Pumpsmart Helps...

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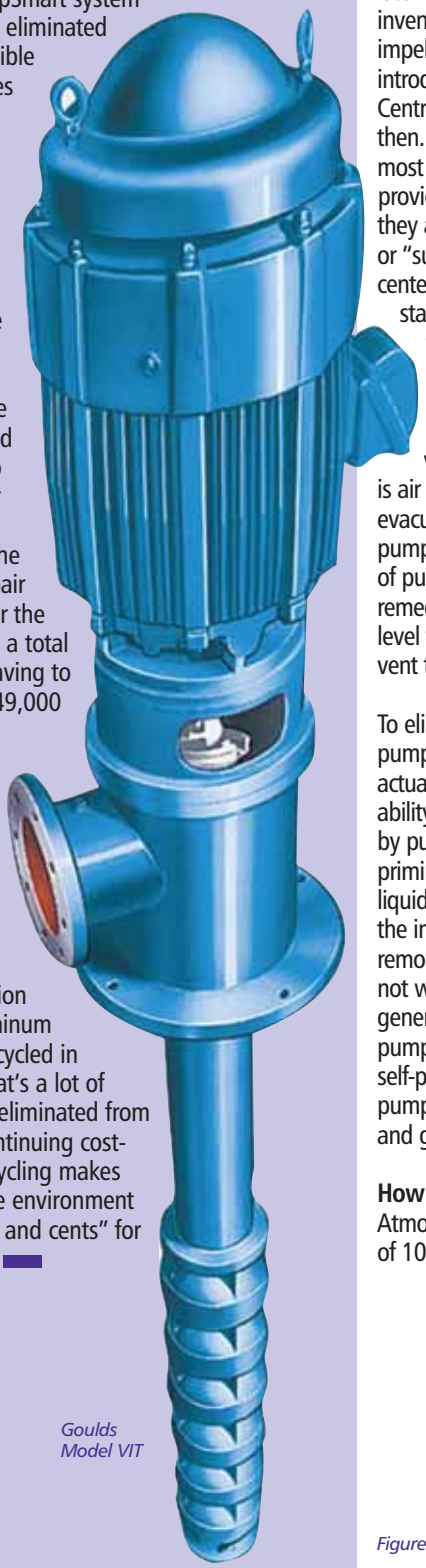
PumpSmart's continuous monitoring and reaction to the pump performance conditions meant greater reliability and longer life.

Wayne was sold. The new PumpSmart PS200 system was installed. The VIT had a TEFC motor that was mounted on a structural steel frame 10 feet below grade. The new Goulds PumpSmart system immediately eliminated the submersible pump failures due to high temperature and continuous cycle rates. What's more, by reducing the HP by 65%, savings in energy alone are estimated at $7,000 to $10,000 per year. It also eliminated the constant repair bills to repair the old motors-- a total estimated saving to Scepter is $49,000 per year! PumpSmart certainly was the smart choice.

In the last thirty years, over 14 million tons of aluminum has been recycled in America. That's a lot of solid waste eliminated from landfills. Continuing cost-effective recycling makes sense for the environment and "dollars and cents" for the recycler. ■



Goulds Model VIT

Tech Talk

Self Priming Centrifugal Pumps: A Primer

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Centrifugal pumps can be traced back to the late 1600's, when Denis Papin, a French born inventor, experimented with straight vane impellers. British inventor John G. Appold introduced a curved vane impeller in 1851. Centrifugal pumps continued to evolve since then. Next to the electric motor, they are the most popular machines in the world. Pumps will provide satisfactory service to the user, assuming they are in a system offering a flooded suction or "suction head" (fluid is located above the centerline of the pump). The drawback of standard end suction centrifugal pumps is that they do not fare well when the liquid is below the pump centerline. Liquid must be delivered to the pump so the process can begin. The pump can not lift liquid vertically to begin the process. The reason is air in the suction side of the pump can not be evacuated from the casing. The centrifugal pump will become "air bound" and incapable of pumping any additional liquid. The only remedy for this situation is to raise the liquid level to the pump inlet and have the operator vent the suction line before starting.

To eliminate this problem, self-priming centrifugal pumps were developed. The term self-priming is actually an industry term that describes the ability of a pump to create a partial vacuum by purging air from the suction line. The self-priming pump unit uses an initial quantity of liquid (usually water) to create the vacuum at the impeller eye and continuously "digest" or remove air from the suction line. This benefit is not without cost. Self-priming pumps are, in general, slightly less efficient than an end suction pump. Marlow Pumps manufactured the first self-priming centrifugal pump in 1932. This pump design would go to the source and get liquid to be pumped.

