The Rise of ALTEK's Side Mounted Electromagnetic Stirrers – the installation of the future

ALTEK have experienced great success with their low energy, air-cooled electromagnetic stirrer range (EMS), achieving excellent results in the installations around the world.

ALTEK have dedicated a lot of continued research and development into the enhancement of this product, to distinguish them from the other side mounted stirring technology that may exist in the aluminium industry It is with this innovative product that ALTEK are now considered world-leaders in Side Mounted Electromagnetic Furnace Stirring systems. , and as a consequence are the preferred supplier for many companies across the industry.

When developing the side mounted Electromagnetic Stirring system, ALTEK paid close attention to factors such as the many differing furnace types and shapes in the market, the operational costs involved in running the EMS, potential installation difficulties, innovative control systems to allow adaptive and flexible control schemes within the furnace cycle and eliminating issues with existing technologies. The end product is a system which addresses each of these challenges and successfully overcomes them.

ALTEK's EMS can be installed onto almost any type of furnace size or shape, capable of stirring the molten aluminium through all refractory types and thicknesses (currently up to 750mm). This covers melting, holding, top-loaded, round, side-well and multi-chamber furnaces. This is made possible because ALTEK's EMS is an optimised electromagnetic inductor and this unique design means that it is not only very powerful but can be installed on any part of the furnace to ensure positive circulation effect. For furnaces with a basement, bottom mounted installation is preferable. However, the ALTEK EMS can also be retrofitted to existing furnaces on the side or back and its performance is comparable to bottom mounted installations.

With regards to operational costs the unique inductor design and innovative control system plays another crucial role. The major part of the electrical energy supplied to the stirrer is used to generate the alternating magnetic field to induce eddy currents, which couple with the magnetic field to provide a driving 'Lorenz' force.

A portion of this electrical energy is also used to overcome the ohmic resistance of the induction coils (significantly more so in water cooled electromagnetic stirrers than in solid conductor type (ALTEK) electromagnetic stirrers), and dissipated as heat in the coils (the I^2R effect) and heat losses. Due to this heating effect the coils need to be cooled (some technologies by water and in this instance for the ALTEK SIBERFORCE inductor, Air). This is very pronounced in water cooled induction stirrer coils and was one of the main reasons to develop this different design of induction coils.

In the past 2 years there has been a notable increase in the awareness, sale and implementation of ALTEK's side mounted installations at multiple locations around the world. Most recently a leading company within the Global Aluminium Industry

has purchased 4x ALTEK Side-Mounted EMS devices following implementation of an ALTEK SIBERFORCE TYPE 500 stirrer in 2014, to help improve their furnace performances in North America. The first of these machines will be commissioned at the end of January 2015.

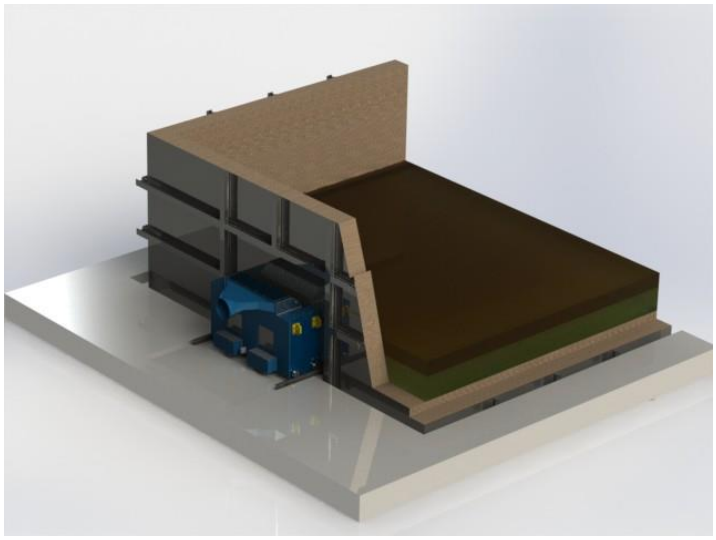

Fig 1 – Side mounted device on a stationary furnace

ALTEK know of the importance of proving the technology works. For a customer to invest in a new technology there is an inherent risk that if it fails then there could be serious consequences for both the buyer and the seller. Proving the side stirring technology was made possible during the first two side mounted installations at Constellium, France where strict performance trials were carried out.

