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INTELLIGENCE BULLETIN #12

IMPORTANCE OF LIFE CYCLE ASSESSMENT IN THE VALUE CHAIN OF PERMANENT MAGNETS

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Life Cycle Assessment (LCA) has emerged as a crucial tool for evaluating the environmental impact of products throughout their entire lifespan. In the context of permanent magnets, which play a vital role in numerous technological applications, understanding and optimizing the environmental aspects of their value chain is crucial. This report delves into the significance of LCA in assessing the environmental impact of permanent magnets, examining their production, use, and end-of-life phases.

INTRODUCTION

Permanent Magnets (PMs), including neodymium, samarium-cobalt, and ferrite magnets, are indispensable components in various industries like electronics, automotive, renewable energy, and healthcare. The demand for these magnets continues to the rising trend, so it becomes imperative to assess and mitigate their environmental footprint.

LIFE CYCLE ASSESSMENT (LCA) OVERVIEW

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LCA is a comprehensive methodology that evaluates the environmental impact of a product or process, from raw material extraction to disposal. It considers factors such as resource use, energy consumption, emissions, and waste generation. Applying

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LCA to the PMs value chain provides a holistic perspective on their sustainability. LCA has become an essential tool for businesses, policymakers, and researchers to minimize the environmental impacts of products and processes, and to contribute to a more sustainable and responsible decision-making. LCA considers all the different stages of the value chain which can be divided in four main groups:

1. RAW MATERIAL EXTRACTION AND PROCESSING

The extraction and processing of the raw materials is the first stage of the value chain. LCA helps identify the environmental implications of mining activities, energy consumption, and chemical processes. Initiatives to reduce the environmental impact at this stage include sustainable mining practices and recycling efforts.

2. MANUFACTURING AND PRODUCTION

The production phase involves transforming the raw materials into magnets. LCA evaluates the energy consumption, emissions, and waste generation during manufacturing. Optimizing production processes, using eco-friendly materials, and adopting energy-efficient technologies can minimize the overall environmental impact.

3. PRODUCT USE AND APPLICATIONS

The energy efficiency and durability of permanent magnets will be a key parameter during their application. LCA assesses the environmental impact of these magnets in devices such as electric motors, generators, and medical equipment. Products with longer lifespans and higher energy efficiency contribute to a smaller overall footprint.

4. END-OF-LIFE MANAGEMENT

The end-of-life phase will involve strategies for recycling, reusing, or properly disposing of magnets. LCA guides the development of efficient recycling processes,

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reducing the need for new raw materials and minimizing waste. Implementing take-back programs and designing magnets with recyclability in mind are relevant considerations.

CHALLENGES AND OPPORTUNITIES IN PASSENGER PROJECT

Challenges

PASSENGER project, aims to develop innovative technology to produce permanent magnets based on rare earth free materials such as Mn-Al-C alloys and improved strontium ferrite.

One of the primary challenges faced in this context is the scarcity of comprehensive LCA data for Mn-Al-C magnets and improved ferrite. Gathering accurate and detailed data for these alternative materials could pose difficulties, reflecting in the accuracy of the LCA.

The magnet production value chain is intricate, involving various stages, from raw material extraction to end-of-life. Conducting a thorough LCA for each stage presents a challenge due to the complexity of the supply chain and potential variations in manufacturing processes.

The PASSENGER Project involves technological innovation, and the development of Mn-Al-C magnets and improved ferrite. Keeping LCA data up-to-date will be important to reflect technological advancements and changes in the production process which can be challenging.

The magnet industry operates within interconnected global supply chains. Assessing the environmental impact of alternative materials may require considering the global nature of supply chains.

Determining the environmental impact of Mn-Al-C magnets and improved ferrites at the end of their life cycle, including recyclability and disposal, is challenging. The

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lack of an established recycling infrastructure for these materials may affect the overall sustainability profile.

Opportunities

- LCA provides an opportunity to highlight the environmental benefits of replacing rare-earth magnets with Mn-Al-C magnets and improved ferrites, enhancing the project's credibility and attractiveness.
- LCA results can guide strategic decision-making within the PASSENGER Project. The insights gained from the assessment can inform decisions on material selection, manufacturing processes, and supply chain optimization to minimize the project's overall environmental footprint.

- LCA could be used as a tool for communication with stakeholders, sharing the LCA results with customers, investors, and the general public can foster trust and support for the project, showing commitment to sustainability and responsible environmental practices.
- LCA is an iterative process that allows for continuous improvement. The PASSENGER Project can leverage LCA to identify areas for improvement and implement changes over time, ensuring a commitment to ongoing sustainability enhancements.
- LCA results can be used to demonstrate compliance with environmental regulations and standards. Demonstrating compliance with sustainability goals can facilitate regulatory approval and support for the project.
- Highlighting positive LCA results can serve as a valuable tool for market differentiation. Demonstrating a superior environmental profile can be used as a competitive advantage in the marketplace.
- LCA will play a crucial role in how well the PASSENGER Project aligns with circular economy principles, emphasizing the importance of recycling and

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end-of-life considerations. This alignment can contribute to the broader goals of sustainability and resource efficiency.

CONCLUSION

Life Cycle Assessment plays a pivotal role in understanding and improving the sustainability of permanent magnets throughout their value chain. By identifying environmental hotspots and implementing targeted improvements, stakeholders can contribute to a more sustainable and environmentally responsible future for the permanent magnet industry.

As the demand for permanent magnets grows, integrating LCA into the decision-making of the project processes becomes more important for companies and industries to know the environmental goals and contribute to a more sustainable global economy.

In the framework of PASSENGER project, balancing the challenges and opportunities requires a robust and adaptable LCA framework, that will allow for flexibility in addressing emerging issues and incorporating new data as the project progresses. Update and refine the LCA data will be crucial for maintaining the project's commitment to sustainability and environmental responsibility.

Additional information can be found in the following links:

- EU’s knowledge base that responds to business and policy needs towards sustainable production and consumption: https://eplca.jrc.ec.europa.eu/
- Environmental Footprint methods: https://green-business.ec.europa.eu/environmental-footprint-methods_en

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