Application Note to the Field	**Common Fluid – Pumping Sodium Hydroxide with Liquiflo Gear Pumps**
Application Note Number: 0101-1	**Date: January 18, 2001; Revised Aug. 2008**

Last month we covered one of the most common chemicals: sulfuric acid. This month we will look at another one (eighth highest volume produced in the U. S.) that is found in many of the same places that sulfuric is.

Sodium hydroxide (NaOH), or lye, is used in papermills, water treatment plants, and any number of a variety of other places. It is very often used for PH control (to raise it) as it is very alkaline, or basic. It is, in fact, often known as caustic.

The most common concentration of NaOH is 50%, although it can range from trace to about 70%. At ambient temperature, 316 SS has an "A" rating and can be used for the pump housings, shafts and drive gear. For 20-70% concentration and temperatures beyond 170°F (76°C), however, Alloy-C becomes a requirement (up to 20%, 316 SS can go to about 212°F/100°C). The maximum practical temperature that a Liquiflo gear pump can be used up to on this product is about 248°F (120°C). 316 SS *can* stress-crack at 50% caustic, so if the pump in question is being operated near the edge of its performance envelope, it might be good to go to an Alloy-C drive gear, shafts and keys.

One thing to watch out for, especially at lower concentrations, is that the viscosity does not fall too low when the temperature rises. (For example, 50% NaOH has a viscosity of ~ 87 cP at 77°F/25°C, but this drops to only 3 cP at 212°F/100°C. At caustic concentrations below 10%, the viscosity vs. temperature characteristic is close to that of water. See table on next page for a comparison of the viscosities of 50% caustic and water.) This could cause excessive slip and wear, especially with higher differential pressures. (Consult Liquiflo to determine if the application is feasible based on the conditions of service.)

Since sodium hydroxide does not attack or cause swelling of carbon or any plastic offered by Liquiflo, choices can be made based solely on mechanical considerations. Many people use a Teflon idler gear, wear plates and bearings. A significant increase in durability can be realized by going to bearing grade PEEK (or at least Ryton) for the idler gear, and carbon for the bearings and wear plates. For concentrations above about 15% (varies with temperature, differential pressure, pump size and operating speed), plain shafts can be used. If coated shafts are necessary (consult Liquiflo), tungsten carbide is the preferred coating material.

For concentrations below 10%, a single mechanical seal can be used successfully; however, above this it is necessary to go to either a properly supported double mechanical seal or a mag-drive pump. The reason for this is that caustic will tend to crystallize as it crosses into the air and the resultant pieces of salt will destroy the seal faces rather quickly, causing it to leak. If using a double seal at ambient

temperature, a simple dead-ended water flush is usually all that is required. Make sure that the pressure is adequate for your application and the source is reliable. If the flush fails, caustic will enter the area between the seals, causing both to be worn and leak, as well as possibly contaminating the flush system.

Sodium hydroxide freezes at moderate ambient temperatures (varies by concentration; see table below for melting point at 50%). This may be a concern where supply tanks, pipes or the pump itself is located outdoors. If freezing begins to occur, solids will become a problem. If this may be the case, trace the equipment in question and/or use a suitable heat jacket (on the pump) and properly insulate everything.

Because of the flexibility afforded by our gear pumps for the above reasons, we are able to pump this chemical across a wide flow and differential pressure range quite reliably. We can go from just barely turning over the H1/31/41 to running the 314 at 1150 RPM (about 58 GPM).

As usual, if there is any doubt about what to use, contact the factory.

Viscosity vs. Temperature for 50% Caustic vs. Water (@ 1 atm)

Temperature		Viscosity (cP)	
(°C)	(°F)	50% NaOH	100% H_2O
0	32	–	1.79
10	50	–	1.31
12 *	53.6 *	169	1.24
20	68	112	1.00
25	77	86.5	0.89
30	86	67.4	0.80
40	104	41.4	0.65
50	122	25.9	0.55
60	140	16.4	0.47
70	158	10.5	0.40
80	176	6.8	0.35
90	194	4.5	0.31
100	212	3.0	0.28
110	230	2.0	–
120	248	1.4	–
130	266	0.94	–
140 **	284 **	0.65	–

* Melting Point of 50% NaOH ** Boiling Point of 50% NaOH