

The Perfect Game — Minimizing Pumping-System Friction Losses

Eliminating the causes and choosing the proper pump will increase efficiency and cost-savings

Dimensioning pumping-systems is a difficult task: Very much like in sports, where a team's performance relies on the combination of each player's individual talents, the efficiency of a pumping system relies on several factors: piping, fittings and, of course, the right pump have to be considered when creating the perfect game.

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Imagine a major-league pitcher standing on the mound. He looks in for the signal, starts his windup, rears back and propels the baseball toward home plate. The pitch's maximum velocity is reached at the moment the ball leaves the pitcher's hand. From that point, studies have shown that the velocity decreases by one mile-per-hour for every seven feet traveled. So, if a pitch leaves the pitcher's hand at 100 mph, by the time it covers the 60 feet, 6 inches to home plate it will be traveling around 92 mph.

Conversely, if the mound were only 30 feet from home plate, a 100-mph pitch would be moving at 96 mph upon arrival at the plate, making the pitch much more efficient and harder to hit.

The pitched ball slows down because of the air resistance, or drag. Many variables contribute to the drag, among them air density, gravity, temperature, wind velocity and direction, and barometric pressure.

Now imagine a piping system through which a medium is driven by a mechanical pump. Much like the thrown ball, the pumping systems that operate most efficiently are those designed to have the media— which can range from water to more viscous fluids or even semi-solids like concrete— travel the shortest, most unobstructed path possible.

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Pipework in a factory. Efficient piping systems combine state-of-the-art pumping technology with a simple unobstructed flowpath of the medium, which can range from water to more viscous fluids or even semi-solids like concrete.

The Challenge of Friction Losses

The challenge of pumping operations is that energy losses because of friction are inevitable. As fluids flow through pumps, pipes and fittings, there is a resistance which adversely affects pumping efficiency.

These energy losses are caused by friction between the fluid and piping walls or the friction between adjacent fluids (higher

viscosity fluids have higher losses). But also rough surfaces on the pipe's inside and turbulences created when redirecting the fluid via a bend or a restriction (e.g. a valve, fitting or reducer) increase the friction significantly: The higher the flow rate and the smaller the pipe, the higher the resistance— and the higher the friction with its effects on energy loss. Long pipes and bends, kinks or sharp turns further increase friction losses.

Basically, there are four ways to reduce friction losses in a piping system:

- Increase the pipe diameter of the system.
- Minimize the length of the piping in the system.
- Minimize the number of elbows, tees, valves, fittings and other obstructions in the piping system, while simplifying the layout as much as possible (if you have to turn a corner, a gentle bend is better than a sharp 90-degree turn).
- Reduce the surface roughness of the piping in the system.

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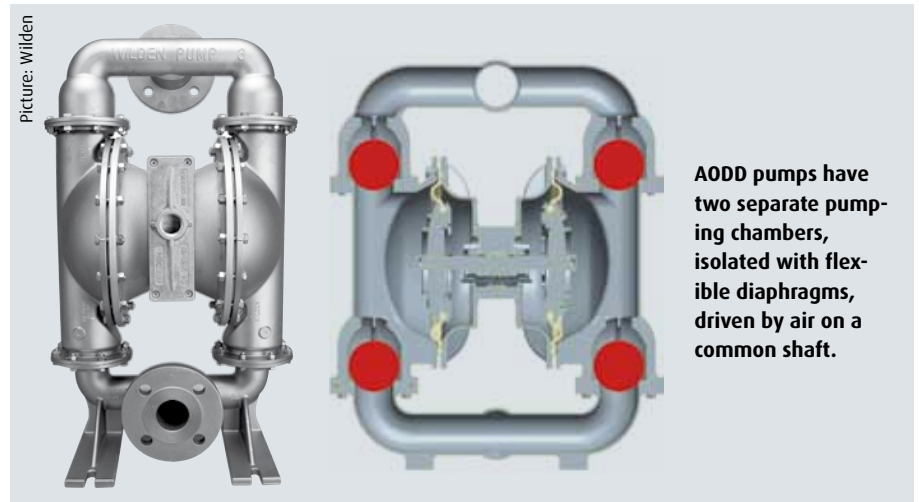
The Right Pump

Another important consideration is to select the best type of pump possible. Positive displacement pumps with air-operated double-diaphragm technology (AODD, for further information see box) have been among the most versatile pumps for all kinds of fluids, no matter the viscosity.

A pump can only develop a certain amount of head pressure, or "pressure energy". If the piping system is restrictive in some way (undersized and/or excessively long piping with unnecessary elbows or tee sections) much of the pump's pressure energy is wasted in overcoming these obstacles. At some point the excessive restrictions can even case the pump to "dead head," meaning that it no longer has the enough "head pressure to move the fluid, causing it to stall. AODD pumps can handle this dead-heading without being damaged, which is not the case for all types of positive displacement pumps.

Recent AODD pumps were desinged to minimize friction losses. These pumps have a larger flow/wetted path, reducing internal friction while maximizing output and efficiency.

Advanced pumps can also feature a bolted configuration that ensures total product containment. A variety of elastomer options are



AODD pumps have two separate pumping chambers, isolated with flexible diaphragms, driven by air on a common shaft.

able to meet abrasion, temperature and chemical-compatibility requirements.

Designing the Perfect Game

Think back to that pitcher and the game of baseball. In effect, the game's creators laid out their "system" perfectly. In the search for competitive balance, placing the pitcher's mound 60 feet, 6 inches from home plate maximized the efficiency of both the pitcher and the hitter, making the game what it is today; if the mound were 30 feet closer, the

pitcher would be at an unfair advantage, if the mound were 60 feet farther back, the score of a "pitcher's duel" would be 20-18.

The same considerations must be taken into account when designing a piping system. The most efficient systems—ones that make the best use of a pump's "pressure energy"—are those designed with the least amount of impediments to maintain the optimum flow. That means creating a piping configuration that contains the shortest possible piping runs, few or gentle bends, a minimum of obstructions and large pipe diameters that maximize flow rate.

The best systems also need pumps that work hand-in-glove with the piping to maximize the operational ability of the system through the minimization of friction losses. AODD pumps that satisfy those parameters are ones that feature advanced wetted paths that are larger and reduce energy-robbing friction losses. These considerations can also help to save energy and decrease downtime thereby reducing operation costs.

DOUBLE DIAPHRAGM PUMPS

Workhorses for Highly Viscous Fluids

AODD pumps feature two separate pumping chambers, each isolated with a flexible diaphragm. Both chambers are connected to the same inlet- and outlet-pipes by ball valves. The diaphragms are driven by air on a common shaft. If one diaphragm moves inward, sucking fluid into one chamber, the other one moves outward, pressing the fluid out of the opposite chamber. AODD pumps can be used for aggressive or abrasive fluids as well as media with high viscosity (e.g. concrete).