Steel Mill Eliminates Unscheduled Production Delays with New Gas Cooling System

Commercial Metals Company

Problem:

CMC Steel South Carolina operates a baghouse connected to an electric arc furnace (EAF) direct evacuation system (DES). The baghouse operates at temperatures over 350°F (177°C) with peak temperatures in the ductwork preceding the baghouse as high as 1,200°F (650°C).

The previous evaporative cooling system was unable to maintain a consistent temperature in the ductwork and the baghouse. The system's air atomizing nozzles were located too close to an elbow in the ductwork and produced droplets that were too large for effective cooling.

The inconsistent cooling effect of the sprays caused several baghouse high temperature alarms each week. The EAF automatically shut down until the temperature decreased. These interruptions significantly reduced production and the excess water created maintenance problems, including wet ductwork and wet dust in the baghouse.

Solution:

Spraying Systems Co.'s solution was an AutoJet® Gas Cooling System with three FloMax® air atomizing nozzle lances. FloMax air atomizing nozzles produce very small drops with exceptional efficiency, use less compressed air and energy than other nozzles and provide higher turndown ratios than standard air atomizing nozzles.

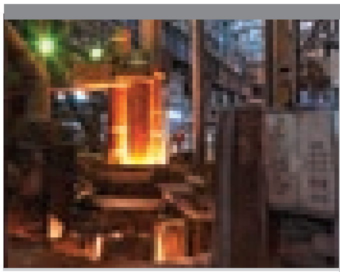
FloMax nozzle size was determined based on the gas flow and velocity in the duct. Three nozzles were installed, providing a total flow of 75 gpm (284 lpm). The system was designed to accommodate a fourth nozzle and a total flow of 100 gpm (379 lpm) to handle increased gas volume or higher gas temperatures in the future.

The location of the FloMax nozzles was critical to the success of the system. Working with CMC Steel, it was determined to install the spray lances in a different location to allow longer droplet residence time and ensure complete evaporation of the cooling water. The nozzles are now positioned around the DES duct. They spray co-current with the exhaust gas flow inside the duct at an angle approximately 40° from the duct wall.

The AutoJet system's PLC uses a proportional, integral, derivative (PID) closed-loop algorithm to maintain a specific target temperature. The spray controller adjusts pump speed using a variable frequency drive to ensure the proper flow of cooling water. The desired droplet size is maintained by varying the atomizing air pressure based on the liquid flow. Thermocouple inputs monitor the temperature at the end of the DES duct and an alarm is triggered if the duct outlet temperature exceeds a specific limit. The system interfaces with CMC Steel's control room for easy monitoring.

AutoJet Gas Cooling System

FloMax Nozzles

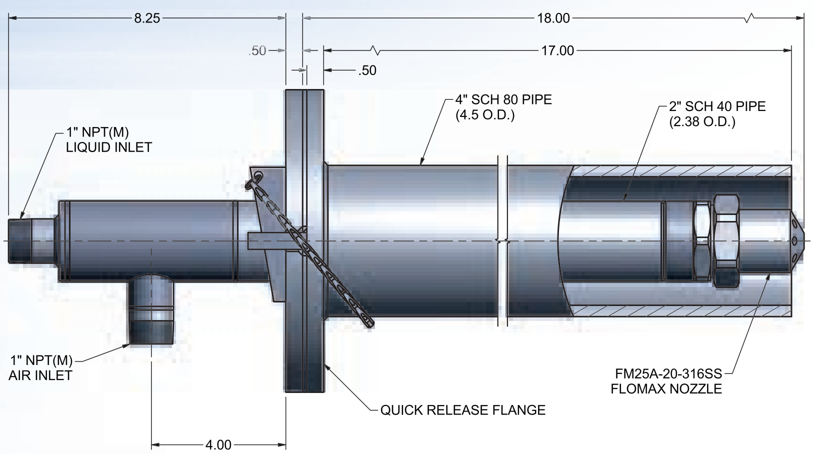


Steel Mill Eliminates Unscheduled Production Delays with New Gas Cooling System – Continued

Results:

The AutoJet® Gas Cooling System provided immediate results. DES and baghouse inlet temperatures were decreased and EAF shutdowns due to high temperature alarms were eliminated. CMC Steel was able to maintain production schedules with fewer interruptions. Now that the cooling water completely evaporates, CMC Steel's stream of wastewater has been reduced by more than 15,000 gallons (56,000 liters) per day. The combined value of these factors resulted in a payback period of approximately two months for the AutoJet Gas Cooling System.

A CLOSER LOOK AT THE SYSTEM



FloMax nozzles are attached to a 2″ schedule 40 pipe lance (2.38″ O.D). The lances, equipped with quick release flanges for easy maintenance, feature a 1″ NPT (M) liquid inlet and a 1″ NPT (M) air inlet. Each lance is protected by a 4″ schedule 80 pipe (4.5″ O.D.) to prevent buildup on the nozzles and to shield the nozzles from direct contact with the hot exhaust gases in the duct.

FloMax® A Series: Principle of Operation

Stage One: Primary Fluid Breakup – Air and liquid converge at the annulus allowing high velocity air to shear the liquid column

Stage Two: Secondary Fluid Breakup – Focused stream impacts the target bolt forcing additional mechanical breakup

Stage Three: Final Mixing – Air cap acts as a final mixing chamber. As liquid crosses multiple orifices, an additional pressure drop provides the final atomization

Spraying Systems Co.®
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