LIFE CYCLE ASSESSMENT OF A TYRE: TOWARDS THE DESIGN OF TRULY SUSTAINABLE MATERIALS AND PROCESSES

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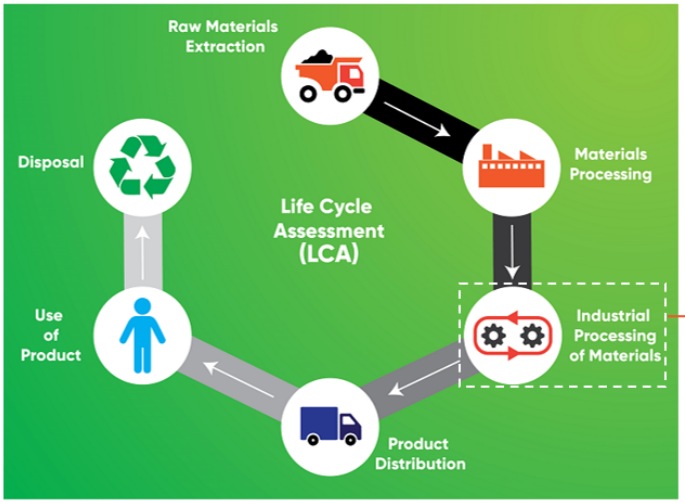
Tire industry holds significant environmental relevance due to its intensive use of natural resources, emissions associated with production, and disposal of end-of-life tires. From this perspective, Life Cycle Assessment (LCA) has become a crucial tool for evaluating the environmental impact of product throughout its entire life cycle.

LCA can provide a comprehensive overview of the environmental implications of a tire production process across all stages, from raw material extraction and processing to component manufacturing, assembly, and finishing. Therefore, integrating an LCA study into decision-making processes can ensure environmental and economic benefits, allowing for the identification of "hot spot(s)" during the process and enabling companies to adopt strategies for improving efficiency and developing more eco-friendly products.



In-depth exploration of the individual transformation processes in tyre manufacturing

- Determination of the **environmental impact** of each processing step
- Identification of **opportunities** to improve the environmental performance of the hot-spot(s)
- **Material-specific** evaluations
- **Synergy** with other departments for the acquisition and usage of new primary data in LCA analysis

The tire companies are considering the use of recycled and/or more sustainable raw materials. Unfortunately, the use of "greener" materials is not necessarily advantageous for the environment. Besides assessing the actual benefits of resorting to recycled/bioderived resources, which can bring non negligible additional burdens, the use of new materials requires substantial changes to the production chain. This implies the necessity of building a detailed model of the whole tire production phase following the LCA rules.

This PhD project aims at a detailed analysis of the transformation processes for tyre manufacturing (mixing, semifinishing, curing) based on a LCA approach «from cradle to gate», having raw materials acquisition and the realization of the final product as boundaries. Assessments will be done via material-specific evaluations (e.g. different emissions in mixing of CB- and silica-based rubber compounds) through a collaboration between the several industrial departments for the LCA primary data acquisition. The interpretation of LCA results and the determination of the environmental impact will be used for the individuation of the most critical process stages for benchmark and as a starting point for technical solutions in alternative systems aimed at the minimization of the environmental burden.

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