Materials of construction in sulfuric acid plants

Materials of Construction (MoCs) are extremely important in all chemical applications, but the sulfuric acid process offers a unique set of challenges. If the wrong MoC is chosen, there is a good chance equipment item(s) will fail in a short period of time.

For example, oleum and sulfuric acid require different MoCs. Iron may be appropriate for strong acid, but will likely be damaged when used in oleum service. Oleum cracking in gray cast iron and ductile iron is believed to be caused by SO_3 penetration along the graphite and subsequent oxidation of the exposed graphite flakes or silicon in the alloy. The products of either of these reactions build up pressure and eventually crack the alloy. Carbon steel or 304 SS should be used with oleum. Oleum cracking does not occur in these alloys.

Figure 1 shows an example of oleum cracking. When a pump designed for strong acid service is installed in oleum service, oleum cracking could occur. The discharge pipe of the acid pump is constructed of grey cast iron. When the acid pump was mistakenly placed in oleum service, the discharge pipe failed in a short period of time.

Figure 1: Oleum cracking on discharge of pump.

MoC can be difficult to identify with the naked eye, but there are two methods that can be used to determine the MoC. First, the pump should have a serial number or some other form of identification of MoC. This can be checked with the pump vendor to confirm the material. Second, a sample of the alloy can be placed under a microscope to distinguish if graphite is present.

LESSON LEARNED

MoC is extremely important to the life of any piece of equipment. The wrong choice can result in failure of that unit. MoC should be checked anytime a new unit is installed to prevent corrosion and possible failure. In oleum service, carbon steel, or 304 SS are acceptable and should be used to prevent premature failure.

Proper location of control instrumentation in sulfuric acid plants

It is important to choose a proper location for instrumentation probes in order to get reliable instrumentation readings, especially for critical or control instrumentation elements, such as flow, temperatures and concentration. Proper upstream and downstream straight-run distances are well known for flow elements, but it is also important to make sure that concentration and temperature probes are properly located as well.

For example, a two-stage temperature bypass was installed around a strong acid cooler to control the acid temperatures.

Figure 1 shows a simplified schematic. Figures 2 and 3 show the bypass piping and thermocouple installation.

Upon pre-commissioning inspections it was seen that the thermocouple probe was installed too close to one of the bypass tie-ins. Thus, whenever the No. 2 temperature control valve would open (see Figure1), the temperature reading would be inaccurate, due to the inadequate mixing. The thermocouple had to be relocated further downstream to ensure adequate mixing. If this had not been found and corrected, the result would have been erratic poor temperature control, leading to possible poor absorption and stack emissions.

LESSON LEARNED

During model reviews, it is important to ensure there is adequate mixing of combined streams ahead of the location of instrumentation. Improper instrument locations can lead to poor control and/or costly re-work.

The above Lessons Learned submissions were provided by MECS Inc. For more information, please contact Dan McClaws by phone at (314) 275-5700 or by e-mail at daniel.j.mclaws@mecsglobal.com. ❑

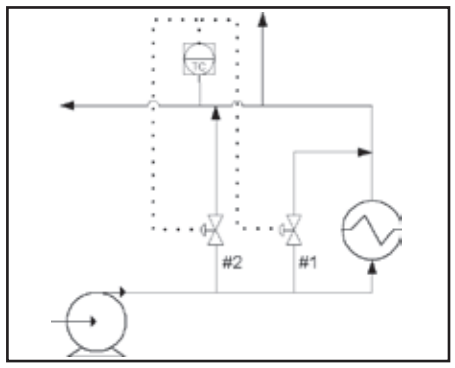

Figure 1: Bypass Piping – Schematic

Figure 2: Bypass Piping – Side View

Figure 3: Bypass Piping – Front View