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Impact of Muriatic Acid on Stainless Steel Appliances

Muriatic acid is a dilute form of hydrochloric acid that is commonly used as a cleaning agent in the preparation of tile and concrete floors. Therefore, it is quite commonly utilized by contractors in the renovation of restaurant, commercial, and even residential kitchens. What is often overlooked, however, is the impact that vapors from the use of this cleaning agent has on the stainless steel surfaces of appliances and other kitchen equipment.

So how does this relate to property claims? Let's take a look at a case study.

Case Study

A contractor was preparing tile floors in a commercial kitchen using muriatic acid as the cleaning agent. The acid was left on the floor overnight and by the next morning rust began breaking out on all refrigerator, freezer, oven and table stainless surfaces throughout the kitchen. To mitigate the rust, the Insured attempted to clean the surfaces with two different types of metal cleaners but without much success. A restoration company was brought in to attempt mitigation of the appliances but again the stainless steel surfaces could not be brought back to a pre-event condition. The Insurer decided to pay for replacement appliances and subrogate against the contractor.

The contractor contended that they did not see the rust prior to the Insured using abrasive chemicals on the stainless steel surfaces. They blamed the cause of the loss on the cleaning materials used by the Insured.

To determine the cause of the rusting, a review of the two cleaning chemicals used by the Insured was first conducted. Cleaner #1 was found to be a commonly used aqueous oxalic acid (an organic rather than mineral acid). Although a mild abrasive, the product did not contain any chlorides. The product is listed as a cleaner for stainless steel surfaces and is recommended by several appliance manufacturers (e.g. West Bend, Delta Faucet, All-Clad, Bradley, etc.) to remove rust from their stainless steel products. Cleaner #2 was found to have a similar chemical composition of aqueous oxalic acid and an abrasive with the addition of alcohols to promote slower drying and also ammonium hydroxide to neutralize the cleaner and the stainless steel surface. The product is listed specifically as a stainless steel polish, contained no chlorides, and is again recommended by several manufacturers.

Contrary to the statement made by the contractor, the use of abrasives on stainless steel is an accepted practice for rust removal. Most stainless steel appliance manufacturers provide a surface maintenance procedure that includes the use of abrasives, as long as scrubbing occurs in the direction of the polishing marks or grains of the surface. This procedure is also specified by the North American Association of Food Equipment Manufacturers (NAFEM) in their "Stainless Steel Equipment Care and Cleaning Guide".

Obviously neither of the products used by Insured could have led to the initial rusting and therefore the Insured was not the causer of the loss. Through later chemical testing of pH and chloride concentrations on stainless steel surfaces at the loss site, it was proven that hydrogen chloride fumes from the muriatic floor treatment was the definitive cause of the loss. Of note is that all galvanized surfaces (e.g., electrical conduit and splice boxes) within the space were also found to be rusted by the muriatic vapors, similar to the "acid gas" effect of the combustion of PVC plastic materials (a future newsletter topic).

The Staining of Stainless

Stainless steel is used primarily for its corrosion resistant properties and is often thought of as "rust-proof". However, many of the greater than 12 grades of stainless steel can still be damaged by chlorides in the natural environment (e.g., sea salt) or in cleaners. The various grades of stainless are determined by the amount of chromium, nickel, molybdenum, and nitrogen used in the formulation, as well as the amount of heat used in the manufacturing process. Only marine grade stainless steels (e.g., Alloy 2507 with 25% chromium, 7% nickel, 4% molybdenum and 0.28 % nitrogen) may be considered truly "stainless". Stainless steel kitchen equipment is almost exclusively constructed of Grade 304 stainless steel (18% chromium, 9% nickel).

Stainless steel surfaces normally prevent corrosion by the natural formation of what is know as a "passivated surface". The chromium and nickel in the steel react with oxygen in the air to form chromium and nickel oxide, respectively, on the surface of the metal. There are many chemical substances that can break through this passive surface layer. Normally, rinsing and drying will remove the contaminant and allow the surface to naturally reform the passive oxide surface. Mild abrasives are recommended for cleaning stainless steel since stubborn contaminants are removed and a nicely passivated new surface is formed.

However, chloride salts (metallic salts are formed when such surfaces are in the presence of hydrogen chloride vapor) either in excessive concentration or over a large amount of time, will form pits or "pitting corrosion" on Grade 304 stainless steel. This pitting, which can only be

formed by chlorides, is very difficult to remove even with abrasion. If the chloride concentration is high enough or too much time has passed, the surface will never be able to be restored.

All manufacturers of stainless steel equipment warn against the use of muriatic acid and other chlorine containing agents, such as bleach, on or near such surfaces. Many appliance warranties also contain specific wording on protection of the surface against chloride containing chemicals and the warranty will be voided if excessive exposure occurs.

Of interest relative to the case study is that the two cleaners used by the Insured both contained "oxalic acid". This substance functions as a de-rusting agent by preferentially forming an "oxalate" with rusted iron, displacing ("precipitating") the rust and exposing the underlying bare metal. The use of this substance, followed by abrasion, allows the re-formation of a passivated, corrosion resistance surface on the stainless steel.

Photograph of a rusted 304 stainless steel grill grate.

Please address any comments or questions on these articles via email to Mark Krzyzanowski at mark@eqdamcon.com. Please also feel free to suggest newsletter article topics related to technology equipment and property claims.

December 7, 1941, never forget Pearl Harbor

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