LESSONS LEARNED Case histories from the H_2SO_4 industry

Chevron in primary scrubber vessel

In process applications where gas and liquid come into contact, the gas can entrain liquid to downstream equipment. This phenomena causes corrosion, makes vessel level control more difficult and increases consumption of absorption chemicals. A chevron demister is used in some scrubbing applications to eliminate liquid entrainment and keep large particulates out of the gas stream. However, proper material of construction (MOC) and maintaining intermittent wash spray are important to prevent warping and plugging of the chevron.

In this example, a high adiabatic saturation temperature in the scrubber caused the thin vanes to warp, which were not designed to withstand the gas temperature above 80 degrees Celsius (C). As shown below, the warping and dust accumulation on the blades created an open section in the middle of the chevron demister, resulting in improper gas distribution and increased gas velocity through remaining clean areas.

The chevron demister damage caused liquid carryover to enter the downstream equipment. The liquid carryover led to increased solids (iron content) in the downstream scrubber vessels (as shown in picture below), which can plug packed beds, foul equipments, and reduce overall scrubbing efficiency of the system. Fouling leads to reduced heat transfer, increased pressure drop, blocked ducts and pipes, and these effects are costly. The cost factors include increased fuel consumption, reduced throughput and increased maintenance.

Lessons learned:

Proper maintenance and material of construction are critical in specifying chevrons. Plants need to be diligent in 1) making sure operating temperature is compatible with materials, and 2) maintaining the intermittent chevron wash spray to keep its surfaces clean.

Chevron warping

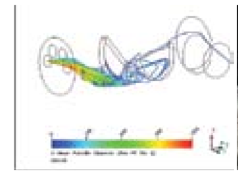
Sample test from primary scrubber vessel

Flame on!

While most operators do a good job of controlling the bulk furnace temperature, local conditions often exist that are much hotter than the rest. Hot spots are the result of improper fuel/air mixtures, which are normally caused by poor fuel atomization or stagnant zones due to a lack of mixing.

Although bricks are very strong in compression, they tend to lose strength as the temperature rises above their design limit. And, when impingement occurs, it is not unusual to find bricks and other ceramic material that have reached the melting point.

In the above furnace picture, it is fairly easy to see where sulfur was striking the underflow baffle and the resulting damage. The piece of rubble on the right is a firebrick from the same furnace, fused to a glassy consistency in several areas by high temperature.



The above CFD model shows the path of sulfur droplets in a conventional sulfur furnace with two baffles and a side outlet. Only one gun is shown for clarity. Note that after the first baffle, only the very smallest sulfur particles remain unburned (blue color). Should larger sulfur particles be generated, because of a problem with a sulfur gun, unburned sulfur droplets will be found further downstream.

In a worst-case scenario, unburned sulfur can reach the boiler tubesheet and burn on the refractory or in the tubes (above). Although baffles help to minimize failings of the sulfur guns, improper atomization can result in major equipment damage.

Lessons learned:

It is very important to keep sight ports on the furnace clean so that flame pattern of burners and sulfur guns can be monitored. Don't put off taking that shutdown to replace that faltering sulfur gun. The risks are just too great.

The above Lessons Learned submissions were provided by MECS Inc. For more information, please contact Leon Sewkarran by phone at (314) 275-5700 or by e-mail at leon.sewkarran@mecsglobal.com. ❑