Groundwater Pressure

Finding the Right Pump to Match Your Dewatering Needs

By Nick Zubko

Water is everywhere. It covers more than 80 percent of the earth's surface and makes up 70 percent of the human body. But one place the average person probably doesn't think to look for water is underground. Actually, that's where about 95 percent of the fresh water in the United States is derived. Some of it comes from underground reservoirs or aquifers, but the rest is simply groundwater — collected and absorbed into the ground every time it rains, snows or sleets.

While the average person might not know how groundwater works, those involved in underground construction are usually well aware how much H^2O is soaked into the ground. Every time an excavator or backhoe loader digs deep enough, they're bound to reach a level saturated with water — either below the water table or what is called "perched" water, which is often found above the actual water table. In either case, how well a contractor can control the flow of water into a freshly dug trench or excavation pit can mean the difference between success and disaster.

"If you've ever tried to dig a hole at the beach, the deeper you dig, the wider the top of the hole becomes. This is result of the water in the sand allowing the sand particles to move, or 'float' with very little friction," explains Jack Lake, consultant for Rain for Rent, a Bakersfield, Calif.-based company that specializes water-handling, irrigation, and temporary liquid storage. "Contractors face the same problem when they attempt to build a structure in an area with a high water table."

That's where a process called dewatering comes in. Dewatering involves removing water from the ground during excavation – through a variety of methods, usually involving a series of high-performance, engine powered pumps. When a site is dewatered, the soil is compacted through the removal of water from between the soil particles, allowing greater densities to be achieved through compaction, depending on the types of soils at the site.

"One of the most important things a contractor tries to do in planning a project is predict his cost – it determines the bid price," notes Joe Abbott, national sales manager for Godwin Pumps, a Bridgeport, N.J.-based company that makes and distributes industrial pumps used for both site dewatering and sewer bypass applications. "The dewatering part of project can be a major expense. And since engineers almost never specify the dewatering system, those decisions are typically left up to the contractor – so the equipment is very beneficial. Depending on the part of the country, I don't think most contractors could survive without having a pretty good knowledge of dewatering systems."

Dewatering Fundamentals

The process of dewatering has actually been around for centuries, and in varying forms, even a couple millennia. The ancient Romans, Egyptians and Babylonians have all been reported to have used "passive" dewatering in their massive construction endeavors, digging conveyance ditches to channel off watery obstacles. Methods became much more advanced as the Industrial Revolution swept through Europe in the 1800s; most notably in England, where innovators began producing centrifugal pumps that utilized external vacuum devices to lift water to the pump end.

The technologies eventually started to make their way to the United States in the 1920s, and many of the

original principles remain largely the same to this day. Still one of the more straightforward approaches to dewatering is referred to as open-pit pumping, which involves digging a ditch around the excavation pit. Once the water flows into the ditch, it is pumped away from the jobsite.

"For this method of dewatering, you don't need a highly sophisticated pump," notes Bill Thompson, president of Thompson Pump & Mfg., a Port Orange, Fla.-based producer of engine-powered portable pumps. "You need one that will lift the water a relatively small distance and pump it away from the jobsite, so it doesn't recirculate. What contractors typically use for that is a self-priming, centrifugal trash pump – or in cases where the ditch is a little deeper, they might use a hydraulically driven submersible pump or an electric submersible pump, both of which are used by submerging the pump head into the water or the liquid that you're pumping."

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The process known as wellpoint dewatering is a little more complicated, but it can also give contractors the ability to handle much larger and more intricate projects. It involves a series of small wells called wellpoints, which are installed around the excavation and connected to a manifold or "header pipe." The header pipe is connected to a wellpoint pump that is designed to handle the water (and other trash, ground, dirt). When designing a wellpoint system, it is necessary to give first consideration to the physical conditions of the site to be dewatered.

