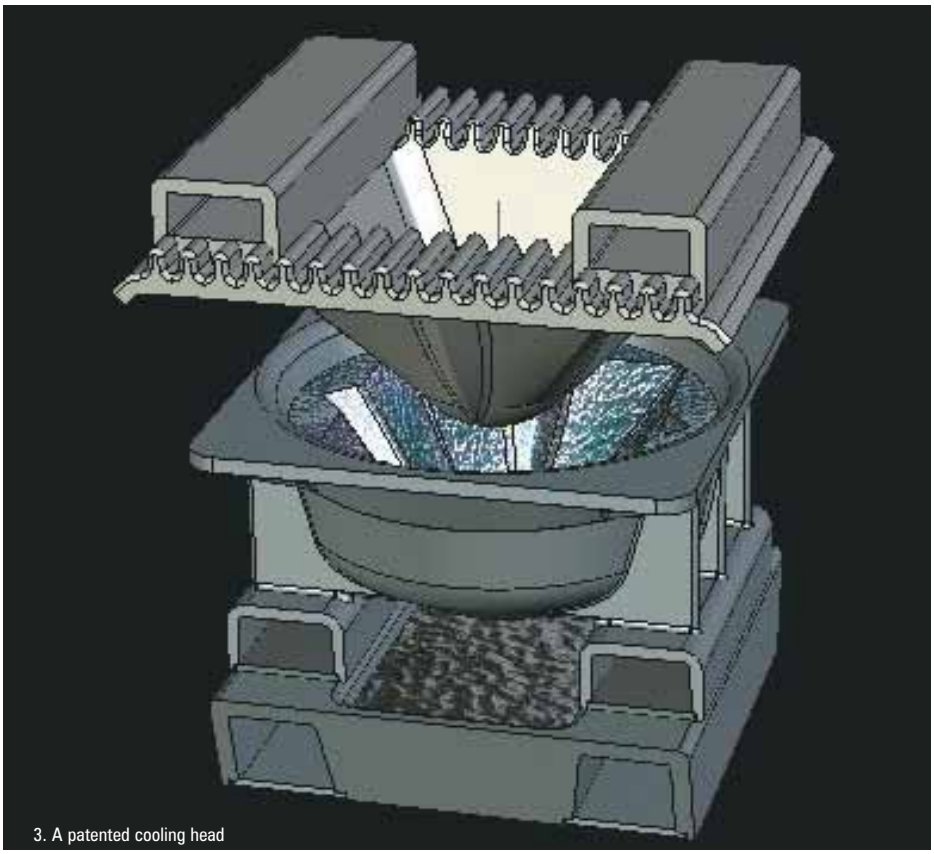
The art of dross management

James Herbert C.Eng, Business Development Manager, of the USA-based company of Altek-MD, describes procedures for maximising dross values and minimising dross generation.

Feature



3. A patented cooling head

While it is generally acknowledged that dross generation should be kept to a minimum, too often the importance to maximise the aluminium content of the dross is overlooked. Some mistakenly believe that a low metal content is a good thing and that the aluminium is being kept in the furnace. In reality, this metal is most likely being lost due to insufficient cooling and thermiting.

Much can be gleaned from looking at the dross that is generated in a casthouse; in fact, the quality of dross can provide a good indication of the overall efficiency of the operation. If the Reader's dross looks like that shown in fig 1, there is significant opportunity to not only improve the working environment but also the profitability of the organisation. Based on current aluminium prices, a recovery improvement of just 3% for a facility producing 500 tonnes of dross per month can provide savings in excess of $ 460,000 per year. Effective dross management also results in better metal quality, improved fuel efficiency, prolonged refractory life and improved yield in the entire facility.

Over the years, as facilities have focused on better dross cooling and handling techniques, dross recoveries have improved. Today, dross recoveries should be in the range of 60 – 70%. This article, the first in a series of three, will provide insight into the evolution of dross management and how internally generated dross should be handled. It is hoped the Reader can assess how efficient his current operations are and gauge the potential for improvement.

The second article will provide the criteria in which secondary processors should be evaluated to maximise the value of the dross being processed. A company can lose as much metal here, as in their own facility. The final article in this series will describe equipment and process techniques for minimising dross generation.