The results were conclusive. A TYPE 400 side mounted ALTEK EMS was installed on the side of a 70-tonne stationary reverbatory furnace at a CONSTELLIUM plant in June 2009 and a second in the same company on a similar sized furnace in April 2012. An alternating sequence of heats with and without stirring were carried out over 5 days at the rate of 3 to 4 heats per day.

The furnaces were dry hearth melting furnaces of 70T capacity emptying fully at the end of each cycle. On average, the melting rate increased by from 10.7 to 12.8 t/h (+20%) with the adoption of the ALTEK EMS as discussed in a published paper at TMS in 2011.

The impact on the quantity of energy needed for melting only was assessed from the end of charging up to the transfer temperature (730°C). Analysis of the data indicates a significant reduction in energy consumption from 906 to 777 kWh/t (–14%).

In addition to this temperature homogenisation tests were conducted. One probe was placed at the bottom of the bath in one corner, and another in the top of the bath in the opposite corner. Once the stirrer was turned on, it took only 4.5 minutes (270 seconds) to achieve a temperature difference <5°C between the probes (seen in Fig 2). This not only proves how effective the stirrer is at effectively circulating large

quantities of molten aluminium, but also indicates that any alloying additions would be dispersed in equal measure throughout the bath creating excellent chemical homogeneity as well.

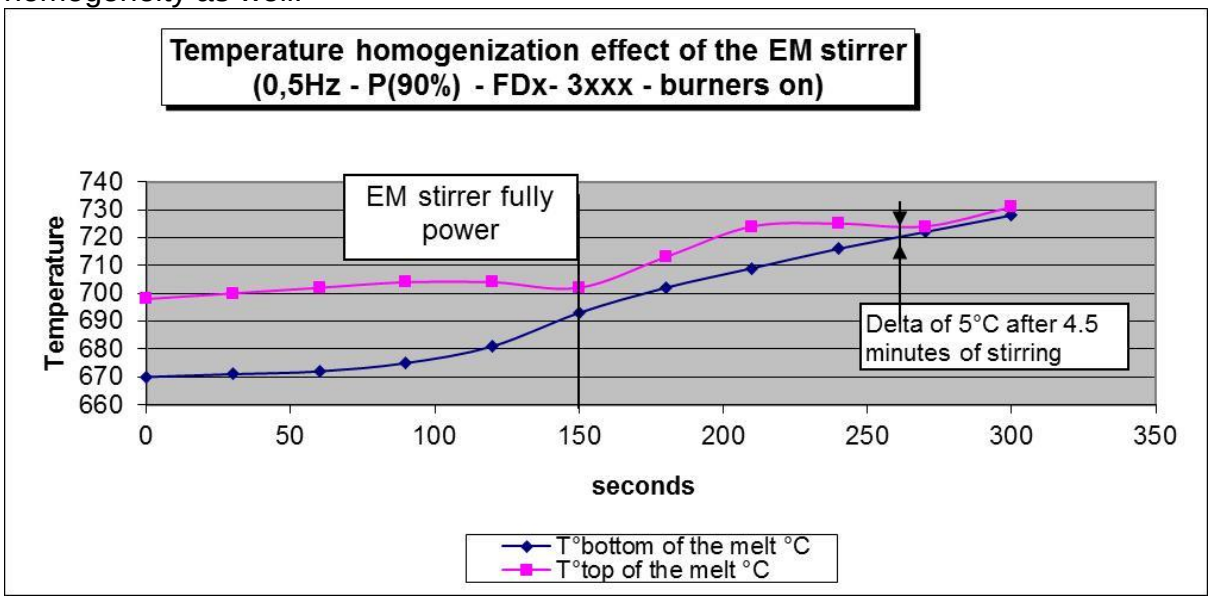

Fig 2 – Typical linear flow pattern on an ALTEK side mounted electromagnetic inductor on a side well furnace

Multi-Chamber / Side-Well Furnaces

A common misconception is that all stirrers have the same stirring pattern in the furnace. This is an incorrect assumption as the flow patterns do vary significantly. A water cooled stirrer has quite a different flow pattern in the bath compared to air cooled stirring technology due to the design of the coil and the method of operation of the inductor system.

