APRIL 2023
PUMPSANDSYSTEMS.COM

PUMPS & SYSTEMS

The Leading Resource for Pump Users Worldwide

Oil & Gas

HIGH PRESSURE SOLUTIONS

- Weld overlay procedures
- Water management
- Enhanced oil recovery
- & more

DEFINING THE PUMP SYSTEM CURVE

WASTEWATER LIFT STATION SAFETY

PROPER COMPRESSOR SELECTION & SIZING

Magnetic Drive Self-Priming Centrifugal Chemical Pumps

How to use these pumps in different applications.

PETE SCANTLEBURY | Finish Thompson

IMAGE 1: Self-priming pumps (Image courtesy of Finish Thompson)

Magnetic drive centrifugal pumps are widely used and accepted in a myriad of chemical applications, including those pumping the most corrosive liquids. Many of these applications use standard flooded suction models where the liquid source is above the pump centerline to ensure there is liquid flowing into the pump.

Self-priming pumps can be used in applications where the liquid source is below the pump centerline like a sump or below grade storage tank, giving them extra application flexibility. Suction lift exists when the surface of the liquid supply to the pump is below the pump centerline. For this type of application, a self-priming pump is the best option.

Once initially filled with fluid, self-priming pumps create a vacuum in the suction pipe allowing atmospheric pressure to push the liquid up the pipe and into the pump inlet. This means there are limits on how high they can lift liquids. Factors such as pipe friction loss, specific gravity and altitude can decrease the maximum lift capability.

Considerations

Equivalent lift

To determine equivalent lift, adjustments need to be made when dealing with applications at an altitude higher than sea level and/or liquids that have a specific gravity higher than 1.0.

For applications at higher altitudes, lift is reduced by approximately one foot for every 1,000 feet of altitude. For example, if the pump's maximum lift capability is 25 feet and the altitude where the pump is being operated is 5,000 feet, the equivalent lift is 20 feet.

For fluids with a specific gravity higher than 1.0, determine the maximum lift capability of the pump under consideration and divide it by the specific gravity of the fluid to be pumped. For example, if the pump's maximum lift capability is 25 feet and the fluid being pumped is 1.84 specific gravity, the equivalent lift is 13.6 feet.

If corrections are required for both altitude and specific gravity, first make the adjustment for altitude, then make the adjustment for specific gravity based on the altitude adjusted value (if done in reverse, a correction to pressure that does not exist will be made).

Suction pipe diameter

The suction pipe needs to be at least as large as the pump's inlet diameter. The next size pipe diameter has certain advantages, like increased flow and reduced frictional losses, but will also take longer to prime, so ideally the pipe would be the same diameter as the pump suction.

Priming time

The pump casing will be initially filled with fluid and recirculate the fluid inside the pump during priming. All centrifugal pumps add heat to the fluid being pumped. This is due to friction from the rotating impeller. On water, this is approximately 3 F for a magnetic drive. Long suction lengths and larger suction pipe diameters can cause extended prime times. Check with the pump manufacturer for estimated prime times by equivalent lift.

Discharge check valve

If a discharge check valve is used, make sure it is installed at least as far from the discharge of the pump as the suction pipe length. Self-priming pumps are not air compressors. If a check valve is installed too close to the discharge, there will not be sufficient pressure to open the check valve. This will result in the liquid being recirculated in the housing, creating potentially damaging heat. If the check valve can not be installed at the correct distance, an air vent will be required. Typically, this is a small diameter pipe returned to above the liquid source allowing the air to be vented.

Applications

Bulk storage tanks

Many corrosive liquids are stored in large aboveground tanks. To reduce the chance for leakage, it is becoming common for storage tanks to no longer feature an outlet below the liquid level like a bulk head fitting.

A self-priming magnetic drive centrifugal pump can be installed at ground level with the suction piping extending up to the top of the tank and then down to the desired level inside the tank.

The pump will create a suction in the intake line allowing liquid to flow up the pipe inside the tank. It then flows down the discharge pipe into the pumps suction, effectively becoming a flooded suction application. Some pump manufacturers have separate curves for flooded suction and various lengths of lift.

The self-priming pump can also be installed on top of the tank, but because it is constantly operating in a lift condition, it will not achieve the same performance as when compared to a pump installed at ground level discussed above.

In addition, a pump installed at ground level is easier to monitor and service.

Chemical sumps

IMAGE 2: Chemical sump

Many companies using liquid chemicals use sumps for various reasons. Some are catching overflow like hydrochloric acid rinse water found in steel pickling lines. Others are in areas where bulk storage tanks are located. Industries include plating, electronics, metal treatment, chemical plants, battery manufacturing, aerospace and automotive products.

Tanker truck/rail car

IMAGE 3: Self-priming pumps used to unload rail tanker cars

An electrically powered self-priming mag drive chemical pump is ideal for offloading tanker trucks and rail cars. It allows the chemicals to be removed through the top, preventing potentially hazardous leakage. It also eliminates the need to use compressed air pressurized to push the liquid out of the tanker truck or rail car. Compressed air is one of the most expensive sources of energy in a plant. The overall efficiency of a typical compressed air system can be as low as 10% to 15%. For example, according to the U.S. Department of Energy, to operate a 1-horsepower (hp) air motor at 100 pounds per square gauge (psig), approximately 7 to 8 hp of electrical power is supplied to the air compressor.

Replacing in-solution vertical pumps

IMAGE 4: Self-priming pump replacing in-solution vertical pump

Many chemical sumps use vertical pumps that are submerged in the liquid being pumped with the motor extending out of the top of the sump to protect it from liquid damage. When the pump requires service, the whole pump must be pulled out, which can be difficult and time consuming. The exterior of the pump is covered in the chemicals located in the sump, increasing the possibility of worker exposure. Self-priming magnetic drive centrifugal pumps are mounted on the surface making access much easier. In addition, because the exterior is not wetted, it reduces the chance of worker exposure to potentially dangerous chemicals.

Difficult plumbing

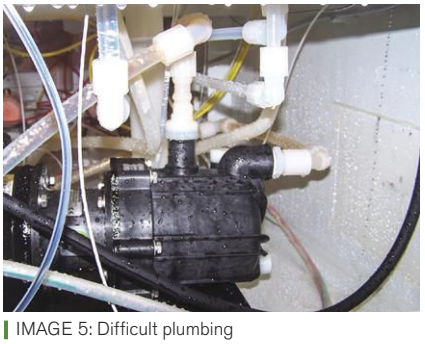

IMAGE 5: Difficult plumbing

> Many users choose AODD pumps due to their versatility.

Because self-priming pumps do not require a flooded suction, they can be ideal problem solvers where the plumbing may contain one or more high spots that prevent pumps that are not self-primed from becoming filled with the fluid to be pumped, resulting in no flow and potentially damaging the pump from dry-run due to a lack of liquid.

Replacing AODD pumps

IMAGE 6: Electric self-priming pump replacing AODD pumps

Many users choose air-operated double diaphragm (AODD) pumps due to their versatility. They can run dry and are self-priming, but if they operate frequently, they will consume a tremendous amount of electricity to create the required compressed air. This is especially true with large AODD pumps.

Magnetic drive self-priming centrifugal pumps offer application flexibility, energy savings when replacing compressed air, enhanced environmental protection and reduced exposure to potentially hazardous chemicals. ■

Pete Scantlebury is vice president of development at Finish Thompson, where he has worked for more than 45 years. For more information, visit finishthompson.com.