Melting aluminium scrap

UK based company Melting Solutions Ltd (MSL) is a supplier of furnaces for scrap melting. The thirty tilt rotary plants that the company has recently supplied worldwide show that melting aluminium scrap makes sense. Clive Hall* explains.

Investments in scrap re-melting facilities are paying off across the whole spectrum of the aluminium industry including; primary, secondary, semi finished casthouses and the foundry/die casting sectors.

Recycling utilises resources and scrap is a low cost feedstock with huge energy savings, over the primary reduction route. A fact not wasted on the aluminium industry.

So, what are the key profit drivers for scrap melting? Low energy, high productivity and above all maximum metal recovery. To achieve these goals, when melting such a complex and varied material as scrap, the furnace and its process technology must be tailored to the operators needs.

MSL have years of experience melting scrap backed by a proven track record, in delivering many cost effective melting plants, worldwide, for all types of scrap.

The MSL Tilt Rotary plants continue to deliver. This is demonstrated in the following case studies, where results have been achieved on both oxy fuel and air fuel furnaces.

**Leading US recycling company – Kentucky commissioned 2013**

The 15T capacity tilt rotary is equipped with the latest natural gas hybrid burner technology able to fire with oxy-gas or air/oxy gas to optimise combustion conditions, metal recovery and fuel cost. A further breakthrough on this plant is a new side loading charging system able to charge without stopping the melting process. This is made possible by Melting Solutions furnace door system, which can open in both horizontal and vertical planes.

Simultaneous charging and melting – no production time lost no significant energy losses

The furnace transfers metal in 1.5T ladles to the central melting/casting plant in the foundry. The furnace is a flexible melting tool for the customer, who can take advantage of low-grade scrap materials as they are available on the market. These include; reject castings (with and without iron attachments), taint babor, profiles, swarf/chips, UBC and drosses (pressed and loose). Energy released from organics on the scrap (plastic oils etc) are liberated by direct controlled oxidation in the furnace and used to heat the charge. During this phase of the melt cycle the gas flow is reduced.

**Summary of key data:**
- Charge input 15T.
- Cycle time – tap to tap including all non-melting activities (charging, pouring and tipping slag) 3.0 hrs.
- Actual energy usage, Natural Gas 539 M3, Oxygen 1,078 M3. Equating to 31.25 M3 natural gas/ 312.5 kW per tonne and 62.5 M3 oxygen per tonne.
- Productivity per 24 hour cycle > 100 tonnes.

30,000 tonne a year dross processing plant - Middle East gulf – air fuel

*Model TR21 commissioned 2010*

This is one of the largest Tilt Rotary furnaces in operation, fired by a single air/natural gas burner system, with a nominal firing rate of 5.4 MW. The rotary body has an internal volume of 40m³, internal door opening of 2m and liquid capacity of 11m³ which is a nominal capacity of 25 tonnes. The furnace is mainly used for melting primary drosses, with a capability of more than 30,000 tonnes of dross per year.

The burner is fitted with mass flow control, where the fuel ratio is adjusted according to the stage of the melt cycle to reduce oxidation. Metal is either cast directly into sow moulds or directed to a holding furnace, where the melt can be alloyed with a dedicated caster, to continuously cast 7kg foundry ingot. The holding furnace is equipped with a non magnetic stainless steel base plate, ready for upgrading to a non contact electromagnetic stirrer.

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*Clive Hall* is International Sales Executive, Melting Solutions Ltd

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Recovered metal can be cast out with the door closed down on the close fitting slag rake, thus saving fuel and preventing the ingress of cold air into the furnace, minimising oxidation.

Similarly the slag can be tipped out of the furnace with the door down.

In addition to tilt rotary furnaces Melting solutions supplies a range of reverberatory melting furnaces; wet hearth, dry hearth, multi chamber, side well, coreless induction and crucible melters from 500kg – 70 tonnes.

Furnaces are available with metal stirring and circulation systems, mechanical and electro-magnetic. For example, using metal submergence systems and porous plug systems, melting light gauge scrap.

A recent unusual project was for a sloping hearth furnace supplied on the island of New Caledonia to melt a stockpile of 10,000 tonnes of complete car and lorry engines, thought to be virtually without value.

However more than 20% of aluminium was recovered and separated from the scrap whereby 8,000 tonnes of separated iron and steel scrap plus 2000 tonnes of high value alloyed ingot, were exported from the island. Energy consumption was extremely low, as the organic components of the charge are burnt in the melt chamber, using MSL’s controlled vortex injection, during the melting phase.

Producer IMPOL of Slovenia, in connection with their recycling department, needed a solution to test incoming parcels of scrap, where the content and chemistry were unknown. Melting Solutions supplied a complete test facility, based around two hydraulic lip axis tilting crucible furnaces.

The crucible furnaces were completely sealed, so all melting was by indirect means, minimising oxidation, so the melt could be carried out under ‘laboratory conditions’.

Both furnaces were mounted on weigh cells, providing IMPOL with a sophisticated test method. On each batch, energy consumption, melting characteristics, dross weight, organic weight loss and above all accurate metal recovery could be defined and recorded.

**Summary of key data:**
- Charge input 25.3t.
- Pure melt time 3.5hrs.
- Gross melt rate 7.3 t/hr.
- Cycle time – tap to tap including all non-melting activities (charging, pouring and tipping slag) 4.7 hrs.
- Actual energy usage, Natural Gas 1,804 M3. Equating to 71.3 M3 natural gas / 71.3 kW per tonne.
- Productivity per 24 hour cycle > 125 tonnes.

**Tilt rotary upgrading**
Melting Solutions has also completed a number of successful upgrades to existing tilt rotary furnaces. This can include burner and process improvements upgrading to oxy fuel and hybrid fuel solutions.

In order to optimise metal recovery it is possible to install weigh cells for live real time weighing of the furnace charge and thus recovery.

These projects need very close co-operation with the customer and have delivered energy and process savings repaying the investment in a short time.

Upgrading of the door system to fit Melting Solutions multi direction furnace door, allows operation in both horizontal and vertical planes.

A first step is to model in 3D the existing furnace, and then to “mock up” the furnace by fabricating an identical tilt cradle. Then the new door is then fully manufactured at Melting Solution’s facility, where all the door components; hydraulics, pipe work cables and new burner system are fully completed.

The new door can then be installed onto the original furnace in a short time, getting the furnace into production as soon as possible in a matter of days.

The Multi Direction door has reduced fuel cost by as much as 15%. Other benefits include less heat loss in the refractories and better process control as the operator can directly view the charge by lifting the door up, without stopping the burner or interrupting the melting cycle.