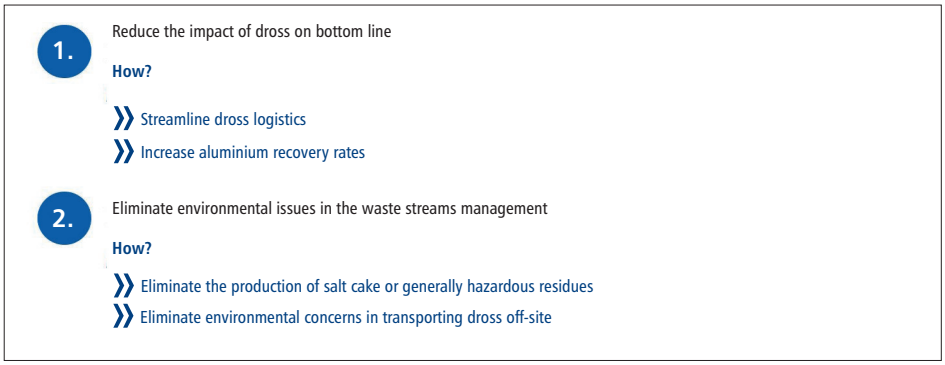
# Sustainable and profitable dross practices

By **David D'Aoust***

For the aluminium industry, the subject of dross has become a point of frustration. Globally, regulatory bodies have been steadily tightening environmental legislation, forcing smelters to reduce carbon footprints and reduce or manage their hazardous wastes in an environmentally acceptable fashion. Simultaneously, competitive pressures are continually forcing smelters to find new ways to reduce costs and increase production efficiencies. In summary, aluminium smelters are seeking to reduce the impact of dross on their bottom line, while eliminating the environmental concerns associated with the waste stream.

Unfortunately, today, the only standardised technologies for dross recycling although profitable to operate, create more environmental issues than they solve. The industry standard, Rotary Salt Furnace (RSF) is no longer acceptable from an environmental perspective. In the RSF process, dross is charged with a salt flux in the furnace. Salt is added in the furnace to protect the metal from oxidation and facilitate the separation of the metal from the oxides. As much as 50% salt can be added to the dross in RSF. Fluxing salts do an imperfect job of protecting recoverable metallic aluminium from oxidation or thermiting during processing and as a result as much as 10-20% of the metallic aluminium can still be lost to thermiting. Another 5-15% metallic aluminium is lost by merging deeply inside the oxides which have now become saturated in salts and are considered salt cake or salt slag residues. In total the RSF process will typically recover around 85% of the metallic aluminium that is contained within dross. The resulting salt cake residue is a mixture of oxides, metallic aluminium, salts and nitrides, and is extremely hazardous, presenting significant environmental challenges. Salt cakes are highly reactive in a landfill environment and, even worse, toxic leachates can be released, contaminating water tables. The salt vapours emitted by the process also cause their own challenges as they tend to be corrosive. For these reasons, it does not make economical sense for an aluminium smelter to operate RSF on-site and as a result, a comprehensive network of off-site dross processing companies have formed around the world, offering tolling services to the aluminium industry.

Figure 1. Impact of dross on the bottom line




In todays model, a typical aluminium smelter will allow their dross to cool so it may be transported to a toller's facility. During the cooling process, significant amounts of metallic aluminium contained within the dross is lost as it reacts with the atmosphere, thermiting and converting into aluminium oxides. The transportation of the cool dross is also expensive and in some cases requires special permitting. Loading containers or trucks with dross is very difficult and time consuming. In addition, during shipment, the dross cannot come into contact with water as it may react and release harmful and potentially flammable gases. In certain circumstances it is possible for the dross to spontaneously combust.

