Dross: A Solution to the Conflicting Goals of Maximum Economic Returns and Minimal Environmental Footprint

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Abstract

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In a world increasingly conscious of its ecological responsibilities, the pursuit of economic growth and environmental sustainability often appears as a conflicting dilemma. Businesses face the challenge of maximizing profits while minimizing their environmental impact. This presentation spotlights a solution that has solved these conflicting goals for aluminum dross, providing an important building block for sustainable economic growth in the aluminum industry.

The presentation commences by emphasizing the urgency of reconciling economic growth and environmental stewardship in the context of the aluminum industry in general and dross in particular. The aluminum sector, a vital player in numerous industrial applications, generates substantial wastes including dross during the production and the recycling of the metal. Concurrently, emissions are generated not only in the production of the metal but also in the treatment of those waste streams.

Typically, dross generated in primary cast houses ranges from 0.5 % to 2.0 % of metal by weight for primary production. At secondary smelters, dross of up to 10 % of aluminum produced is common when recycling less clean scraps. With the industry growing as a whole and scrap recycling even more so, the issue of dross generation is on the rise presenting a challenge and substantial waste reduction opportunity.

Historically aluminum dross has been cooled after being removed from the furnace it originated in, transported to a recycling facility and then re-heated there utilizing tilting rotary furnaces (TRFs) to recover aluminum metal. To maximize recovery rates (i.e. the economic return), the industry has turned to adding salts in the metal recovery process to preserve metal during reheating. The toxic non-metal residuals of these processes have historically been landfilled. With this practice being at direct odds of environmental sustainability and an increasing number of jurisdictions outright outlawing it, technologies were created to render the residual materials inert. These waste treatment technologies present an additional cost that diminishes the economic returns and increases the overall emissions from metal recovery from dross. An example of the dilemma of conflicting goals in practice.

A carbon footprint analysis of dross processing technologies conducted by Ernst & Young Netherlands concluded that per 100 t of dross treated with the legacy process utilizing tilting rotary furnaces 26.9 t of CO_2 equiv. are emitted. The cleaning process of the residuals adds another 13.2 t of CO_2 equiv. per 100 t of dross yielding a total of 40.1 t CO_2 equiv. per 100 t of dross. As shown in Figure 1, 64 % of those emissions are Scope 1 from direct emission primarily from petroleum or natural gas fuel combustion (e.g. in furnaces).

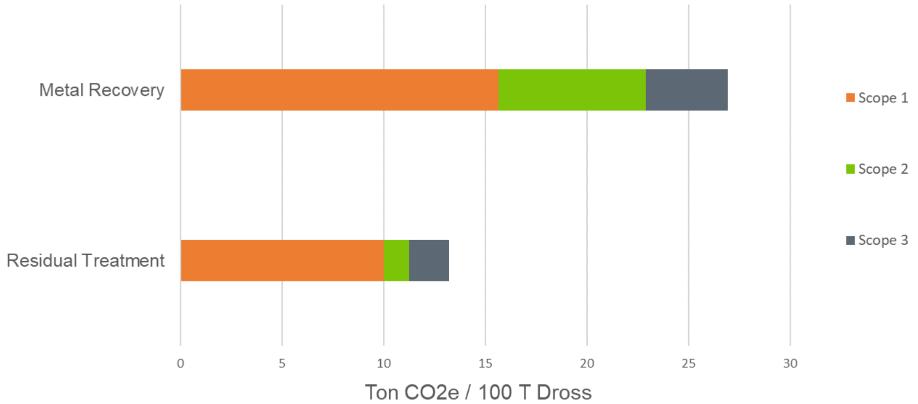

Figure 1. Legacy technology (TRFs) emissions benchmark.

The presentation will introduce the Hot Dross Metal Recovery Process (HDMRP). With this process aluminum metal can be recovered from aluminum dross and the residuals can be converted into valuable resources without the use of fossil fuels and a minimal energy requirement in full alignment with the principles of a circular economy and environmental sustainability.

The HDMRP was designed to use the energy inherently present in the dross when it is freshly skimmed from the furnaces it stems from, thereby avoiding the need for cooling, offsite transport, and re-heating. Furthermore, the need to add salts to maximize metal recovery rates is removed and thus, whilst obtaining highly competitive economic returns, the residuals are not contaminated through the metal recovery process and the need for additional cleaning processes is removed. Within the presentation we will also show the opportunity that the HDMRP provides to fully utilize all residuals as valuable secondary resources.

The Ernst & Young Netherlands carbon footprint analysis found that through utilizing the inherent energy within hot dross and eliminating the need to clean the residuals the total CO_2 equiv. emissions per 100 t of dross using the HDMRP are reduced to 7.5 t CO_2 equiv. (refer to Graph 2), an 81 % reduction compared to legacy technologies.

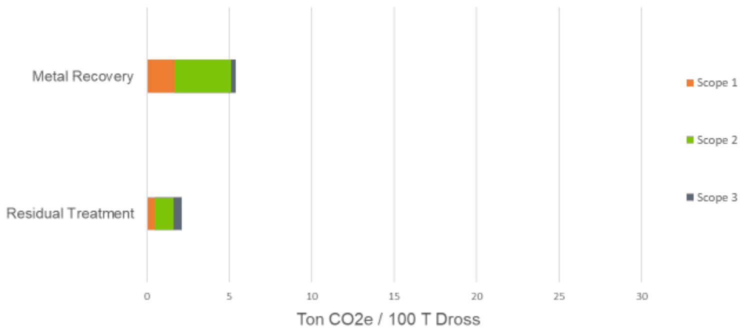

Figure 2. Hot Dross Metal Recovery Process (HDMRP) emissions benchmark.

By reducing the processing steps (no cleaning of residuals required) and removing the need for re-heating, cost savings logically follow. A case study has shown that cost savings of more than US$ 100 per tonne of dross are easily obtainable.

In conclusion, the presentation " Dross: A solution to the conflicting goals of maximum economic returns and minimal environmental footprint" introduces a sustainable alternative to maximizing metal recovery rates from aluminum dross. By converting waste into valuable resources and