Pumping Difficult to Handle Liquids with Hydra-Cell Pumps

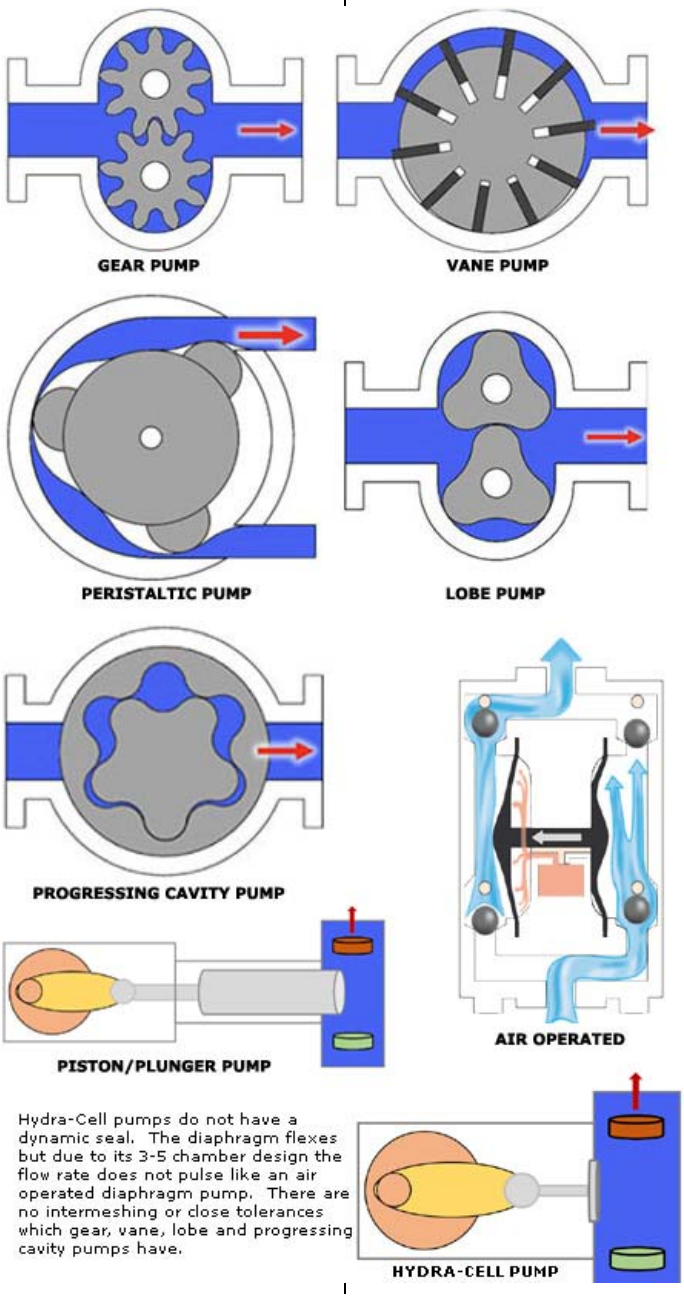
By: Chris Pasquali, CEO Factory Direct Pipeline Products, Inc.

A significant characteristic driving many of our pump applications is the sealless design of the Hydra-Cell Pump. Although the product line is capable of pressures from 30 to 5000 PSI, the majority of our applications are for lower pressures involving liquids that contain abrasive particles, slurries or are viscous, non-lubricating and hazardous. This article touches upon these types of applications highlighting advantages of our pump design compared to other designs as well as special considerations affecting pump sizing and integration into the piping system.

Hydra-Cells are a type of positive displacement pump having no mechanical seals, packing or similar dynamic method to isolate the pumped liquid from the environment. Each rotation of the pump shaft displaces a fixed volume of liquid and the discharge pressure reflects the resistance to flow for that displacement. Stated another way, Hydra-Cell pumps output a flow rate proportional to the pump shaft RPM at whatever pressure is required based upon downstream restriction. The unique hydraulically balanced diaphragm design is what sets the Hydra-Cell apart from other positive displacement pump designs which include progressing cavity, gear, vane, rotary lobe, air operated diaphragm and peristaltic pumps. Most of these other designs have a seal or pump mechanism which is damaged by particulate within the liquid, are dependent upon the pumped liquid for cooling and lubrication of the pump mechanism or are incapable of high pressures and operating reliably continuously.

Simplicity of Design

Whereas many pumps were designed for a specific type of liquid or application, Hydra-Cell Pumps were designed to maximize reliability by reducing the frequency, complexity and cost of pump maintenance. This innovative pump design lends itself to a broad application base most easily defined as “liquids that are difficult to pump”.