When the toller receives the dross, they will process the material for a fixed fee per metric tonne using an RSF system, and then return the aluminium, which was successfully recovered back to the smelter in the form of ingots. Finally the toller must decide what to do with the remaining toxic salt cake residues, and is therefore left with a significant environmental liability. This is a hidden liability for the smelter

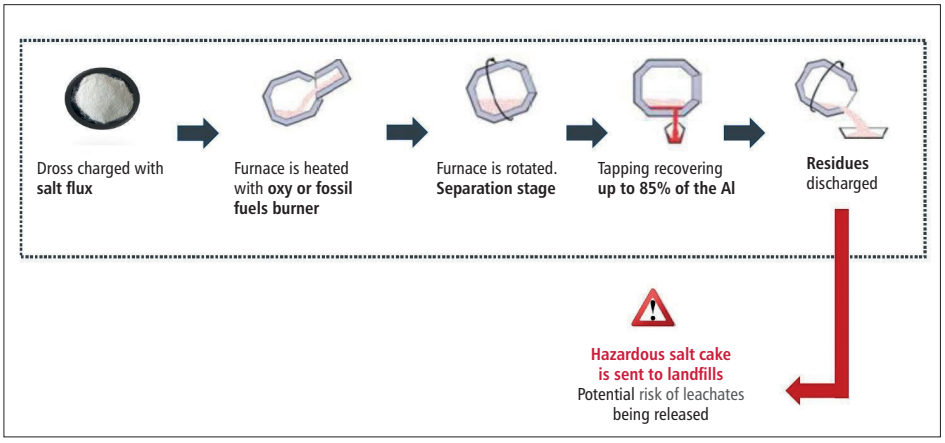



Figure 2. Rotary salt furnace process

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Figure 3. On-site dross supply chain versus off-site dross supply chain

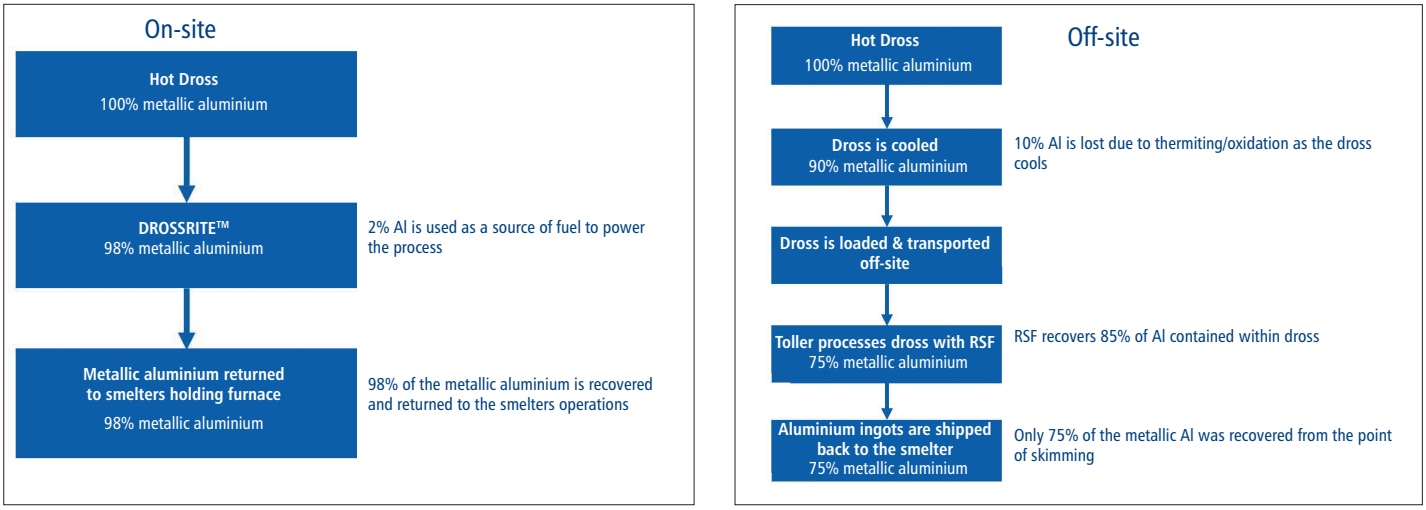
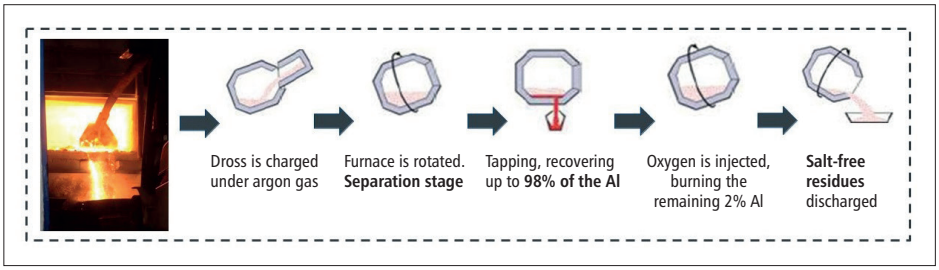



