Outotec® SAF Smelting

Outotec closed-type Submerged Arc Furnace (SAF) is an environmentally friendly solution with very good energy efficiency and low specific raw material consumption. The Outotec Ferrochrome Process, including Steel Belt Sintering, Preheating and SAF Smelting, is classified by the European Union as a Best Available Technique (BAT). As a proof of our technology success, 35% of the world’s ferrochrome is produced using the Outotec Ferrochrome Process.

Outotec SAF smelting technology is suitable for various ferroalloy applications:
- FeCr
- FeMn/SiMn
- FeNi
- Ilmenite (TiO₂ slag)

Benefits
- Minimized energy, coke and electrode paste consumption
- High productivity, especially with sintered chromite pellets
- High recoveries for metals
- Effective utilization of CO₂ gas in the process
- Low operational costs
- Low CO₂ and dust emissions
Outotec® Preheating Kiln

Smelting charge materials are preheated up to 600°C by burning cleaned carbon monoxide (CO) gas from the closed smelting furnace in a gas-tight shaft-type preheating kiln. Preheating removes water and other volatile components, which stabilizes operational conditions in the smelting furnace and decreases the specific electric energy consumption. Every 100°C increase in preheating saves approximately 70 kWh per ton of metal in smelting.

Preheating allows the smelting furnace capacity to be increased by up to 20%. In addition, coke and electrode paste consumption is minimized. The smelting furnace gas phase pressure is also easier to control when a dry and preheated charge is used. The Outotec Multi Preheating Kiln is designed for large scale furnaces.

Outotec® Submerged Arc Furnace

Outotec closed-type Submerged Arc Furnace minimizes leakage air into the smelting furnace, as well as dust emissions from the smelting furnace to the working area and environment. In ferrochromium smelting, a closed furnace eliminates the formation of toxic hexavalent chromium. Efficient off-gas cleaning minimizes emissions and enables the energy utilization of CO gas that is produced in the closed SAF smelting process.

The furnace is equipped with a conductive carbon lining, water-cooled walls and an air-cooled bottom. When heat is conducted through the carbon lining into the cooling media, some molten material is solidified on the surface of the refractories, forming skull. This autogenous lining increases the lifetime of the carbon lining.

Outotec® Furnace Roof

Outotec offers various furnace roof design options for different Submerged Arc Furnace applications. The closed roof solution enables better production and ensures safer smelting and maintenance operations. The furnace roof is usually made of water-cooled steel panels, but also a hybrid roof solution with a combination of water-cooled steel panels and refractory construction can be used. All the sealings are gas tight, which guarantees good production figures, low emissions and efficient CO gas collection and utilization. With a gas tight furnace roof, there is no oxidizing atmosphere inside the furnace, so the formation of hexavalent chromium is minimized.

Outotec® Electrode Equipment

Outotec offers robust, fail-safe and easy-to-maintain electrode equipment that includes lower and upper parts. The lower part of the electrode column transfers electricity into the electrodes for the reduction and smelting process in the electric furnace. The upper part holds, moves and slips the electrode, as well as warms the electrode paste in the electrode column with an air heater and a fan.

The electrode equipment has its own hydraulic and automation systems. The hydraulic system is designed according to the fail-safe principal. The hydraulic unit includes a hydraulic power pack, hydraulic control panel, valves, instrumentation and piping. Outotec provides programming and software for the control system. The electrode control is integrated in the plant automation system.

Outotec® Venturi Scrubber

The Outotec Venturi Scrubber is a high-pressure scrubber that cools down and aspirates hot furnace off-gas, as well as effectively pressurizes the scrubber system gas line. The scrubber is equipped with water seals, and it is especially designed for handling of explosive gases in the safest possible manner. In addition to minimizing air pollution, Outotec Venturi Scrubbers improve electric furnace operation and increase equipment availability. Scrubber slurries are efficiently cleaned and recycled to minimize process water consumption.

Outotec® CO Gas Filter

Outotec has developed a cassette-type filter that enables the removal of even the smallest particles that pass through scrubbers, with collection efficiencies close to 100%. After the Venturi Scrubber, CO gas is fed to a cassette filter, where fine particles are separated from the gas. Nitrogen pulsing is used to clean the filter. The cleaned CO gas can be used as a secondary energy in ferroalloy production and adjacent works or fed to a Cogeneration plant.
Outotec’s experienced planning, engineering, procurement and commissioning teams ensure close cooperation and the successful implementation of plant and equipment. Outotec’s engineering and project implementation capabilities include the design and delivery of large-scale furnaces up to 100 MW. Outotec also offers complete solutions for smelting furnace rebuilds.

**Slag granulation**

Typically FeCr slag is granulated with water sprays during the tapping. The granulation process is a cost effective way to handle and utilize the slag. The granulated slag has low leaching properties thanks to the crystalline structure and can be used for construction purposes. Granulation water is recycled to minimize water consumption.

**Outotec® Smelting Furnace Control System**

The Outotec Smelting Furnace Control System combines the whole process, from batching the raw material to storing the final product, as well as off-gas handling. The specific heating power control in the Outotec Preheating Kiln and efficient electric power control in the Outotec Submerged Arc Furnace are assured by the automation system.

**Furnace Lining Monitoring System**

Outotec Furnace Lining Monitoring System is a system specifically developed for monitoring of the state of the lining inside the smelting furnaces. By monitoring the state of the system it is possible to predict when the lining needs to be changed and to examine the changes occurring in the furnace lining. The system works continuously and online. As an input the system takes the temperature measurements from the different depths of lining and as an output gives the current status of the lining.