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Corrosive chemicals that require special pumping considerations

Ten common chemicals to keep in mind

Corrosive chemicals are fluids that will attack and destroy the materials they come in contact with. Metals, stone, glass, elastomers and even some types of plastics can be susceptible to corrosion from various acids, bases and solvents. Some corrosive materials can even cause physical hazards when exposed to incompatible materials. For example, when exposed to an incompatible metal, many inorganic acids can release hydrogen gas, which can pose a fire and explosion hazard.

This is why care must be exercised when selecting pumps to handle these corrosive chemicals. Here, we review the most commonly used industrial chemicals, including their pertinent characteristics, and explain why working with these chemicals requires special considerations when choosing industrial pumps to transfer them safely.

Chemicals that corrode transfer pumps

1. Ferric chloride dissolved in water yields a highly corrosive solution. Approximately 80% of its use is as a coagulant and flocculant for many industrial and sanitary wastewater treatment applications. It is also used as a catalyst in organic synthesis. It is a fairly strong acid and dehydrating agent. Typical concentrations range from 30% to 60%.

2. Hydrochloric acid, also known as muriatic acid, is a strong acid. Common concentrations range from a few percent to 36%. Hydrochloric acid is hydrogen chloride gas dissolved in water. It has a high vapor pressure which causes it to fume in higher concentrations. Typical uses are pH control, steel pickling, and the production of various organic and inorganic compounds.

3. Hydrogen fluoride dissolved in water yields hydrofluoric acid, which is highly corrosive due to the electronegativity of the fluorine atom present. Despite being one of the most dangerous inorganic acids, it is considered a weak acid. Even brief physical contact with hydrofluoric acid can cause severe skin and tissue burns. Common concentrations range from a few percent to more than 50%. Applications include titanium pickling and semiconductor wafer manufacturing.

4. Hydrofluorosilicic acid is used mostly in industrial or municipal applications/processes. The most common application is the fluoridation of municipal drinking water supplies. Common industrial solution strength concentrations are 23% to 25% and 40% in water. Hydrofluorosilicic acid is very corrosive and interacts with various metals to produce hydrogen gas.

5. Hydrogen peroxide Primarily used as an oxidizing/bleaching source, hydrogen peroxide is also largely used as a rocket propellant. Even though nonflammable, it is a powerful oxidizing agent that can cause spontaneous combustion when it comes in contact with organic material. Typical concentrations range from 20% to 50%.

6. As a strong acid, nitric acid reacts violently with bases and is corrosive to most metals. It also



FIGURE 1: A lab technician is checking pump performance. This ULTRAChem pump is used for pumping a variety of caustic chemicals in an industrial lab. Courtesy Finish Thompson



FIGURE 2: Finish Thompson ULTRAChem pumps installed in an electrochlorination system, in which sodium hypochlorite is produced from running saltwater through electrolytic cells. It's for use in the water and waste water treatment industry. Courtesy Finish Thompson

reacts violently with organic chemicals (e.g., acetone, acetic acid, acetic anhydride), causing fire and explosion hazards. Production of nitric acid is the sixth-largest chemical industry in the U.S. It is utilized across many industries, but primarily in the manufacture of fertilizers and explosives. Other applications include plating, titanium pickling (combined with hydrofluoric acid), semiconductor wafer manufacturing, and clean-in-place solutions used in the food, beverage, and pharmaceutical industries. Common concentrations range from 15% to 70%.

7. Frequently referred to as caustic potash, potassium hydroxide is classified as a strong base. It is also very chemically active and reacts violently with acids, producing significant heat in the process. The leading use of KOH is in the production of potassium-containing compounds (50%), while approximately 10% is used to manufacture soaps and detergents. Typical concentrations range from a few percent to 50%.

8. Sodium hydroxide, also known as lye or caustic soda, is the most commonly used base in the world. It is a strong base, has a high specific gravity, and is highly exothermic. One of the common concentrations of sodium hydroxide is 50%, at which it is somewhat viscous and freezes at 58° F (14.4° C). Sodium hydroxide is used to manufacture soaps, plastics, and paper. It is also used in processing cotton fabric, metal cleaning, electroplating, and peeling fruits and vegetables.

9. Sodium hypochlorite (bleach) is commonly found in 5.5% concentrations (i.e., household

bleach) because it is more stable than higher concentrations. It is very corrosive to a wide variety of materials. Industrial strength sodium hypochlorite is typically 12% to 15% concentration and is often produced at these higher concentrations to reduce shipping costs but is then cut by the user to approximately 5.5% due to the more stable nature of the lower concentration. Typical uses include disinfection of potable and wastewater and disinfection at food processing plants.

10. Sulfuric acid is the most commonly used acid in the world. It is a strong acid, has a very high specific gravity in concentrated forms (it's heavy compared to water), is extremely exothermic when mixed with water (liberates large quantities of heat), and is extremely corrosive to many materials. Common concentrations include 98% and 93%. Common uses are the manufacture of fertilizers and chemicals, petroleum refining, and as an electrolyte in lead-acid batteries.

Learn more about corrosive chemicals

Complete knowledge of a chemical's hazards and suitable construction materials for the transfer pump and associated piping, valves, etc., is critical. The consequences of improper selection of suitable materials can be devastating.

There are several ways to learn more about the specific hazards associated with corrosive chemicals. Start with the SDS (Safety Data Sheets) available from the chemical supplier. Next, numerous chemical resistance guides can be found through Internet searches, and many pump manufacturers have their own guides. In addition, some pump manufacturers have electronic selection programs that ensure only compatible materials are selected. If there is any doubt about compatibility, consult with the pump manufacturer at the earliest possible stage in the specification process. ²

Pete Scantlebury is vice president of development for Finish Thompson, Inc. He has more than 45 years' experience in several technical positions with the company and is the go-to resource on the nuances and applications of industrial pump systems. Finish Thompson designs and manufactures pumps to transfer a wide variety of corrosive fluids safely. For more information, visit www.finishthompson.com.