Figure 4. DROSRITE™ process




as well, as most developed countries have implemented extended producer responsibilities which ensure the smelter remains legally liable for their waste streams until end-of-life. In some regions of the world it is still possible to landfill this material under expensive permitting, although this is viewed as a short-term solution and these regions will likely eventually follow suit with the rest of the world in banning the landfill of salt cakes. In Europe, there is a growing capacity of salt cake processors, who utilise newly developed technologies to recycle the salt cakes and convert the material into an inert, stable residue. Unfortunately, salt cake processing technologies require a significant footprint and have high operating costs, which of course must be built into a toller's fees, increasing costs to the aluminium smelters.

To avoid salt cake production, some tollers have attempted to operate RSF without adding any fluxing salts. While it is possible to recover aluminium from dross with zero salt flux added using an adapted RSF system, it comes at a significant economic cost and yet does not solve the underlying environmental issues. The RSF process requires the use of a burner which means the atmosphere inside the furnace is uncontrolled. While the dross is being processed, it is continuing to react with the atmosphere inside the furnace and the metallic aluminium is thermiting and converting into oxides. Operating RSF without fluxing salts results in extremely low aluminium recovery rates, and the remaining residues will still be hazardous as they contain a significant amount of unrecovered metallic aluminium and a high concentration of nitrates, due to the prolonged exposure to the atmosphere at high temperatures. For these reasons, simply removing the fluxing salts from RSF operation is not a solution. Various other salt-free solutions have been explored over the years, none of which received worldwide recognition or standardisation, including the Plasma Rotary Furnace and DROSCAR. Both of these technologies were salt-free, but suffered from high CAPEX and OPEX costs, low aluminium recovery rates, and still produced a residue that was still challenging in its management as they contained high levels of metallic aluminium and nitrates.

It becomes clear why the aluminium industry has found dross to be a challenging subject. As regulatory bodies tighten restrictions on what can be land-filled and how waste streams must be managed, and market forces continue to drive aluminium smelters to seek cost savings and production efficiencies, there has not been any solution that can provide financial improvement and simultaneously solve all the environmental concerns associated with dross processing.

Fortunately thanks to a word-leader in thermal waste management technology, PyroGenesis Canada Inc., there is a proven salt-free dross recovery technology which increases aluminium recovery to 98% and eliminates the production of hazardous waste residues called DROSRITE™ available to the industry.

In the DROSRITE™ process, hot or cold dross can be charged into the furnace. The DROSRITE™ system will automatically inject a controlled amount of argon gas quenching any thermiting reaction and preventing further loss of metallic aluminium. The furnace rotates, separating the metallic aluminium from the oxides. The recovered metal is tapped and returned directly back into the smelter's holding furnaces in a molten condition or cast into ingots. The inert argon atmosphere protects the aluminium from thermiting and facilitates the metallic aluminium to separate from the oxides and coalesce, enabling the DROSRITE™ system to recover 98% of the aluminium that was contained within the dross.

Next, a partial amount of the remaining oxide/residue material is discharged from the furnace, and a small amount of hot residue material is left inside the furnace. This residue material still contains about 2% metallic aluminium, so the DROSRITE™ furnace injects a controlled amount of oxygen to which causes a thermiting reaction, oxidising the remaining metallic aluminium, which will increase the furnace temperature to prepare for the next charge of hot or cold dross.

Thus, DROSRITE™ does not require any external heat source (no burner required) or salt fluxes, making the process energy requirements very low and the carbon footprint significantly lower when compared to competing technologies. What is most important is that the final resulting residues are salt free, free of metallic aluminium, and have a low concentration of nitrates.

The simplicity of managing the non-toxic DROSRITE™ residues allows a compelling business case to be made for operating the technology on-site. ■