How it works.
Atmospheric air exerts a pressure of 101.3 kPa (14.7 PSI) all around us. The pump creates a partial vacuum as it removes air from the suction line. The vacuum causes atmospheric pressure to push water up to the pump through the suction line. In a laboratory, with perfect vacuum, the atmospheric air would push liquid 10.3m (33.9 feet) up a column. The practical application limit for self-priming pumps is about 7.62m (26 feet) of liquid.

Typical Self Priming Centrifugal on Industrial Sump Service

The self-priming process occurs automatically once the pump is started with the initial quantity of liquid. Without operator involvement, the pump can prime itself with the pumpage and begin pumping. If the vacuum is broken, the pump is able to reprime and continue pumping. The savings in time, effort and cost are substantial; especially in dewatering applications such as in mining where pumps often run dry for brief periods.

The advantages of using a self-priming pump are clear. It should be pointed out that numerous varieties of self-priming methods are in existence today. Most are related to the two methods that will be discussed now: diffuser priming and volute priming.

Volute Priming
Just as in a standard centrifugal, everything starts with the impeller.

There are three common impeller designs (Figure 1).

The Closed Impeller has shrouds on both sides of the vanes. It is a desirable design for higher pressures and clear liquids.

The Semi-Open Impeller has a shroud on one side of the vanes. It can handle a moderate amount of solids in the liquid.

The Open Impeller has the shroud cut back completely except where the vanes are located. It can pass a high concentration of solids.

Figure 1. Closed, Open and Semi-Open Impellers

The impeller is placed inside a progressively expanding spiral-shaped casing called a volute. At one point on the inside of the volute, there is a close clearance between it and the outer edge of the impeller. This point of close clearance is usually called the "cut water" or "peeler." The purpose of the volute is to collect liquid being flung off the whirling impeller vanes and direct it to the discharge of the pump. The volute takes high velocity liquid from the impeller and increases the flow area gradually; liquid entering it at a high velocity is gradually slowed. As the liquid slows down, the pressure is increased, since these two are inversely related. It is this action which produces the pressure that the pump develops. The volute can either be cast into the pump casing or bolted in, depending on the design.

The priming process begins with filling the casing with liquid. The liquid is usually added through a tapped plug in the casing. This initial liquid is used to create the vacuum and seal against leakage. The casing is divided into two sides: the suction side and discharge side. The division is made by a solid partition inside the casing with the only opening between the two sides at the impeller "eye" or center. Once the casing is filled from an external source it is ready to begin the process.

As the pump is started the impeller takes liquid from the "eye," or center of the impeller, and throws it to the circumference. This action will create a vacuum at the eye that is the source for the self-priming pump. The liquid filling the casing is pulled through the impeller from the suction side. Once the initial liquid is pulled from the suction side, the impeller will continue to create the vacuum and begin pulling air from the suction line. (Figure 2)

Air is drawn toward the vacuum in the impeller eye and mixes with the liquid at the impeller tips. The air / liquid mixture is peeled away by the cutwater. Then air/water mixture percolates upward through the casing because it is now less dense than the liquid around it. The air separates as it rises and is vented to atmosphere in the discharge line while the liquid falls back to the casing to be used again. It is this action that digests the air from the suction line and creates the partial vacuum. The process continues until all the air has been evacuated and full prime is achieved. It is important to vent the air on the discharge side. The pump will not compress the air and will not prime unless the air is allowed to escape. (Figure 4)

Advantages of Volute Priming

The advantage of volute priming are solids handling ability. The pump has a single cutwater allowing solids to be passed without clogging. When used with a trash handling impeller the unit will effectively pass large

