Application Note to the Field	**Hydrogen Peroxide**
Application Note Number: 0110-1	**Date: October 5, 2001; Revised Aug. 2008**

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 nickel. 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 (50-70% 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. 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 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 rapid decomposition into hydrogen and oxygen gas. 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-C276 and tungsten carbide (TC – a shaft coating that uses nickel as a binder).

Silicon carbide (SiC) is a very pure material, but there are also some limitations for its use. First of all, SiC is extremely hard. It is, in fact, harder than almost any other material except diamond. Since we cannot use TC coating on the shafts that would run against it, it can tend to machine down the softer ceramic. As well, there have been instances of a phenomenon that looks like wear, but is not (and has not been fully explained to Liquiflo), on items like bearings and seal faces being used on water and fluids mechanically similar to water.

The materials of construction that Liquiflo offers that have proven over the years to work are: passivated 316 SS (Liquiflo passivates all 316 SS parts except coated shafts as the sealant would be damaged by this process), Teflon, aluminum oxide and chrome oxide.

Materials Liquiflo usually recommends would be the following:

- Basic pump material: 316 SS
- Sealing method: Mag-drive (preferred) or single internal seal (Teflon vs. ceramic)
- Drive gear: 316 SS
- Idler gear: Teflon
- Wear plates: Teflon
- Bearings: Teflon
- Shafts: Coated, either with aluminum oxide or chrome oxide – chrome oxide is preferred

Due to the necessity of using the above materials, there are some physical considerations. Teflon is a relatively soft material (compared to BG PEEK or carbon, for example) and can be deformed under higher loads. This means that the differential pressure must be kept to a reasonable level to prevent premature failure and/or high wear rates to items such as the idler gear and bearings. In the smaller pumps (H1-H5/31-35/41-45) it is best to keep the differential pressure below about 60 PSI (4.1 bar). The larger pumps can go a bit higher, approximately 65 PSI (4.5 bar). (These pressure limits should be derated by 0.25%/°F at temperatures above 80°F. In addition, Teflon gears should be properly trimmed when operating above 80-100 °F – depending on the pump size – to account for the high thermal expansion of PTFE. The maximum recommended use temperature for a Teflon gear is 230°F.)

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.

It must be noted that this is not a perfect solution, but it's the best that can typically be expected with a difficult fluid.

Some Physical Properties of Hydrogen Peroxide @ STP

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

STP = 68°F (20°C) & 1 atm (1.01 bar)
Note: Hydrogen peroxide is nonflammable but can be explosive, especially at concentrations over 70%.