Solvay USA Uses ChemLine® 784/32 for 99+% Sulfuric Acid Service in Rail Tankcars

ChemLINE®
CASE STUDY

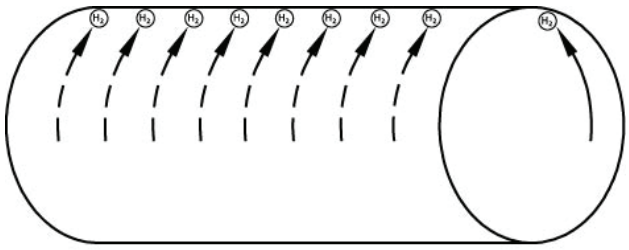
Solvay USA Inc. is a world-leading producer of essential chemicals including 99+% sulfuric acid and other products. 99+% sulfuric acid is used in a range of industries, most notably in oil refining for alkylation to increase a refinery's yield of automotive gasoline. This purified sulfuric acid is mainly transported from Solvay USA via tank railcars to customers. After unloading, the rail tankcars are re-filled with spent alkylation sulfuric acid that is returned to Solvay USA for regeneration. This transport cycling process is continually repeated.

Solvay USA ECO Services.

Understanding Hydrogen Grooving Corrosion

According to Mr. George Wang, Solvay USA Senior Process Technologist, ECO Services GBU, and a 37-year veteran at the company, there has always been an inherent corrosion problem with rail tankcars carrying 99+% sulfuric acid and spent alkylation sulfuric acid. Corrosion occurs when sulfuric acid produces hydrogen gas. As the gas moves upward in the railcar (see illustration), it corrodes the steel surface causing a grooving pattern. Mr. Wang explains that unlined tank railcars are not usually retired from service due to uniform corrosion, but from deep hydrogen grooving.

Hydrogen grooving is a type of corrosion that can be observed on surfaces exposed to H_2SO_4 in the upper portion of horizontal tanks. Such corrosion is caused by bubbles of H_2 (Hydrogen) formed by H_2 molecules derived from the actual corrosion of carbon steel in sulfuric acid. The rise of hydrogen bubbles creates turbulence, exposing the metal to acid. The disruption of the film is not uniform, but rather occurs along preferential paths that are generally parallel to each other. The formation of vertical grooves on cylindrical surfaces run circumferentially from 9 o'clock to 12 o'clock.*



Hydrogen Grooving

Waste sulfuric acid that contains a higher concentration of water, impurities, and/or dissolved gases can cause an acceleration of metal corrosion. Sometimes the cleaning process of the rail tankcars can also cause corrosion issues. Solvay USA has studied this problem for years. Mr. Wang says, "Baked phenolic coatings simply do not work for this demanding service carrying fresh sulfuric acid and returning with spent alkylation acid. So our lab tested coupons

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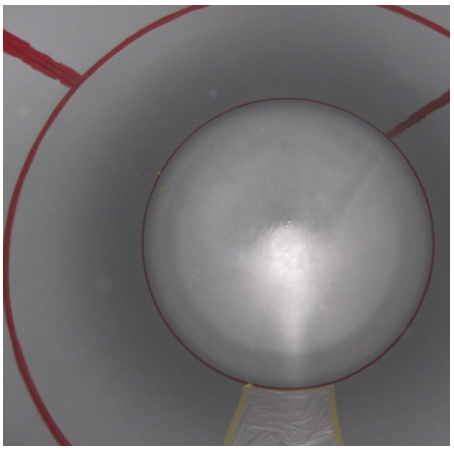
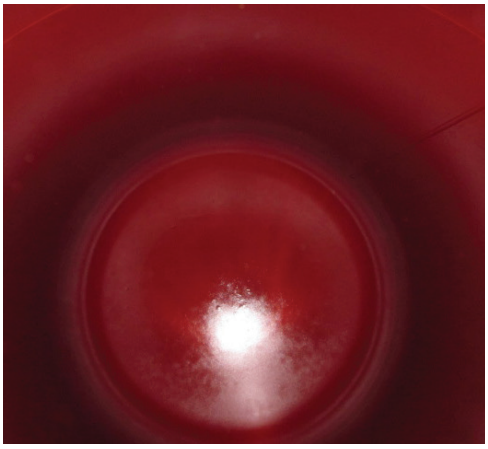

2012 initial application work with two coats of ChemLine® 784/32. First, a grey base coat followed by a red top coat.

with a coating called ChemLine® 784/32 from Advanced Polymer Coatings, as a possible solution, and after testing we decided to proceed with an actual railcar test."

2012 – Initial Application Work

Satisfied with lab tests, Solvay USA decided to line two tank railcars in April 2012 with ChemLine® 784/32 to see if their service life could be extended. The 14,500 gallon rail tankcars are leased to Solvay USA. The tankcars were brought to Seaboard Railcar Repair in Hugo, OK where an inspection showed some pitting and other problems. Seaboard prepped the internal surface through grit blasting to clean out contaminants and pitting, grinding the sharp edges caused by grooving, and repairing areas as needed so the tankcars would be structurally suitable for application.

Next, a grey base coat of ChemLine® 784/32 was applied followed by a red top coat. The tanks were then forced hot air cured, per coating manufacturer's specifications. Within a few days, the rail tankcars were put back into service.

2013 – One-Year Inspection

These same two tank railcars lined with ChemLine® 784/32 were brought in July 2013 for a one-year service inspection. On hand were Solvay USA representatives and personnel from Advanced Polymer Coatings.

The inspection showed that the overall condition of both rail tankcars was good, with the lining intact with no corrosion or grooving observed. Dry film thickness (DFT) readings were also recorded in both railcars, and these were shown to be consistent with DFT averages from the initial application.

Several areas in the tank where repair work was performed the previous year during initial coating were beginning to peel; however, the lining underneath was intact with no degradation. The original gloss of the coating had been lost and some staining occurred, however this did not affect any performance of the lining. Thus easy repair touch-up work was done and the tanks were again put back into service.

Mr. Wang says the results of the one-year service inspection shows that the service life of the rail tankcars can be extended with ChemLine® 784/32, providing the internal tank corrosion protection that Solvay USA needs. "The grooving problem has stopped, which is a significant development," he adds. "We think there will be a significant increase in the service life of Solvay USA rail tankcars with ChemLine® 784/32, which will provide tremendous cost savings."

Looking Ahead

In 2014, after a second year of service carrying fresh and spent alkylation sulfuric acid, Solvay USA will again inspect the two ChemLine® 784/32 rail tankcars. "Since Solvay USA uses hundreds of sulfuric acid rail tankcars, and thousands in the sulfuric acid industry, ChemLine® 784/32 could be a big solution for safe transportation for fresh and spent sulfuric acid," Mr. Wang points out.

* From "Corrosion of Carbon Steel Pipes and Tanks by Concentrated Sulfuric Acid: A Review"