Application Note to the Field	Hydrogen Peroxide
Application Note Number: 0110-1	**Date:** Oct. 5, 2001; Revised Sept. 2022

Water can be a challenging fluid to pump with a gear pump due to its low viscosity and the attendant difficulties such as slip and wear. Hydrogen peroxide (H_2O_2) is mechanically very similar to water, but in addition, has material limitations as a function of its physical and chemical properties. Liquiflo has extensive experience pumping hydrogen peroxide and working around its eccentricities.

The materials of construction used for H_2O_2 must be ***pure and contain no free nickel*** which can come in contact with the fluid.

Impure materials can cause gassing (by decomposition of H_2O_2 into oxygen gas and water) similar to when the commercially available 3% solution is poured on a cut. Gassing of peroxide in the concentrations typically used industrially (30-70% is most common) can cause several problems. Gas moving through a system is usually not desirable, but the pump does not like it either. The pump depends on the process fluid to provide film lubrication. All parts have microscopic peaks and valleys, which are known as *surface asperities*. Forces within the pump are trying to force surfaces together such that the peaks may contact each other to one degree or another, causing heat and wear. The better the film lubrication, the longer the pump will last, all else being equal. Conversely, if the film is degraded or eliminated (such as when a gas is present rather than a liquid), the pump will wear out more quickly, or in extreme cases, fail. In the case of sleeve bearings, this can amount to the same thing as running them dry, but with a load, as there is still fluid moving through the rest of the machine. Additionally, wear throughout the rest of the pump is increased. Impure materials, so far as hydrogen peroxide is concerned, would include carbon, bearing grade (BG) PEEK and Ryton.

Nickel can cause far more severe problems, as it acts as a catalyst to rapidly decompose H_2O_2 into hydrogen gas (H_2) and oxygen gas (O_2). Since the volume the gas occupies is far greater than that of the liquid, and it happens so rapidly that there is usually little chance of it escaping (even venting is typically not enough), an explosion can occur. For this reason it is extremely dangerous to have any material with significant nickel content in contact with the process. Materials that Liquiflo offers that are to be avoided for this reason are: Alloy-C (nickel-based alloy) and tungsten carbide (TC – a shaft coating that uses nickel as a binder). 316 Stainless Steel, which has a nominal nickel content of 12%, is safe to use with H_2O_2 because its chromium oxide passivation layer essentially isolates the nickel from the surface of the metal.

The materials of construction that Liquiflo offers that have been proven over the years to work are:

- 316 Stainless Steel
- Teflon (25% glass fiber reinforced)
- Virgin PEEK
- Silicon Carbide (SiC)
- Chrome Oxide (shaft coating)
- Virgin Teflon (O-rings)

443 North Avenue, Garwood, NJ 07027, USA Phone: 908-518-0777 • Fax: 908-518-1847

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Materials Liquiflo usually recommends would be the following:

Pump Component	Materials – 1st Choice	Materials – 2nd Choice
Housing & Shafts	316 SS	316 SS
Drive Gear	Virgin PEEK	316 SS
Idler Gear	Virgin PEEK	Teflon
Wear Plates	SiC	Teflon
Bearings	SiC	Teflon
Shaft Coating	Chrome Oxide	Chrome Oxide
O-rings	Virgin Teflon [1]	Virgin Teflon [1]
Mechanical Seal [2]	Teflon vs. SiC	Teflon vs. SiC

1 - Viton suggested for Models H1/31/41. **2** - Not applicable for Mag-drive pumps.

For high pressure and/or high temperature service, or to achieve a longer service life before maintenance is required, Liquiflo suggests using Virgin PEEK for the gears and SiC for the wear plates and bearings. Virgin PEEK is a pure material and therefore is suitable for H_2O_2 service (unlike BG PEEK, which contains graphite). When using an extremely hard material (such as SiC) for the wear plates with a thin fluid (such as H_2O_2), it is important to avoid the use of any metal gear to prevent a high wear rate of the gear. This is the reason why two Virgin PEEK gears should be used.

If Teflon is to be used for H_2O_2 service, the differential pressure should be limited to 50 PSI and the temperature should be limited to 100°F. Teflon is a relatively soft material (compared to PEEK or carbon, for example) and can be deformed under higher loads and elevated temperatures. This means that the differential pressure and temperature must be kept to reasonable levels to prevent premature failure and/or high wear rates to critical components such as the idler gear and bearings, and in the case of a mechanical seal, the Teflon seal face.

The mag-drive pump configuration is preferred for H_2O_2 service, especially at concentrations over 3% and/or differential pressures greater than 50 PSI (the pressure limit of a Teflon mechanical seal).

In order to determine the best maintenance intervals, it is best to monitor the wear rates of a new application. Once this has been established, repair kits can be ordered and installed at planned times to get maximum running time.

As always, if there are any questions, please contact the factory.

Some Physical Properties of Hydrogen Peroxide @ NTP

Concentration in Water		3%	30%	50%	70%	100%
Specific Gravity	–	1.01	1.11	1.20	1.29	1.45
Viscosity	cP	1.01	1.08	1.17	1.24	1.25
Melting Point	°F	+28	-15	-62	-40	+12
Boiling Point	°F	214	225	237	257	302
Vapor Pressure	mmHg	17	15	10	6	< 2

NTP = Normal Temperature & Pressure: 68°F (20°C) & 1 atm (1.013 bar)
Note: Hydrogen peroxide is nonflammable but can be explosive, especially at concentrations over 70%.