylinders weight reduction is the main driver for replacement of steel by using Twaron® as reinforcement material whilst assuring intrinsic safety. By comparing both solutions over their lifetime, it became clear that for regions with a tropical climate maintenance is an extra driver. A steel cylinder needs to be repainted several times during the lifetime, whilst for the Twaron® based composite gas cylinder this is not necessary.

We considered the lifetime of both as equal, and both are fully recyclable. A big advantage in the use phase is the lower weight of the cylinder: 16,4 kg for steel compared to 4,3 kg for Twaron® based composite cylinders. Maximizing cost performance in the chain expressed in the financial benefits leads for tropical regions to 40% reduction. Over the lifetime of the gas cylinders at least 33% energy and CO_2 emission savings are realized. The positive effects of less weight during transportation over the total lifetime are expected to be significant; these effects are not taken into account yet.

Case study gas cylinders: some figures

calculated over the total lifetime of 25 years

Weight reduction (empty): 74%

Primary energy savings: 33%

CO_2 emission savings: 33%

Cost reduction (TCO): 40%

Note: transport is not included yet.

Figure 2: Case study Gas Cylinders: some figures.

CONCLUSION

The CBM can be used to quantify effects over the whole life cycle of smart solutions. It supports business cases by quantification of financial and ecological advantages of Twaron® based solutions in comparison to the current mainstream. Current and future scenarios can be quantified by changing values of variables. By using the CBM it proves that sustainability can be a driver for business development. It connects environmental performance with sound and sustainable business cases.

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