ALTEK's side mounted EMS can generate the correct flow patterns and produce enough power to effectively transfer molten metal from different chambers within a furnace. This is in addition to all the benefits that the EMS can provide as detailed below.

Side well furnaces have traditionally used conventional pumps for molten metal transfer, however side stirring technology can be successfully implemented as a replacement. A big advantage in replacing conventional pumps is that the stirrer is outside the furnace and has no moving parts. This eliminates mechanical failure risk and significantly reduces maintenance issues. Again location of the stirrer is very important to ensure the correct flow pattern is achieved. This will maximise the impact on melting the scrap, the transfer of metal between chambers and the mixing of the bath for temperature and chemical homogeneity,

During melting the electrical conductivity of aluminium decreases. Therefore, in molten aluminium the penetration and the total forces are stronger than in solid metal and hence the reason you see good movement in a semi flat bath or flat bath conditions with continuous stirring. Inside the aluminium bath the interactions solely

depend on the induced currents and it is almost impossible to move large solid parts by the stirring force in the beginning of the cycle for this reason.

The stirrer will only start at a pre-set time into the dry hearth melting cycle due to there being no liquid aluminium to circulate in this phase of the melt cycle.

As soon as there is some liquid, it will start to cover/wash around the remaining solid scrap and as soon as there is some stirring force in the liquid, the flow is not obstructed anymore by immersed obstacles and starts to easily generate large mixing eddies, which accelerate the heat transfer from the combustion space to the sub surface scrap. This effect can be seen on many furnaces with powerful sub surface stirring action as we witness with the ALTEK SIBERFORCE stirrers with the experience that solid pieces which are buoyant/semi-buoyant get turned over/around and ‘washed around’ by these mixing eddies.

The below series of images demonstrate the changes in mode of heat transfer from initially radiated heat transfer (from the burner and the walls of the furnace) to the latter stages where heat transfer by conduction is the primary mode through metal movement.

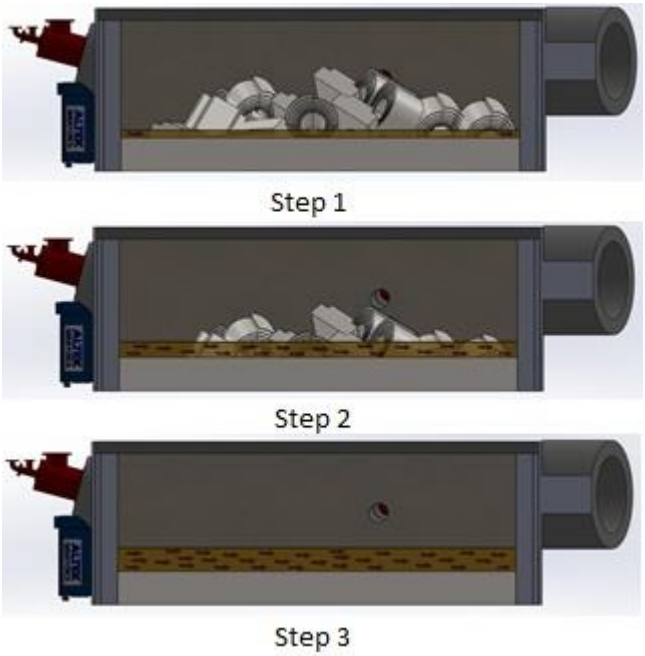

Fig 3 – The melting stages of scrap in a furnace; side stirring significantly improves the heat transfer by conduction to semi submerged and ultimately submerged scrap.

The effect of this powerful circulation on fixed furnaces with side mounted EM stirrers can provide all of the benefits achieved on bottom mounted stirrers as have been proven on numerous installations by ALTEK. These include.

- Furnace productivity increase up to 25%
- Energy consumption decrease up to 15%
- Melt loss reduction up to 30%

- Temperature and chemical homogeneity
- Air-cooled – No water cooling system required
- Very low energy
- Low installation costs
- Multiple working references
- All UK manufactured – CE standards

Please contact us for more information.

www.altek-al.com
sales@altek-al.com