Floor cooling

Floor Cooling was the first and still is the most basic form of dross management, yet this practice can still be found in casthouses around the world today. This method of increasing metal recovery is accomplished by spreading the hot dross over aluminium ingots or a steel slab floor. After the dross is sufficiently cooled, workers will pick out the visible "chunks" of aluminium. Typically, this method will provide a total metal recovery of approximately 30%. While this is a significant improvement on doing nothing, it is a long way from the potential recoveries achievable when using today's available technology. This method of dross management is dusty and hazardous to the environment, equipment and plant personnel.

Dross stirring

Stirring first appeared in the industry in the late 1960's/early 1970's. The basic principle is that dross is skimmed directly into a refractory-lined container. The container is then transferred to the stirring machine which contains a paddle that stirs the dross. After a period of time (four to six minutes), the container is tapped into a sow mould. This method of dross management was the first to provide a considerable in-house drain (20 – 30%), due to the agglomeration of aluminium droplets. The stirring action however promotes oxidation and thermiting which results in a fine dusty material that is difficult to process at the secondary processor. Although this form of dross management was a step in the right direction, these systems suffered significant downtime and maintenance costs. On average, stirring will provide a total metal recovery of 40%.

Rotary dross coolers

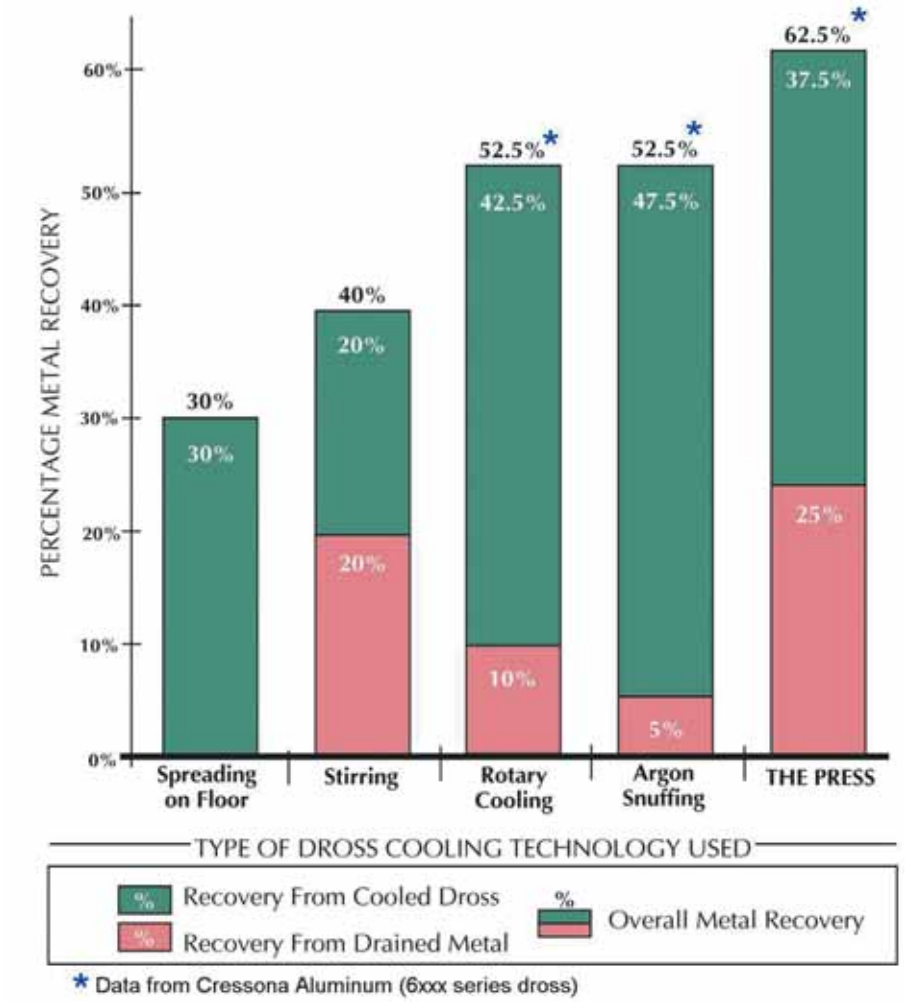
Rotary coolers made their first appearance in the 1970's. The cooler consists of four main components, a large drum which is externally water-cooled, a charging device, a trammel screener and an air-pollution control system. The dross is skimmed into skim pans constructed with drain holes to allow for natural in-house draining. The pans are placed into the charging device and tipped into the drum. The drum rotates and is either sprayed with water, submerged in water, or built with lifters that pour water over the shell. Typically, in-house recoveries are lower than those experienced with stirring machines; however, the superior cooling characteristics of this technology provide for an improved secondary and overall metal recovery typically ranging from 50 – 60%. Rotary coolers also have the advantage of being able to handle thermiting dross. Disadvantages of this technology include high capital and maintenance costs. Although relatively efficient, rotary coolers are seldom sold today due to safety concerns of hot dross and molten aluminium being processed over a pool of water.