"In a wellpoint system, a series of shallow wells is installed along the side of the excavation in which the pipe will be laid," explains Lake. "They are installed to a depth that allows for the removal of groundwater, generally to a level of 2 ft or more below the invert of the pipe. The wellpoint system generally consists of a 3-ft screen, a section of vertical standing pipe called riser pipe and a connection point above the ground.

This system is coupled with a wellpoint pump (typically a centrifugal pump with a vacuum system, a rotary pump or a piston pump.). Wellpoints are installed by a process known as jetting, which is accomplished by washing the points into the ground through the use of a high-

pressure jet pump. After the installation is completed, a manifold (header) pipe is laid along their length and attached to the pipe with a series of connections called "swings." Each swing is made up of a short length of hose, a valve and a connection point on either end to attach to both the riser pipe on one end and the manifold on the other.

"One major feature of a wellpoint pump system is that it has to be able to handle both air and water," says Thompson. "The whole idea is to lower the water table to the point where you begin sucking air. So your pump has to have the capability of pumping both. Deep well pumps don't need that capability, because they are used quite a bit below the sub grade, which is the bottom of your excavation – the bottom of where you are going to lay your pipe or pour your concrete."

Pump Primer

There are a variety of different pumps on the market today, each designed to suit the needs of every jobsite, ground condition and contractor. The main types of pumps used in wellpoint dewatering are centrifugal pumps, which also come with a variety of features and capabilities to suit different needs. Centrifugal units pump significantly more water and develop more pressure than a diaphragm pump, but they need to be filled with water in order to prime.

Another downside is that while basic centrifugal pumps are efficient for water handling, they are not designed to handle solids. The blades of the impeller are traditionally shrouded or covered by a plate on the front edge of the blades, which are spaced closely enough together to allow minimal solids to pass – if any at all.

"Self-priming centrifugal pumps are able to pump a considerably greater amount of water and develop a lot more pressure than a diaphragm pump, but usually they need to be filled with water in order to prime them, " says Thompson. "One of the problems with them, however, is that they are typically not good for handling trash and solids. That's when you need a self-priming centrifugal trash pump, which has features that allow it to handle solids as well, which is obviously important for construction applications."

Trash pumps are able to handle debris small enough to pass between the blades of the pump's impeller. Coupled with a vacuum priming system, this pump becomes extremely versatile and can be used in both bypass and wellpoint applications. According to Lake, some self-priming trash pumps are capable of priming down to 25 ft by the recirculation of water held in a built in reservoir across an orifice that creates the effect of a limited size vacuum system.

Hydraulic submersibles are probably the most versatile liquid-handling pumps on the market. They utilize a hydraulic power unit to deliver a high pressure stream of hydraulic fluid to a hydraulic motor mounted on a centrifugal pump head, one as a high pressure line, the other as a return line to carry the spent, hot fluid back to the fluid reservoir to be coalesced and cooled. Unlike the self-priming centrifugal pump (that must lift the water in order to pump it), the impeller on a hydraulic submersible only has to discharge the material away.

Thompson points out that one of the downsides to a hydraulic submersible is a lower efficiency due to higher energy consumption throughout the unit – in the engine, the hydraulic pump, the hydraulic motor and, finally, the centrifugal submersible pump head. Depending on the needs of the project, these factors

Buying vs. Renting

The spectrum across the dewatering lines is a wide one. It is doubtful that any one contractor would be able to own and maintain an adequate supply of pump products to accomplish every dewatering task encountered. Some of these pumps are job specific. Here are a few suggestions.

Wellpoint Dewatering Pumps & Equipment

Unless the equipment is used on most of the projects, and because of the complexity of the components required, it might be best to rent both the pumps and header swings and points. However, if the wellpoint jobs are small enough (200-lf header and 60 to 70 points) to be handled by one of the multi-purpose pumps (vacuum-assist prime variety) used in wellpointing, bypass, sump or open-type pumping, it might pay to own.

