AI-EMS electromagnetic stirring solutions
Improving aluminum furnace performance
Increase productivity and reduce costs with ABB’s electromagnetic stirring technology

Efficient stirring of the aluminum melt is one of the most decisive factors in speeding up the kinetics of reactions and improving heat and mass transfer, which is essential in terms of increasing productivity with retained or improved quality. With over 250 systems installed worldwide, ABB is the most experienced supplier of Al-EMS systems.

**Al-EMS benefits**
- Reduced dross formation
- Increased aluminum yield
- Increased productivity
- Rapid chemical and temperature homogeneity
- Increased furnace lining life
- Decreased energy consumption
- Lower maintenance cost
- Attractive payback time, often one year or less

**Basic characteristics**
- Both bottom and side mounted versions are available for melting and holding furnaces.
- No physical contact with the melt and no moving parts.
- Normal refractory lining can be used.
- Low maintenance required.
- Stirring can be performed throughout the entire melting and refining period.
- The stirring direction can be reversed, which can facilitate dross skimming and counteract dead corners.

ABB’s electromagnetic stirrers for the aluminum industry (Al-EMS) help to improve productivity and quality and increase cost-efficiency in aluminum melting, holding and refining operations.
**Al-EMS savings**

The ABB Al-EMS can help increase the lifetime of the furnace lining in many ways. One example is that the burner does not have to be used at such high temperatures for a long period of time since the heat exchange between the molten aluminum and the burner is higher. For the same reason, the gas consumption of the burners can be lowered. While the temperature in the molten aluminum is homogenized, there is no need for overheating the surface and for this reason dross formation can be reduced.

Since the molten aluminum is constantly stirred, there is no need to stir the melt using forklifts. Thanks to the reduced door opening times, heat exchange is increased and dross formation is reduced, leading to an increase in productivity.

By constantly stirring, the alloying elements and thermal differences between the top and bottom of the aluminum bath are reduced and efficiently homogenized.
An EMS is based on the principle of a linear motor. An induction coil is placed under or at the side of the furnace and a travelling magnetic field is generated when electrical power is applied to the coil. The metal movement is the result of the interaction between the magnetic field and the electrically conductive metal bath. An analogy can be made with an electric motor, where the stirrer acts as the stator and the melt as the rotor. Generally, all liquids that are electrical conductors can be stirred with EMS electromagnetic stirring in aluminum furnaces. Al-EMS gives efficient mixing of the entire melt with minimal action by the operator. Installation is simple and maintenance is negligible.

Will the Al-EMS fit your furnace? The stirrer can be mounted on round or flat walled furnaces for sizes up to 200 tons. It does not matter if it is a melting, holding or chamber furnace. The installation is simple. What is needed is a non-magnetic plate window (stainless steel) in front of the stirrer, and when the Al-EMS is placed under the furnace, head room of about one meter is required. The Al-EMS has no limitations regarding installation on tilting or stationary furnaces.

Homogenization of temperature and analysis The temperature difference between the top and bottom of an unstirred bath is normally in the range of 50 to 80°C. With the forced circulation of the Al-EMS, the temperature difference decreases to less than 5°C in about two to three minutes after the start of the stirrer. At the same time, the dissolution rate of alloys can be improved greatly.

ABB can also provide side mounted Al-EMS stirrers for stationary furnaces.
Energy savings
Heat transfer to the melt is improved since the temperature difference between the melt surface and the roof is maximized.

Savings up to 15% have been achieved due to reduced heat losses and improved heat transfer to the melt.

Reduction of dross formation
The oxidation of aluminum increases rapidly at temperatures over 775°C. By stirring the melt with Al-EMS a decreased temperature gradient will be obtained resulting in a lower surface temperature which will significantly reduce the surface oxidation.

The rapid and complete homogenization of the analysis throughout the entire melting and refining period coupled with complete elimination of mechanical stirring due to electromagnetic stirring further reduces the formation of dross.

- Reduction of dross formation by more than 25% has been achieved.
- Substantially decreased need for mechanical stirring and knockdown of scrap.
- Stirring pattern on the melt surface can facilitate dross skimming.

Al-EMS are designed for high performance, simplicity, reliability and long life
The power supply equipment is extremely compact, resulting in smaller space requirements in the electrical room. If needed in the facilities, a container solution is also available to house the electrical equipment and the water cooling system.

ABB’s frequency converter and the ABB controller enables both stirring power and direction to be customized to process needs. Low frequency is applied to all Al-EMS systems in order to generate a deep-penetrating magnetic field. Cooling of the stirrer is accomplished using hollow copper conductors, which require a small amount of low conductivity cooling water. In between the windings dry, rigid vibration-proof insulation is used. For air cooled stirrers, solid copper wire is used around the core and cooled by using a cooling fan that blows air between the windings.

By using many of ABB’s standardized components that are well-proven and widely acceptable, the system purchase price can be kept low and technical risks and maintenance will almost be eliminated.

1 Schematic sketch of the temperature homogenization when Al-EMS is turned on. | 2 Dross reduction from customers using ABB Al-EMS.
### Water cooled Al-EMS systems
- EMS unit, standard model ORZ 200, 250, 320, ORD 43 and 55
- Cooling water station
- ABB frequency converter
- Control system
- Dry type transformer
- CFD calculations based on customer furnace design

### Air cooled Al-EMS systems
- EMS unit, standard model ORZ 110, 120, and 150
- Cooling fan
- Wall mounted ABB frequency converter
- Transformer (for ORZ 120 and 150)
- CFD calculations based on customer furnace design

<table>
<thead>
<tr>
<th>Technical data</th>
<th>ORZ 110</th>
<th>ORZ 120</th>
<th>ORZ 150</th>
<th>ORZ 200</th>
<th>ORZ 250</th>
<th>ORZ 320</th>
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ABB AI-EMS is currently used in all parts of the aluminum process, such as primary and secondary aluminum production, foundries and refining process. We provide stirrers for all parts of the aluminum production line.

We can equip new furnaces as well as furnaces already in use and we can customize our stirrers to work with any furnace on the market today! There are many solutions available, for example one stirrer for multiple furnaces, stirrers for tipping and stationary furnaces and many more.
Contact us

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