Sustainable Melting: The Role of Recycled Low Alloy Aluminum

Marcelo Andres Mejia Espinal
Wesley Nicholas Episcopo

Have you ever wondered what happens to the aluminum in old car parts? Can something be done to the material before it is thrown away as scrap? Our project dives into the process of recycling heavily oxidized car chillers to produce high-quality low alloy aluminum, focusing on environmental and economic impacts while experimenting with methods on how to achieve the desire material.

During this thesis, we explored the melting process of recycled low alloy aluminum in partnership with BRYNE AB, designing quality experiments to determine the effects of salt treatment used in aluminum melts. Through this method, we leveraged the company's quality techniques to determine the understand the viability of the aluminum we were working with to later propose a cost and carbon emissions model in relation to enhance economic viability of the process and comprehend its environmental impact.

Our research revealed significant challenges in maintaining the purity of the alloy during the melting process due to the presence of oxides and impurities forming in the melt. The salt treatment helped reduce gas content, to be specific hydrogen, which is essential for quality checks. Imagine you pour carbonated beverage in a transparent container. Bubbles will form due to the soda inside the beverage. These are air bubbles. If these bubbles stay within an aluminum melt and you pour them into a mould, for example, the surface will become uneven and will weaken the overall structure of the melt. Hydrogen content is one of these and salt effectively helps reduce it.

As one of major goals is improve the quality aluminum, the chosen salt treatment was not as effective to remove impurities and oxides, which are critical for aluminum melts. The quality methods we used during our experiments helped us determine that there were no noticeable improvements but, in some cases, it worsens the material. Future experiments are required to test other types of salt refinement methods as well as other treatment techniques that may yield positive results.

With a thorough understanding of what is happening to the aluminum melt after the experiments and research done in parallel, we proposed two mathematical models: a cost model and a carbon emissions model. The models include detailed components of the melting process we worked on, something not seen in research so far. The idea behind these models is to promote accurate calculations of both cost and carbon emissions to help in the decision-making process of companies in changing materials, operations, procedures, to name a few.

Moreover, the models proposed in this project supports global sustainability goals by promoting the use of recycled materials and accurate carbon emissions monitoring, aligning with initiatives such as the Science Based Targets (SBT) for reducing emissions.

In conclusion, our research highlights the potential for significant environmental and economic benefits through improved recycling practices. By addressing impurities and optimizing the melting process, we can enhance the quality of recycled aluminum, contributing to a more sustainable and efficient industry while monitoring such contributions through detailed mathematical equations that will facilitate a company record and track their cost and emissions for a more sustainable future.

Hopefully, you are interested in reading the full paper to understand the process of how to investigate an important process in manufacturing industry and find ways to improve it for it to become sustainably viable, now more important than ever in a time where emissions and costs are critical to control.