Wet Prime/Self-Prime Centrifugal Pumps

Like the old Douglass DC-3, these pumps will probably never go out of style. If the workload warrants it, you might want to own. Properly maintained, they may last forever.

Open Pumping

This covers a wide range of needs and could be covered with anything from a double diaphragm mud hog to ... well, just about anything, except perhaps the wellpoint pump. It's hard to go wrong by owning a multi-purpose pump.

Bypass Work

Bypass work is so diverse that, like the wellpoint pumps, it may be better to rent than own. The exception again might be the frequency and scope of the work being done. If most of the work is shallow and not over 1,500 to 2,000 gpm, a 6- or 8-in. multi-purpose pump might be a good fit. Otherwise, owning could be the way to go especially for municipalities' that keep most of the utility work in house.

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can be offset by the pump's valuable ability to handle larger solids.

"If you are doing open-pit pumping, then you are going to see pumps that have trash capabilities, they will be surface pumps or submersibles," says Thompson. "The submersibles will be hydraulic or electric. Every manufacturer has features and benefits that they will design into a product and tout as something that the users will prefer. That could be high-efficiency, low fuel consumption, ease of operation, ease of repair, higher pressure or solids handling capabilities."

Diaphragm pumps are the main types of pumps used for low-pressure, low-volume (less than 200 gpm) applications. Diaphragm pumps are both self-priming and dry priming, and are effective in handling abrasives and small solids, which commonly refers to anything from muddy water and leaves, to woodchips, sand and rocks.

"Diaphragm pumps use a pair of flapper valves that alternately open and close," explains Lake. "This allows any size material that can get by the flapper valves to pass through the main pump body and out the discharge valve. Generally speaking, these are low-flow, low-head applications, not usually

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greater than a flow rate of 200 gpm and a suction lift of more than 15 feet. Below that point, the flows drop off to the point where the pump will be close reaching a point of economical inefficiency.

In terms of product selection, manufacturers say there is no set of specs to match every job. There are many variables to consider, and every question you ask yourself simply narrows it down. This requires a basic understanding how to match pump performance capabilities to the job requirements, including maximum (peak) flows, pressures required, suction lift, reprime restrictions, discharge pipe, length and elevation changes. Residential neighborhoods often require the use of sound-attenuated pumps. Of course, electrical submersible pumps require some sort of power generator.

"Successful dewatering comes from a good combination of experience and doing your homework," notes Abbott. "You always see soil borings in the bid documents for any project. Basically, the engineers do core drillings around the excavation site. One thing they try to determine from those is where you are going to encounter water. And those borings are going to be the most important thing that determines what is going to be the best option. What are you trying to extract the water from? All of that comes back to experience."

Another basic factor that contractors need to consider is the distance the pumps will place from the excavation. This is a factor into for those residential projects, where space might be harder to come by. Proximity to the excavation is always beneficial, but if logistics require pumping a long distance, you're going to need a more powerful pump. Of course, those types of decisions will impact the final cost of the job.

"The general rule is to try to get as close as possible to the source of your liquid," Thompson explains. "The hardest part is on the suction side of the pump. Submersible pumps don't have to worry about that – they are all discharge. They don't have any suction. Generally speaking, if you have a suction lift pump, then you want to get as close as possible. It's easier to create pressure than it is suction lift. If you get close to the liquid, then your primary concern becomes discharge."

Direction of the Market

Economics and competition have both had strong influences in determining the direction the pump market has taken in the last few years. Driven by the necessity to reduce expenses and increase the bottom line, contractors across the board are turning to more fuel-efficient products that will accomplish the same tasks at a lower cost. Today more than ever, pump manufacturers are responding.

"It wasn't long ago that a wellpoint pump required an extra cylinder on the engine just to drive the vacuum pump," notes Lake. "Today, they can produce the same work with about half the horsepower. Engines can be smaller in displacement, yet deliver the same continuous required horsepower by operating at higher speeds that reduce fuel consumption."

