TANK WASH SOLUTIONS
A JOHN-HENRY COMPANY

Stainless Steel Passivation
For Tankwagons, ISO Tanks, IBC's

Presented by Henry Zeller

Frequently Asked Questions

What is passivation?

According to ASTM-A967, there are several definitions for passivation, depending on the specific application. The following is most appropriate for the tank cleaning industry: "Passivation is the chemical treatment of a stainless steel with a mild oxidant, such as a nitric acid solution, for the purpose of enhancing the spontaneous formation of the protective passive film. Such chemical treatment is generally not necessary for the formation of the passive film."

Why is passivation necessary?

The reason to re-passivate is that the chromic oxide film that should be present in austenitic steel gets compromised regularly, whether from materials being transported, or even the cleaning process itself. Stainless steel is stainless because of the protective chromium oxides on the surface. If those oxides are removed by scouring, buffing, or the presence of mineral acids, such as muriatic or hydrofluoric acids, or by reaction even with the loaded material, then the iron in the steel is exposed and can be rusted. Once rust has breached the chromium oxides, the iron in the stainless steel can also rust. Hence the need for re-passivation. An example of this is a tank whose prior cargo was a chlorinated solvent. The vapors from the solvent hydrolyze in the tank and become hydrochloric acid, thereby compromising the stainless steel surface. Simply cleaning the tank will not restore the tank's chromium oxide passive film.

When is it the right time to passivate?

This is a proprietary decision made by the owner of the tank. There are many factors that can determine the need or time to passivate.

A strategy to systematically passivate an entire ISO tank fleet is sound. A single passivation per year has the potential to slow pitting by 25%, based on four turns per year. If subsequent loads into a passivated tank do not destroy the chromic oxide film, this yield could be even higher.

Tankwagons and IBC's, on the other hand, must be evaluated by a different standard. These containers reload more often, and can sometimes be top-loaded or remain in a dedicated service. Their relatively low purchase price may allow for continued service without incurring preventive maintenance costs, such as for passivation, as the benefits may never be realized.

Should mechanical abrasion, buffing, grinding, or welding occur inside the tank, passivation must be performed, at least on the affected areas. This may be performed with a pickling paste for welds and small spots. For larger areas it is more effective to passivate the whole tank.

What factors should be considered?

Factors include, but are not limited to, the following criteria:

1.) Replacement cost of tank. Is it more cost effective to replace the tank, than to try to prolong its life cycle with costly treatments?
2.) Types of chemicals hauled. Will a passivated tank lose its chromic oxide film on the very next load?
3.) Dedicated, or nondedicated. Will omitting passivation allow future loads of normally non-corrosive materials to further deteriorate the tank?
4.) Return on Investment. Does the tank's owner have modern tracking capabilities to plan, implement, and track passivated tanks, so as to maximize the effort?
5.) Food. If there is any possibility that the tank will haul food - Passivate!

How does one passivate successfully?

Passivating stainless steel is normally accomplished in industry by dipping stainless steel components in a nitric acid solution, per ASTM-A967. A nitric acid solution dissolves free iron and/or other contaminants from the surface, which cleans the metal and re-oxidizes the chromium. But for the tank cleaning industry, you don't need a nitric acid bath to passivate. No one could afford to pickle a tank, as the solution, upwards of 6000 gallons, becomes contaminated with each application. The key is to clean the stainless steel to bare metal, and then coat the tank with a nitric acid spray or fog. Allow to stand for the duration of a pickling event, and the same results can be achieved.

Doesn't stainless steel passivate itself with time?

While metallurgists are far apart on their opinions regarding passivation methodology, they do agree on the following principle: If stainless steel is clean and dry, the oxygen in the atmosphere will form the protective chromium oxides needed. The steel will be every bit as passivated as that which was dipped in acid. But there are problems here. First, it takes longer - up to two weeks for a totally natural restoration to occur. And considering the nature of bulk chemical hauling, who is to say when a tank is truly clean, especially given their current pitted condition. By definition, "clean" denotes that all

contaminants, even in deepest part of pits, have been removed. Second, even if all contaminants and rust particles are removed in the cleaning process, if the tank loads before the cycle for natural passivation occurs, the mission will have failed. Now the current cargo, which may not normally exhibit deleterious effects on passivated steel, resumes pitting the tank, as the corrosion cycle was never interrupted.

OK, what is the best way to passivate tanks?

Regardless of the situation, it would be prudent to reference a proven procedure when requesting passivation. By referencing a specification, such as outlined by ASTM-A967, you do not have to reinvent the wheel. By taking advantage of proven technologies, such as the John-Henry Brand® Passive-8 System you can eliminate much of the guesswork that would otherwise accompany a new process. This technology deploys air and sound to shatter a super-low surface tension nitric acid based solution into a 5-10 micron fog, which then covers the tank uniformly and penetrates even the smallest pits. It is much more effective than coarse sprays or bulk application, as any solution applied in liquid form is impeded by high surface tension, which allows for it to "sheet" right over the pits. If the passivation fails, the potential high cost of the alternative method can be the cost of the cargo. Ouch.

How much passivation solution is used?

Passive-8 is applied to a freshly washed and rinsed tank at the rate of 1 1/2 gal. per 1000 gal. of tank capacity. After it is dispensed through the John-Henry Simplicity Fogger, a process that takes about 3 minutes per gallon, the product is allowed to stand for an additional 45 minutes, and then flushed out with water. In a multi compartment tank, the same formula applies per compartment.

The John-Henry Simplicity Fogger is a device that runs solely from compressed air and can deliver a fairly uniform fog from two nozzles, capable of projecting up to 25 feet in each direction.

How can passivation be verified?

One of the simplest verification tests is the copper sulfate test. Pour a copper sulfate solution onto the floor of the tank, and allow to stand for six minutes, rinse and visually examine. Any copper (pink) color indicates the presence of free iron and the test is considered unacceptable.

If a more scientific method is required (for quality assurance), after rinsing and drying tank interior, surfaces may be checked with the Koslow 2026 Passivation Test Kit.

Using any of the aforementioned methods, if the tank interior tests positive for free iron or still shows signs of discoloration or stains, another Passivation treatment will be necessary.