Inert-gas dross coolers

Inert-gas-dross cooling systems became commercially available in the early 1990's. The system consists of heavy steel skim pans and enclosed cooling stations. In these stations, the atmosphere is replaced with argon gas, or in some cases nitrogen, which prevents further oxidation of the dross. Generally, the performance of these systems are similar to that of the rotary cooler; however, due to the slow nature of cooling (typically 12 – 24 hr) users will typically require many skim pans and cooling stations; this takes up significantly more floor space. It could be argued that the cooling characteristics of the skim pans is more effective in preserving metal units than the addition of the inert gas and it is not uncommon to find the skim pans being used without the cooling stations due to maintenance issues. The skim pans provide a small amount of in-house recovery, typically in the range of 5 – 10%. Secondary recoveries generally range from 40% to 50%.

Dross presses

The dross press became commercially available in the early 1990's and today there are several manufacturers that supply different versions of this technology. The pressing technology is based on the principle that a liquid placed under pressure will sep-



2 A study of dross recovery

arate from a solid and flow to the areas of least pressure. The press system consists of a steel frame, hydraulic unit, a pressing head and a set of skim pans. Once skimmed, the dross is transferred into the press and the head is slowly lowered. The pressure forces metal out into the sow mould under the skim pan and agglomerates the fine particles of aluminium on the outside surface of the dross; this encapsulates the oxides preventing dusting and thermiting (Fig 4). Dross presses were the first technology to reshape the dross, improving the casthouse environment and the recoveries at the secondary processor. The system not only rapidly cools dross but can also provide the highest in-house drain. Overall dross recoveries can range from 60 – 70%. Two areas where the dross press can be less effective are if the dross is too cold to press or if the dross is thermiting. Thermiting dross can be processed but requires practice revisions, longer cycle times and special cooling techniques.

Fig 2 shows the results of a study conducted at Cressona Aluminium in the mid 1990's comparing various dross management techniques. It is important to recognise that these tests were conducted using the same type of dross, ie dross from the same facility skimmed from the same furnaces managed by the same operators. This is the only way to compare technologies.

Cooling heads

Some of the latest technologies have been specifically designed for smaller operations that do not generate enough dross to justify a dross press. Cooling heads are very simple methods for improving the value of dross and consist of a skim pan and a matching cast steel cooling head (see fig 3). The head is positioned onto the dross, using a forklift, providing enough pressure to generate approximately half of the in-house drain experienced when using a dross press. Cooling heads can be effective for cooling thermiting dross since the heads are typically more massive than those used in dross pressing. The heads can also be left in place for longer periods of time to obtain the desired cooling. Overall metal recoveries are typically in the range of 40 – 60%.

Hot dross processing

A quantum leap in dross recoveries can be made if dross is processed in house using a tilting rotary furnace. This method of dross management has been predominately used in Asia, as well as some locations in Europe and the USA. Once skimmed, the dross is immediately charged into the rotary furnace which is essentially used to tumble the dross and coalesce the aluminium particles. After a period of time, the molten metal is poured out of the rotary and since it is the same alloy, can be put straight back into the melting furnace, making use of the available energy. The rotary furnace can be operated with minimal salt additions by charging clean scrap together with the dross. This helps cool the material and controls potential thermiting. This method of dross management can provide an additional 5 – 10% of metal recovery compared to dross pressing. By studying the process, significant improvements can also be made to the overall melt loss at a facility. This can equate to millions of dollars of potential savings per year. Cooling the oxide residue can become the major challenge in this process.

Summary

Over the last 20 years Altek-MDY has gained valuable hands-on experience with various dross management techniques, enabling casthouses around the world to maximise revenues and meet local environmental regulations. Commercial and environmental pressures will continue to make the aluminium industry ever more competitive. Those companies who focus on effective dross management will not only minimise their unit cost of production, but will also benefit from the many process and environmental advantages of a well-managed casthouse.

Reader Reply No.

1 The result of an absence of dross management

4 Dross Press in operation