In addition, the demand for unattended operation is growing, which involves things like automatic start and stop and speed adjustment, GPS capabilities and automatic monitoring. Pump monitoring is a huge cost-saving measure, because you don't need employees driving around all over checking to make sure everything is running properly. Inside his trailer, a contractor can monitor the vitals on dozens of pumps simply by looking at a computer screen.

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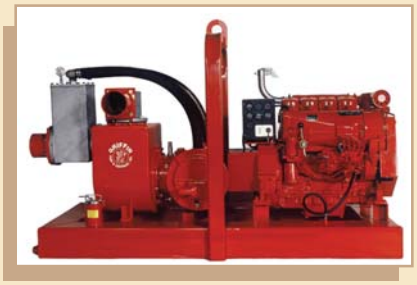

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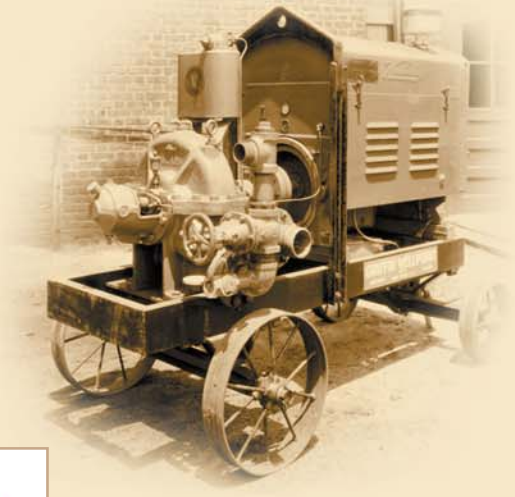

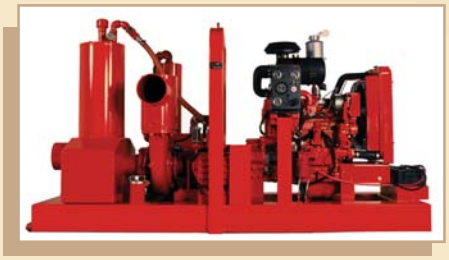

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These unique pumps combine recent innovations with more than 50 years of pumping design technology to create more reliable units that are easy to service, boasting long run times and superior fuel economy. A patented screw-type impeller allows increased flow using the same horsepower as many competitive models. Each unit is fitted with a 15-gal fuel tank for extended continuous run times of up to 100 hours. Powered by 40- to 96-hp Deutz diesel engines, these high-flow pumps have heads of up to 143 ft and can generate lift of 30 ft in 30 seconds. Each also handles solids up to 3.6 in. pump and priming system drain valves to eliminate the risk of water freezing in the unit, and a water lube vacuum pump to prevent oil leaks and other unwanted priming discharge. **Online: www.multiquip.com**

"That sort of technology is used a lot with generators, compressors and even backhoes. But pumps are a little bit different animal," notes Thompson. "Pumps have automatic speed adjustment, because as water rises you may want to pump it down faster. However, if the water is already down, then you might want to slow it down so you're not just wasting fuel. You typically don't have those concerns with those other machines. So with those sorts of capabilities, you're able to reduce downtime and repairs."

Capabilities of dewatering systems have advanced tremendously in the last couple of decades. At the same time, experts admit that the differences between specific makes, models or manufacturers are not what can usually make or break the dewatering portion of a project. For a contractor, what truly makes the difference is the sense of reliability of service and support the manufacturer provides when things don't go according to plan.

"The support a manufacturer gives the customer is probably just as important as the product itself," Thompson says. "In my experience, there are a few big concerns and requirements for contractors in this business, especially for rental purposes. There's availability, reliability and performance. This is almost as much a service business as it is a manufacturing business and it's getting more so. Customers today have very high expectations."

Nick Zubko is associate editor of *Utility Contractor*.