Not federally enforceable

CF Industries, Inc.
Plant City Phosphate Complex
"A" and "B" Sulfuric Acid Plants

Sulfuric Acid Mist Emissions Prevention Plan

Scope of Work

Develop an "Acid Mist Control Preventive Maintenance Plan" for the CF Industries, Inc., Plant City Phosphate Complex "A" Sulfuric Acid Plant to insure mist emissions are maintained within allowable limits. U.S. EPA new source performance standards for sulfur burning sulfuric acid plants set sulfuric acid mist emission limits at 0.15 Lbs/Ton of sulfuric acid produced on a one hour average, and a maximum opacity of 10%. The Florida Department of Environmental Protection specified in the permit for this plant a sulfuric acid mist emission limit based on past performance, of 1.483 Lbs/Hr (0.027 Lbs/Ton) Maximum and 0.83 Lbs/Hr (0.015 Lbs/Ton) average or about 10% of the U.S. EPA level.

In Air Construction Permit Application No. 0570005-020-AC, CF Industries requested to also comply with this Sulfuric Acid Mist Emissions Prevention Plan for the "B" Sulfuric Acid Plant.

Background

Sulfuric acid is produced in the "A" and "B" Sulfuric Acid Plants using elemental sulfur as the raw material. The sulfur is oxidized (burned in a furnace) with dry air to produce sulfur dioxide. The sulfur dioxide is further oxidized (in the converter) to sulfur trioxide. The sulfur trioxide is absorbed (in the absorption tower) into concentrated (nominal 98.5%) sulfuric acid and reacted with free water contained in the acid to form sulfuric acid. The unconverted (residual) sulfur dioxide is removed from the gas to acceptable level in an ammonia-sulfur dioxide scrubbing tower where the sulfur dioxide is absorbed and reacted with ammonia and water to form an ammonium sulfite/bisulfite solution. The scrubbing system exit gas is slightly superheated and contains some ammonium sulfite/bisulfite particles and entrained solution. The gas then passes through high efficiency mist eliminators to remove ammonium sulfite/bisulfite particles and sulfuric acid mist before being released to atmosphere via the stack.

Upstream of the scrubber, sulfuric acid mist particles are formed in the absorption tower. Large particles, above three microns, are produced from entrainment of liquid droplets from the absorber packing surface. These particles are easily removed in the ammonia-sulfur dioxide scrubbing tower. Small sulfuric acid particles (sulfuric acid mist - less than one micron) are produced by the rapid cooling and condensation of sulfuric acid vapor at the inlet section of the absorption tower by a phenomenon known as "fog formation". These mist particles will pass through the ammonia-sulfur dioxide scrubber relatively untouched and are removed in a Brownian Diffusion high efficiency mist eliminator.

Operational Practices - A number of operational practices can significantly reduce or eliminate generation of fine sulfuric acid mist particles in the absorption tower. The following maintenance procedure cover normal operating conditions but do not address startup conditions. Startup conditions are specified in Attachment A.

Sulfuric Acid Mist Emissions Prevention Plan

1. Drying Tower Operation

Minimize the amount of water in the sulfuric trioxide gas stream entering the absorption tower by through drying of the inlet air to the plant, minimizing acid carryover from the drying tower (decomposes to water and sulfur trioxide on heating), and detecting steam/water leaks (from boilers, superheaters and economizers) into the gas stream.

a. Drying Tower - Insure Good Drying - Maintain sulfuric acid flow at the proper level, acid concentration to the drying tower above 97.5%, and acid inlet temperature to the tower below 170 ^{o}F to minimize the water partial pressure above the acid (water vapor in the gas leaving the tower) monitor acid concentration, temperature, acid circulating pump current (amps), and acid flow to the drying and absorption towers by instruments.

b. Drying Tower - Acid Carryover - Monitor the condition and performance of the drying tower entrainment separator to prevent sulfuric acid droplet carryover from the drying tower. Perform a stick test of the gas exit from the drying tower to monitor acid droplets in the gas stream on a regular basis - once per week minimum.

c. Steam/Water Leaks - The economizer is the coldest area in the gas flow path ahead of the absorption tower, so any excessive water vapor in the gas will result in acid condensation in the economizer. Monitor gas side (casing) drains for condensed sulfuric acid on a regular basis - once per shift minimum. Acid condensate formation indicates excessive water vapor in the gas stream. When this occurs, further investigation to determine the source of the water entering the gas should follow. Check drying tower acid concentration, temperature and acid flow. Perform a stick test for acid droplet carryover from the drying tower. Check steam equipment for leaks - check gas side vestibule blowdowns for indications of moisture.

