Seawater FGD System Uses Q-PAC® to Clean 8,000,000 Nm^3/h of Aluminum Smelter Off-Gas

Abstract

Aluminum smelters can be a significant source of sulfur dioxide (SO_2) emissions. In order to meet emission standards at the Qatalum plant in Qatar (pictured above), four large SO_2 seawater scrubbers packed with Q-PAC® from Lantec Products were installed. The optimized scrubber design using Q-PAC® minimized the system footprint and utilities consumption, while reducing SO_2 emissions well below the regulated limit of 35 mg/Nm^3.

Introduction

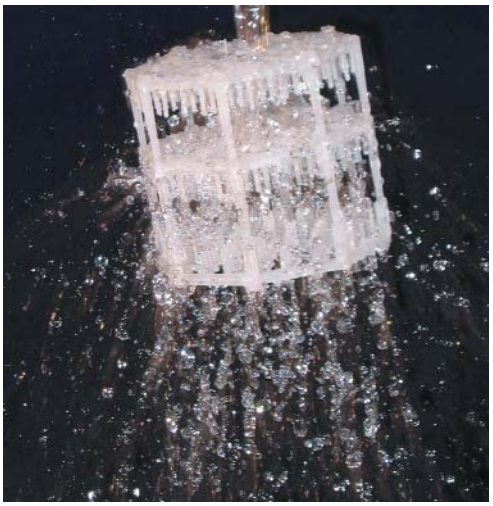
Aluminum metal is produced by electrolysis of aluminum oxide in a molten salt bath. An electric current is passed through the molten material and aluminum ions are reduced to aluminum metal at the cathode. As the carbon anode is consumed, carbon is oxidized to carbon dioxide and impurity sulfur to SO_2. The amount of SO_2 generated depends on the mass of aluminum produced and the sulfur content of the coke and pitch used to make the anodes.

The two primary sources of SO_2 emissions from this process are the potlines and the anode baking furnace. SO_2 emissions must be closely monitored due to their health and environmental impacts.

The Solution

Flue gas desulfurization (FGD) by scrubbing with seawater in a packed tower is an economical option because of its simple operating principle and high reliability. The process uses the natural alkalinity of seawater to absorb and neutralize SO_2 in the exhaust gas. The flue gas enters the packed tower and flows counter-current to seawater. The packing inside the tower facilitates mass transfer of contaminants from the gas to the liquid phase. The water is then re-oxygenated and returned to the sea with no environmental impact.

Fives Solios was contracted to build the SO_2 treatment system for the Qatalum aluminum smelter facility. For this project, Fives Solios chose to use Q-PAC® from Lantec Products as the scrubber packing. Q-PAC® is a patented, high-efficiency, high-capacity random packing. Its flow-through structure uses drip points and gas turbulence to create millions of small droplets, multiplying the surface area for gas-liquid contact while imposing minimal resistance to flow. It has a very high void fraction and a uniformly spaced grid structure that allows small solid particles to pass through without clogging it. This unique combination of high scrubbing efficiency, high flow capacity, and fouling resistance results in a smaller system footprint, lower capital costs, less power consumption, lower maintenance costs, and reduced SO_2 emissions.



High-Capacity Tower Packing Q-PAC®

Performance

After several years in operation, the seawater scrubbers at the Qatar aluminum smelter are reducing the SO_2 emissions far below the emission standard of 35 mg/Nm^3. The system was designed to process a maximum of 8,000,000 Nm^3/h, with a normal operating condition of approximately 6,500,000 Nm^3/h. This flow is split between four systems, each having four sections (16 total sections). While all sections consistently reduce the SO_2 emissions below the requirement, FTP1-B has achieved a removal efficiency as high as 95.6% with an outlet of < 7 mg/Nm^3. The data for this scrubber section are shown below.

FTP1-B Wet Scrubber Results

OPERATING CONDITIONS		
Inlet Gas Flow Rate:	414,000 Nm^3/h	262,542 scfm
Inlet Gas Temperature:	95°C	203°F
Inlet Gas Moisture Content:	1~2% (v/v)	1~2% (v/v)
Inlet SO_2 Content:	152 mg/Nm^3	53 ppm_v
Seawater Flow Rate:	733 m^3/h	3,228 gpm
Seawater Temperature:	36~40°C	97~104°F
Seawater Alkalinity:	134 mg/L (as $CaCO_3$)	134 mg/L (as $CaCO_3$)
Seawater pH:	8.9	8.9
SCRUBBER DESIGN		
Tower Cross-Section:	7500 mm x 8500 mm	24.6 ft x 27.9 ft
Packing Height:	3000 mm	9.8 ft
Packing Type:	Q-PAC	Q-PAC
PERFORMANCE		
Quenched Gas Temperature:	42~48°C	108~118°F
Outlet Gas Temperature:	28°C	82°F
Outlet SO_2 Concentration:	6.8 mg/Nm^3	2.4 ppm_v
SO_2 Removal Efficiency:	95.6%	95.6%
Packing Pressure Drop:	2.2 mbar	0.9 in.WC