Low-temperature Oxyfuel successful in aluminum re-melting.

Re-melting capacity boosted 60%.

Linde has successfully applied the principles of flameless technology into the compelling and innovative Low-temperature Oxyfuel solution. Low-temperature Oxyfuel has been proven to deliver higher melt rates with reduced oxidation, lower fuel consumption, and ultra-low NO_x emissions.

The main benefits of Low-temperature Oxyfuel, are:

- More uniform heating and melting, avoiding hot spots and dross.
- Higher furnace thermal efficiency, saving fuel and increasing production.
- Ultra-low levels of NO_x emissions – reduced by up to 90%.
- Integrated flame monitoring by UV cell for safe operation in all process steps.
- Low maintenance costs and no need for recuperator or regenerative solutions.

In May 2007 Linde converted the first line for production of primary foundry alloys at Hydro Aluminum Metal Products at Årdal in Norway to Low-temperature Oxyfuel. The second line was converted in June 2008. By using the Low-temperature Oxyfuel technology, Hydro Årdal can replace 50,000 tonnes of liquid primary aluminum from the old Söderberg plant that was closed in 2007, by re-melting cold metal. Previously, the charge mix was 8 tonnes cold and 22 tonnes liquid metal, Now the mix is 13 tonnes cold and 17 tonnes liquid metal, resulting in a re-melting capacity increase of 63% for the four furnaces at the cast house.

"By using Low-temperature Oxyfuel, we can produce at least as much in the same amount of time as we did previously despite now melting cold aluminum. In addition the propane consumption and CO_2 emissions have been halved,

Low-temperature Oxyfuel in the melt shop at SAPA Heat Transfer, Sweden.

which is also very positive", says Wenche Eld gard, cast house manager, Hydro Årdal.

In general the use of oxyfuel combustion substantially increases the thermal efficiency of a furnace. This is due to the fact that radiant heat transfer of furnace gases produced by oxyfuel combustion is significantly more efficient than those of air-fuel. Due to the absence of nitrogen in the combustion mixture, the volume of exhaust gas is also substantially reduced, thus lowering total heat loss through the exhaust gas. The improved thermal efficiency increases melting rates and productivity rates while also reducing fuel consumption and CO_2 emissions.

For more than 20 years, Linde has pioneered the use of oxyfuel applications in the aluminum industry. Linde has invested extensive R&D efforts in oxyfuel for aluminum melting and introduced solutions as URTF, WASTOX®, AIROX® and FLEX FLAME®.

Although oxyfuel is accepted as state-of-the-art for rotary furnaces, the aluminum industry has been more cautious to adopt the technology in reverberatory furnaces. One reason for this is the risk of over-heating the aluminum surface with a high flame temperature and thus creating hot spots. This risk should be taken seriously, whether it is managed by selecting correct burner positions and power or by applying automatic burner power control. Linde has taken a significant step towards enabling more efficient remelting of aluminum in reverberatory furnaces by applying the principles of flameless combustion and developing the Low-temperature Oxyfuel burner.

Linde first developed flameless oxyfuel combustion for larger steel reheating furnaces and since 2003 most new installations have employed this technology. It provides excellent temperature uniformity, low flame temperatures, and reduced NO_x emissions. These are features that are perfect for aluminum melting conditions leading to higher melt rates, less hot spots and less dross formation.

A conventional flameless burner relies on the fact that industry standards allow for the absence of a stable UV-signal at process temperatures above the ignition temperature of 750°C. Aluminum re-melting furnaces partly operate close to this temperature and variations between the cold batch and the roof may appear. Therefore the Low-temperature Oxyfuel burner was developed and designed to use permanent supervision by a UV-cell flame safeguard. This design is unique and patented by Linde.

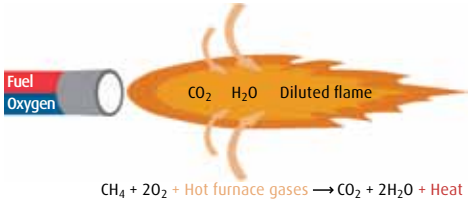
Success at five plants and more under way

Low-temperature Oxyfuel has so far been successfully installed in eight furnaces, at five plants and the interest from the industry is very high. The Low-temperature Oxyfuel system was first installed in a remelting furnace for rolling mill scrap and primary ingots at SAPA Heat Transfer in Sweden. SAPA installed oxyfuel back in 1995 to increase production and to reduce NO_x emissions. The furnace was optimised in collaboration with Linde in 2002. To further improve the performance, the 28-tonne furnace was equipped with Low-temperature Oxyfuel in 2005. Since the switch from conventional oxyfuel, SAPA has seen a 10% increase in melt rate, a 10% reduction in fuel consumption, a 9% reduction in dross formation, and a 90% reduction in NO_x emission.

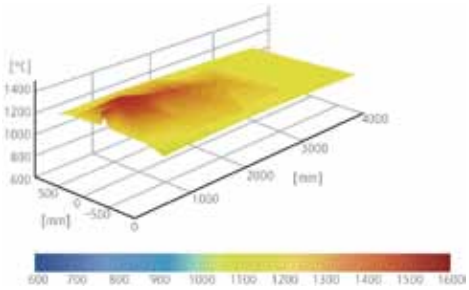
At Stena Aluminum in Sweden, a 50,000 tonnes per annum producer of high-grade aluminum alloys, a Low-temperature Oxyfuel installation was commissioned in 2009. For the re-melting process, Stena uses the URTF technology. The new technology is employed in a 24-tonne alloying furnace. The benefits include increased productivity, as Low-temperature Oxyfuel more efficiently supplies the energy needed for dissolution of added alloys. Additionally, Low-Temperature Oxyfuel reduces greenhouse gas emissions such as CO_2 and NO_x.

Left: In 2009, Low-temperature Oxyfuel was installed in an alloying furnace at Stena Aluminum.

Below: The two lines for primary foundry alloys production at Hydro Aluminum's Årdal works were converted to Low-temperature Oxyfuel in 2007 and 2008.



The flame temperature is lowered by effective dilution, while still retaining the same energy content, therefore resulting in uniform melting with less dross and NO_x emissions.



In-furnace temperature measurement shows a uniform and low flame temperature without peaks, which helps to achieve higher melt rates and thus avoiding hot spots and thermal NO_x.

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