2. Absorption Tower Operation

Operate the absorption tower outside the fog formation region. Operate the absorption tower to maximize sulfur trioxide absorption by maintaining proper acid concentration, temperature and flow.

a. Operate Outside Fog Formation Region - Fog formation is dependent on the concentrations of sulfur trioxide, water and sulfuric acid vapor in the gas stream and the partial pressure of sulfuric acid and water above the acid in the bottom, gas inlet area, of the absorption tower. Operate the plant at acid concentrations above 97.5% and at acid temperatures above 160 ^{o}F to reduce or eliminate fog formation. Monitor the acid concentration and temperature in the control room.

b. Maximize Sulfur Trioxide Absorption - Maintain sulfur trioxide absorption by maintaining the proper acid flow and acid concentration (above 97.5%) to the absorption tower. Monitor the acid circulating pump current (amps), acid flow and concentration in the control room.

3. High-Efficiency Mist Eliminator

Maintain the water spray wash of high efficiency mist eliminator elements (water spray at the inlet to the mist eliminator vessel) to saturate the gas and prevent ammonium sulfite/bisulfite/sulfate solids build-up. Build-up

could cause restriction (plugging) of the gas passages in the mist eliminator elements, increasing pressure drop and causing excessive particle emissions to the stack.

Water Spray High Efficiency Mist Eliminator - A low mist eliminator gas pressure drops insures wash spray is effectively saturating the gas and preventing solids build-up on the elements (solids build-up is a slow process). Monitor high-efficiency mist eliminator's fan discharge pressure and water flow to the mist eliminator in the control room. Water flow to the sprays is ensured by maintaining a level in the high-efficiency mist eliminator's basin and monitoring the pumped flow from the Brink's basin to the scrubber.

4. Stack Opacity

Monitor the integrity of the high efficiency mist eliminator system. Monitor stack appearance by visual operator inspection on a regular basis (once per shift minimum). High stack opacity may indicate a leak in one of the elements, element flange leak, element seal leg problem, or failure of the glass fiber bed in one or more elements. Optimize operational practices items 1-3 above to minimize mist entering the mist eliminator, until the plant can be shutdown and the mist eliminator problem repaired.

Preventive Maintenance Practices - Maintenance inspection and testing during the plants regular maintenance outage (turnaround) insures proper performance of the high efficiency mist eliminator system for the next operating period.

During the turnaround the plant is purged, cooled and inspected, and any required maintenance repairs or replacements are performed. All areas of the plant are inspected. Boilers are inspected and hydrostatically tested for water tightness; towers are inspected, including acid distribution, flow, acid cooling, and entrainment separators; acid pumps are inspected, rebuilt, or in many cases, replaced with a spare; instruments are inspected and calibrated; etc. The high efficiency mist eliminator system is inspected and elements repaired or replaced as required.

Preventive maintenance tasks to be accomplished during the turnaround are as follows:

1. Inspect High Efficiency Mist Eliminator System - Inspection should include visual inspection of the elements, element to tubesheet flange connections, seal legs, and the inlet water spray system.

    a. Visually inspect each mist eliminator vessel and each element for unusual flow area, bulges in the element glass, loose flanges, flanges missing bolts or nuts, element wire failure, etc.

    b. Start inlet water spray and check the spray pattern and flow.

    c. Visually inspect element seal legs for damage.

2. Test System - Perform leak check of Element System - Use high intensity light in each element or use smoke generator (smoke bomb) to detect leaks in the mist eliminator system. Tighten flanges, repair seal legs, repair or replace any leaking or plugged elements as indicated and required.