Liquids Containing Particles

The maximum particle size for a given Hydra-Cell Pump model is related to the pumps internal check valves and how far they open. The check valves in Hydra-Cell pumps ensure the direction of flow is from the inlet and through the outlet of the pump. Piston, plunger and air operated diaphragm pumps have similar check valves to control the flow path while progressing cavity, gear, vane, rotary lobe and peristaltic pumps create a mechanical downstream restriction. The close tolerances involved with progressing cavity, gear, vane and rotary lobe style pumps result in component wear OR, if those tolerances are adjusted, less efficient pumping. Peristaltic pumps and air operated diaphragm pumps are relegated to low pressure applications and offer some advantages such as suction lift, maximum free passage and the ability to pump higher viscosity liquids compared to Hydra-Cell Pumps.

Pumping Slurries

Liquids having a high concentration of particles are considered a slurry. Hydra-Cell pumps work well for non-precipitating particulate slurries up to 25% concentration, which is far beyond where a typical progressing cavity, gear, vane or rotary lobe pump would be applied with any efficiency. Peristaltic pumps excel at slurry pumping applications due to their ability to gently pass large (diameter & length) solids.

Just about any reclaimed or recycled liquid contains particulate, use of Hydra-Cell Pumps often reduces the level of filtration required based upon its check valve design. Even though piston and plunger style pumps have a similar check valve design, they also have a mechanical seal as a barrier between the pumping chamber and pumping mechanism. These seals have very small tolerances and their IOM manuals often specify filtering the pumped liquid to 25 microns for optimal seal life. Hydra-Cell pumps do not have a mechanical seal, so

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it's not a reliability or cost concern to pump particles >25 microns. Thus, the level of filtration required is coarser and that is typically less expensive for the filter media as well as for reducing the frequency of cleaning or replacing the filter element.

Viscous Liquids

Some pumping mechanisms are better than others for liquids having a higher viscosity than water. Peristaltic pumps excel at pumping viscous liquids; the efficiency of progressing cavity, gear, vane and rotary lobe style pumps are increased with viscous liquids and their internal components benefit from lubricating liquids. Hydra-Cell Pumps can handle viscosities up to 1100 cps which is approximately 5200 SSU. The advantages the Hydra-Cell provides for such applications is the lack of a mechanical seal and ability to handle particulates.

The viscosity of non-Newtonian fluids varies as they are shear sensitive and for low pressure applications centrifugal pumps are often used; Hydra-Cells have a gentle high frequency, short stroke and can pump non-Newtonian fluids like sauces (ketchup), bentonite slurry and paper/pulp slurry without the solids and viscosity limitations centrifugal pumps have.

Non-Lubricating Liquids

Thin liquids, water, fuel, solvents, liquified gases and surfactants are difficult for pump designs requiring close tolerances of intermeshing internals due to the lack of a liquid film to protect these components from wear. Likewise, there is an exponential loss of volumetric efficiency (referred to as slip) for high pressure applications. Centrifugal pumps work well for such fluids and customers generally turn to positive displacement pumps when they require higher discharge pressures; this is where the check valve style flow control excels compared to the close tolerances required by progressing cavity, gear, vane and rotary lobe style pumps. Centrifugal pumps are not ideal for chemical metering applications which typically are low flow rate applications requiring a consistent flow at variable pressures.

Hazardous Liquids

There are many reasons a liquid might be considered hazardous, it might be at an extreme temperature, chemically aggressive, poisonous to personnel or harmful to the environment. Such applications benefit from a simplified, reliable design with minimal chance of fugitive emissions and interaction with personnel. Since the only components of a Hydra-Cell pump which are in contact with the pumped liquid are its check valves and elastomers, they operate effectively with liquids between 15F and 250F. Another advantage of minimal components is the ability to offer them in a wide variety of materials to address specific characteristics of the liquid. Chemically aggressive applications might benefit from Hastelloy and ceramic check valves while abrasive applications from stainless steel alloys or tungsten carbide.

The lack of a mechanical seal significantly reduces fugitive emissions because mechanical seals are a wear component and thus piston, plunger, progressing cavity, gear, vane and rotary lobe style pumps will eventually leak.

Pump sizing and integration into the piping system

Hydra-Cell pumps have suction lift ability and therefore might be a better fit for some low NPSHa applications. Always try to position the pump as close as possible to the feed vessel to minimize pressure loses. Especially if it is a pressure-fed inlet condition, oversize the inlet pipe to minimize turbulence and cavitation; although Hydra-Cell pumps are not damaged by cavitation or a starved/closed inlet, they can only displace liquid efficiently when the volume of liquid within the pump chamber is equal to or greater than the displacement rate.

Particulate laden and viscous liquids usually benefit from lower velocity pumping, referred to as "oversizing" the pump. The slower stroke rate and larger internal pump pathway reduces the abrasive effect entrained particles apply to pump components (such as check valves) and there is less resistance for the liquid to flow into the pump head.

It's not that the Hydra-Cell pump is magical and can do anything, rather they compete with many different pump designs due to their innovative, reliable and simplistic design. Difficult to pump fluid applications can be challenging from many different perspectives. Let us put our experience to work for you by calling or emailing us with your application description; we often reply with a proposal or alternative pump suggestion the same day.