

## ENERGY EFFICIENCY AND ENVIRONMENTAL IMPACT OF MELTING SECONDARY ALUMINIUM IN TILTING ROTARY FURNACES

The paper will present some of the latest developments in energy saving practices and burner control procedures for secondary aluminium melting furnaces. Comparing results and analysing the impact of air - fuel burners and oxy - fuel burners as fitted to Tilting Rotary Furnaces.

*Author:* John Simpson, Commercial Director of Dross Engineering: design and manufacture of furnaces and foundry equipment for secondary metals recycling.

### **Introduction**

The Tilting Rotary Furnace is now a well known part of the secondary aluminium smelters 'armoury' of furnaces. Over the last 10 years or so, a growing number of manufacturers have introduced their particular version of this equipment which first saw the light of day in the copper smelting industry between the World Wars. The TRF is a basically a rotating well furnace set at an angle and of all the types of melting systems available today is probably the most versatile, combining the advantages of reverbs, dry hearths and fixed axis rotaries. It can melt just about anything and provides the secondary aluminium smelters with an extremely flexible tool.

#### ***Advantages:***

- Eliminates or considerably reduces the use of salt flux
- Eliminates 'parasite' air as the furnace works under pressure
- Reduces metal pollution from free iron as it is a 'batch' melting process
- Facilitates alloy change
- Offers the lowest energy consumption
- Guarantees high melt rates

The concept of the TRF facilitates thermal transfer and offers an extremely good thermal yield. Thanks to the movement or 'tumbling' action of the charge contact between the hot combustion gases and the charge itself is optimised.

### **Types of scrap**

There are basically three types of scrap available to today's secondary aluminium smelter:

- Industrial scrap
  - General and household scrap
  - Foundry drosses
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## 1) *Industrial scrap*

The scrap from this source is usually fairly easy to process and the products are normally composed of new, clean or lightly oxidized off-cuts. However, off-cuts sourced from aluminium door and window manufacturers can contain highly fumigant materials such thermal barriers.

## 2) *General scrap*

Products from this sector are very diverse and can be 'clean' or more or less contaminated with oil and grease and can contain coatings (paint & lacquer) or plastics. All of which is in fact 'latent energy' in the charge. Particular care should be taken when processing:

- Old cast (eg engine blocks) that may contain high levels of grease and/or oil
- Lacquered can stock that may carry plastic seals (caps)
- Swarf (chips) that has not been dried

## 3) *Foundry drosses* (Diecasting foundry dross, primary and secondary dross)

To melt efficiently and economically such a range of materials the TRF is the ideal design of furnace however, without a sophisticated and flexible burner control system the design concept cannot be exploited to its full potential.

### **Burner control systems**

For the purposes of this paper in relation to the TRF we will only be considering natural gas fuelled systems using either oxygen or air as the oxidizer, as other fuels, such as diesel and furnace oil are less common in this application.

A detailed understanding of the process is required for the proper design of any control system. Efficiency and performance is enhanced by monitoring the conditions of the charge at different times in the melt cycle to minimise energy consumption and prevent metal loss through oxidation. A badly controlled burner is the source of low yields and high energy consumption.

Over a number of years Dross Engineering has developed a control system for TRF melters that automatically adjusts the fuel flow in function with the type of charge and the different phases of the cycle: Vari-Gas control.

The burner, be it oxy-gas or air-gas fired, operates automatically in gas rich or gas lean mode. Once the burner power has been set by the operator the flow of air or oxygen remains constant and the flow of gas modulates according to the type of charge and the phase of the melt.

Initially the burner power is set at neutral (stoichiometric ratio) then the flame is adjusted to be more or less reducing or oxidizing from the operator control desk. This can be done either manually by the operator or fully automatically via the oxygen sensor that analyzes the combustion products in the flue. So different types of scrap: clean, slightly contaminated, heavily contaminated can be processed to achieve optimum results.

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## *Advantages*

- Exploits the latent energy in the charge. N.B. 1 kg of grease = approximately 1m<sup>3</sup> of gas
- Ensures that the furnace atmosphere is adapted to the phase in the cycle: oxidizing, neutral or reducing
- Ensures optimum yields
- Enables salt free melting of the majority of scrap types

## **Energy Economy**

Incontestably when comparing air-gas burner systems with oxy-gas systems the nitrogen free oxy-gas burner uses less gas, gives a hotter flame and lower volumes of off-gas. However oxygen is not free and needs careful handling.

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