



Application Note to the Field	Using Liquiflo Hastelloy-C Pumps for Hydrochloric Acid
Application Note Number: 0005-1	Date: May 17, 2000; Revised Sept. 2022

Hydrochloric Acid (HCl) is available as "commercial" or "reagent" grade; commercial grade being able to have a predetermined amount of contaminants, and still be deemed acceptable, and reagent grade being significantly more "pure."

The corrosive nature of HCl varies significantly with:

- Concentration
- Temperature
- Dissolved oxygen
- Presence of free chlorine or ferric ions

Liquiflo Alloy-C pumps use Hastelloy[®] C-22 alloy for the housings and C-276 alloy for any internal parts made of metal (i.e., shafts, gears, keys, retaining rings, seal retainer, containment can, etc.). Haynes International (the manufacturer of Hastelloy-C, which is generically known as Alloy-C) publishes a C-276 corrosion rate of < 2 mils/year (0.05 mm/year) in dilute-to-37% HCl at 77°F (25°C), which is given an "A" rating in corrosion guides. C-22 has a corrosion rate of < 5 mils/year (0.13 mm/year) at the same conditions, which is given a "B" rating. These corrosion ratings for Alloy-C vs. HCl acid are acceptable for continuous duty applications at or close to room temperature and assuming low dissolved oxygen. However, a problem with accelerated corrosion often occurs because most hydrochloric acid has, at some point prior to use, come into contact with materials that contaminate the HCl, and produce or liberate such things as ferric chloride, chlorine, etc.

In using a Hastelloy-C pump for HCl, it should be determined what grade of acid you are dealing with, and what it has been in contact with. For example, cast iron is sometimes used for tanks or piping, and because it is a ferrous material, ferric chloride will be formed in the acid. Ferric chloride is a significantly more corrosive chemical than hydrochloric acid.

Sometimes even sophisticated companies may not be aware or certain about how clean their acid is, and as a consequence, some of our pumps have had a very short life. It has been Liquiflo's experience that there is a high corrosion rate with *commercial grade* 2-37% HCl.

What typically occurs is crevice corrosion at the O-ring grooves, causing leakage. This usually happens after *about* two months, depending upon usage rate, still time (time when pump is flooded with acid, but not running), etc.

After *approximately* 4-6 months (once again, more or less, depending upon usage) the containment can or inner magnet are generally "thinned out" to the point that there is catastrophic failure of one or both. At this point, the pump is typically not repairable, due to loss of material to the housings.

Liquiflo Application Note to the Field: Using Hastelloy-C Pumps for HCl Acid

Given the problems associated with the chemical itself, and how people handle it in storage tanks, pumps, etc., plastic pumps have generally become standard. Many plants, however, do not like to use plastic pumps (they are physically weaker, which can be a problem for installation and safety), and therefore may prefer to use a Hastelloy-C pump and understand and accept its limitations. As long as they are made aware of the situation, many people are satisfied with the life they get.

Even with contaminated HCl, it may be possible to make the pump last longer by simply flushing the pump with clean water after use, for several minutes. This can be done by manifolding in a water supply, and switching over to it immediately after running on acid. How effective this is at increasing life will depend on what percentage of the time it is being used on HCl (if it is only used occasionally, and flushed well after each time, it could suspend failure for a comparatively long time).

An alternative to using Hastelloy-C or plastic pumps for HCl, is to use a stainless steel pump having all wetted surfaces lined with a chemically resistant plastic. In 2008, Liquiflo developed a PFA-lined SS gear pump, called the Poly-Guard® and also known as the P-Series, to handle HCl and similarly corrosive chemicals, such as ferric chloride and sodium hypochlorite. PFA (per-fluoro-alkoxy) polymer resin offers excellent chemical resistance to corrosive liquids, such as inorganic acids, alkalis and salt solutions. 300-Series Stainless Steel is used for the housing material, which gives the pump structural integrity and resistance to corrosive environments.

The main advantages of the PFA-lined pump are:

- Extremely chemically resistant – handles wide range of corrosive chemicals
- Ideal for high-purity services, where contact with metal parts must be avoided
- Physically stronger than pumps made with 100% plastic – higher pressure capability
- Economical alternative to expensive metal alloys

For questions on pumping HCl or more information about the Poly-Guard gear pump, please contact the Liquiflo Applications Group.

Some Physical Properties of Hydrochloric Acid @ NTP

Concentration in Water		10%	20%	30%	34%	38%
Specific Gravity	–	1.05	1.10	1.15	1.17	1.19
Viscosity	cP	1.16	1.37	1.70	1.90	2.10
Melting Point	°F	-0.4	-74.2	-61.6	-32.8	-14.8
Boiling Point	°F	217	226	194	160	118
Vapor Pressure	mmHg	17.5	17.7	28.1	68.0	227

NTP = Normal Temperature & Pressure: 68°F (20°C) & 1 atm (1.013 bar)

Note: Hydrochloric acid is nonflammable at all concentrations.