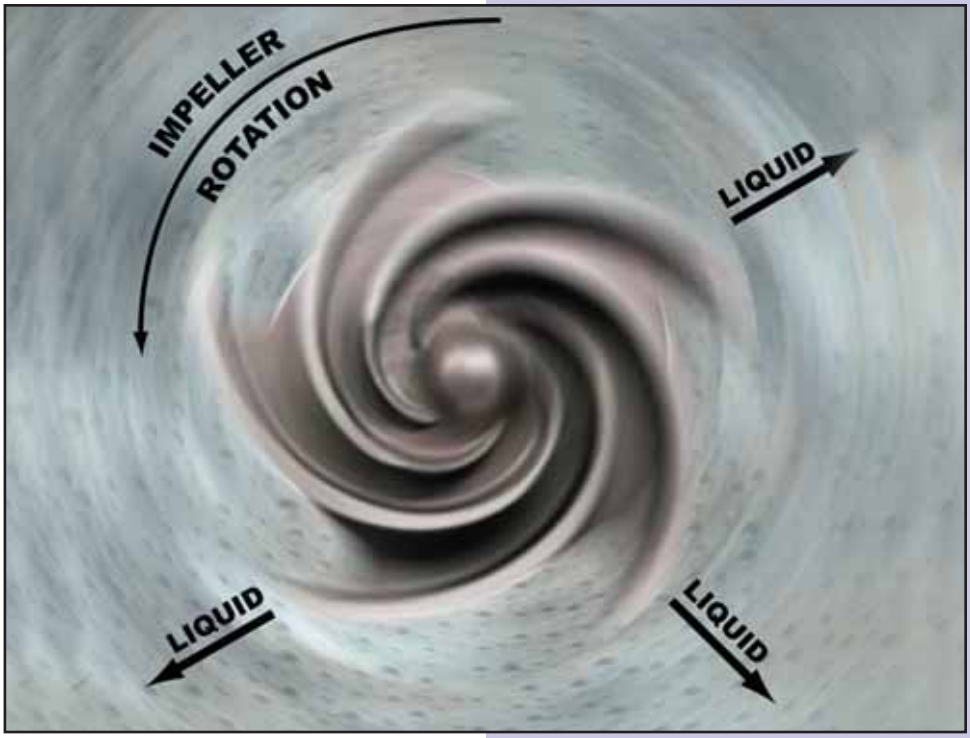

Figure 2. Impeller Rotates and flings liquid.

solids. This design is also maintenance friendly. In some units the rotating end can be replaced as a unit. There is no need to remove suction or discharge piping to work on the power end. This can be used to minimize down time by keeping a spare rotating end. The drawback of volute priming is wear at the cutwater usually means the casing needs to be replaced.

Diffuser Priming

Diffuser priming is similar to volute priming in concept. A diffuser contains multiple stationary vanes or "peelers" that peel away air and water mixture during the priming phase. The multiple stationary vanes each act like a cutwater in volute priming. These stationary vanes are cast into a replaceable ring that surrounds the impeller. The impeller and diffuser combination are mounted inside a pump casing just like in the case of volute priming.

The priming cycle occurs exactly the same way: An initial quantity of liquid is added to the casing. The pump is started and a vacuum is created at the eye of the impeller. The multi-vane diffuser peels the air / water mixture from the impeller where it is separated in the discharge side of the casing. Vacuum is created in the suction line and atmospheric pressure forces liquid into the pump tank. (Figure 4)

Although this design has limited solids handling capability due to the diffuser surrounding the impeller, it does have several advantages over volute priming.

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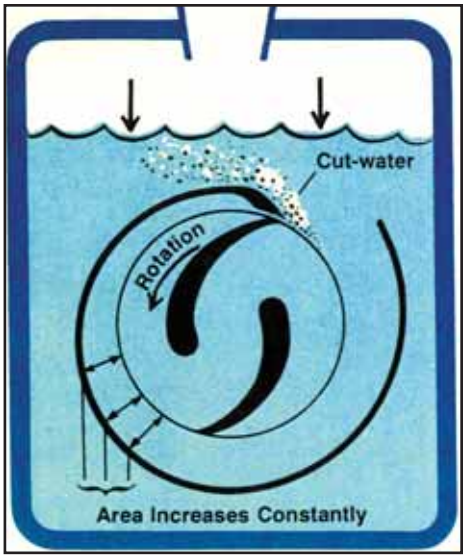

Figure 3. Volute Priming

Figure 4. Diffuser Priming

Tech Talk

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Advantages of Diffuser Priming

- Pump maintains efficient priming for a longer period of time due to the multiple peelers.
- Lower radial loads due to balanced design extends seal, shaft and bearing life.
- Replaceable diffuser allows return to original performance without expensive casing replacement.

With these advantages the diffuser priming method can achieve higher efficiencies than volute priming.

Utilizing self-priming pumps

It is important to note that self-priming pumps will have special considerations that end suction pumps will not. For example a small vacuum leak in the suction line will prevent the unit from priming. The pump will continuously pull air from the leak instead of the suction line until all the priming liquid in the casing is evaporated. This is a common cause of priming failure as the leak can be very small or invisible to the naked eye but will prevent priming.

Another common cause of priming failure for both types of priming methods is venting the air from the discharge line during priming. The pump is not capable of compressing the air during the priming phase and it must be allowed to escape through the discharge and vent to atmosphere. This will prevent all but the shortest priming lifts.

The self-priming pump should also be located as close as possible to the source. It is best to be located directly above the sump with few elbows as possible to reduce friction. Once the unit is primed and pumping it will require net positive suction head (NPSH) as any centrifugal pump. Without sufficient NPSH the unit will cavitate. Therefore lifts through long suction lines or lifts with obstructions will be plagued by cavitation type problems. It could be the case where one problem is solved only to create another. It is these special considerations that must be examined before the installation is cast in concrete. Many owners have puzzled over problem applications because one of these factors had been neglected.

Self-priming pumps have been providing economical and reliable service to their owners for many years. They offer an alternative to vertical or submersible pumps in sump applications, and can help where overhead space is limited. They can be found in virtually any industry; farms to petrochemical . They solve the very basic problem of how to get liquid to the pump.

NEW EDUCATIONAL INITIATIVE: "Pump Systems Matter"™

Goulds Pumps is supporting the Hydraulic Institute's new National Pump Systems Educational Initiative called "Pump Systems Matter."™ The program will place a primary focus on pump systems education and outreach, addressing energy savings, and total cost of pump ownership.

Optimization of pumping systems represents a significant opportunity for U.S. companies and municipalities to save money and energy while reducing maintenance costs and increasing productivity. U.S. Department of Energy (DOE) studies indicate that pumping systems account for nearly 20% of the world's electrical energy demand and range from 25% to 50% of the energy usage in certain industrial plant operations. DOE case studies have shown that better system design and more effective application of pumps can save 20% or more in energy costs and represent a large, frequently overlooked savings opportunity.

HI has begun a national educational initiative to support the development and deployment of pump system educational materials and tools, to administer related training programs and to address outreach and educational efforts to various audiences. The primary goal of the education initiative will be to transform the market for pump systems and services to one based on system life cycle costs rather than equipment first costs. As anticipated by the HI Market Transformation Committee and Board of Directors, an effective pump systems educational initiative will serve to transform the market for pumps and pumping systems by:

- Changing owner/operator and contractor focus on lowest first cost to a total life-cycle cost in purchasing pumps, pump systems and services
- Create opportunities for expanded demand among owner/operators and contractors for value-added services from the pump industry and expand the capacity within the pump industry to meet this need
- Develop new educational materials and tools to train and educate pump and supplier OEMs, owner/operators, contractors, and others
- Develop appropriate outreach efforts to get the message out that "Pump Systems Matter,"™ and begin to transform the market for energy efficient pump systems and services.

For the past few years HI has been involved with developing new educational materials related to pump systems, especially the Pump Life Cycle Cost (LCC) Guide. The e-learning site, **www.pumplearning.org**, with its first course on "Centrifugal Pumps: Fundamentals, Application and Design," and the new Variable Speed Pumping Guide are other valuable resources for pump users.

As a DOE Allied Partner, HI has partnered with DOE to provide technical input for the development of the Pump System Assessment Tool and to offer training for Qualified Pump System Specialists. The "pumps" section of the HI web site already provides considerable "energy savings" guidance, tips, U.S. DOE case studies and tools, including downloadable versions of PSAT software for the benefit of users and non-government organizations. Free downloadable copies of the Executive Summary of the Pump LCC and Variable Speed Pumping Guides are also available from the HI web site, **www.pumps.org.**

"HI and its members, such as Goulds Pumps, are working with the DOE and others to advance the concepts of total cost of ownership. We wrote the book on Pump Life Cycle Cost: A Guide to LCC Analysis for Pumping Systems. Those who focus on total ownership costs, carefully match their pumping needs to system requirements will best be able to reduce their total cost of ownership including energy, operating and maintenance costs. That's what "Pump Systems Matter"™ is all about," explained Robert K. Asdal, Executive Director of the Hydraulic Institute.

The Hydraulic Institute, established in 1917, is the largest association of pump producers in North America, serving member companies by providing forums for the exchange of industry information. The Institute has an 87 year legacy of writing pump standards, and is widely acknowledged as the spokesman for the pump industry in North America. HI invites expressions of interest in pump systems market transformation with a major focus on pump systems education, advancing the concept that "Pump Systems Matter."™ Expressions of interest in "*Pump Systems Matter*"™ should be directed to HI Executive Director **Robert Asdal** at **(973) 267-9700 x 13** or via e-mail at **rasdal@pumps.org.**

Membership in "*Pump Systems Matter*"™ will be open to utilities, market transformation organizations, government agencies, pump users, contractors, consultants, engineering companies, trade and professional associations as well as North American pump manufacturers and suppliers of motors and drives, seals, couplings, bearings, housings, instrumentation and control systems and pump specific software.