AODD Pumps for Harsh Conditions

PRODUCT TYPE AND ENVIRONMENT MUST BE CONSIDERED WHEN CHOOSING THE PROPER PUMP

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Introduction:

Webster's Dictionary offers a number of definitions for the word "harsh," including "having a coarse or uneven surface that is rough or unpleasant to the touch" and "causing a disagreeable or painful sensory reaction." When considering the world of industrial pumps, the word "harsh" has two meanings that must be taken into consideration when choosing the proper pump for the application: the characteristics of the product that will be pumped and the environmental or atmospheric conditions in which the pump will operate, while it goes to reason to say that many times harsh products may need to be pumped in harsh conditions.

So, when identifying and selecting the proper pump for use with harsh products or in harsh conditions, three questions must be contemplated:

1. What considerations should be taken when choosing a pump for harsh conditions?
2. What are some of the pump problems/maintenance issues that can be encountered in harsh conditions that will adversely affect performance?
3. Which pump technology best answers the first two questions?

Let's answer No. 3 first. For more than 50 years, the pump technology that has been proven to perform best in not only handling harsh products, but to do so in harsh environmental conditions is Air-operated Double Diaphragm (AODD) pump technology. AODD pumps are defined as reciprocating, positive-displacement type pumps since their operation sees the pump displace fluid from one of its two product chambers upon the completion of each stroke. AODD pumps have only a few wetted parts – the two diaphragms, two inlet valve balls and two discharge valve balls – while the pumps are air driven by an efficient air-distribution system (rather than by an electric motor). These design characteristics enable the pump to run dry without damage, create a suction lift up to 21 feet (6.4 meters) of water, create positive suction head when necessary, operate while completely submerged and pass compressible solids diameter up to 1 inches (25mm) in size. Taken together, these characteristics make AODD pumps preferable to most other pump types – including internal and external gear, lobe, cavity and piston/plunger – when harsh pumping conditions are present.

Now, let's look at what must be considered when pumping harsh products. First, you need to make sure that the correct wetted material is chosen and that the correct elastomeric material is chosen. For example, if you are pumping a biocide that can be toxic, you have to choose an AODD pump that has wetted parts and elastomers that are compatible with that product.

A pump's diaphragms, valve balls, valve seats and O-rings are collectively known as "elastomers." Generally, there are three types of elastomers: rubber compounds, thermoplastics and Poly-Tetra-Fluoro-Ethylene (PTFE), which is more commonly known as Teflon®. Rubber compounds consist of rubber and man-made additives that have been designed to increase resistance to specific types of fluids. Thermoplastic compounds are constructed entirely of man-made elements that have been designed to increase the tensile strength of the elastomer while maintaining excellent abrasion resistance and are ideally suited to pump many acidic and caustic materials. Teflon® is the most chemically inert manmade compound known which expands the range of applications where Air-operated Double Diaphragm pumps can be used. Since Teflon® is non-elastic, a backup diaphragm must accompany the Teflon® diaphragm; the backup diaphragm provides added support resulting in increased MTBR (Mean Time Between Repair).

Most AODD pumps can be designed to use any of the elastomer types to meet virtually any application requirement. Considerations for specifying elastomers include chemical compatibility, temperature limitations, flex life, abrasion resistance, suction-lift capabilities, sanitary standards and cost.

Another thing to consider is the resistance of AODD pumps components to abrasion. When a highly abrasive fluid is pumped, damage can occur to the pump's internals if the given internals do not possess the level of abrasion resistance needed. Certain powders, as well as slurries containing rocks, metal fines or sand, tend to be highly abrasive and can scratch the pump's internals as they flow through the wetted path of the pump. The pump internals most likely to get damaged in these instances are the ball cages and elastomeric components such as the diaphragms, balls and seats, and any other wetted components that come into contact with the abrasive material being pumped.

Some other things to consider include whether or not the product being pumped requires a pump with a bolted or clamped configuration. Popular choices are pumps with clamped configurations, but bolted pumps are a better choice for products that must be contained at all costs because they seal better. You must also take into account the temperature of the product that is being pumped, as well as the pressure at which it is being moved. Standard AODD pumps are 1:1 pumps, meaning for every pound of pressure they produce, one pound is discharged. However, some applications require a pressure ratio of 3:1 in order to do the job.
That's a look at the harsh conditions that may exist on the inside of the pump. Now, let's consider harsh external, or atmospheric, conditions.

External Considerations:

The obvious one is temperature. Many types of AODD pumps find themselves operating in extreme temperature conditions, from the bone-rattling cold of Northern Canada to the sweltering heat of the Arabian Peninsula. AODD pumps are generally available in either metal or plastic materials of construction. While plastic pumps work well in controlled environments, metal pumps are often the best choice for very hot or

very cold conditions. You must also take into consideration the type of product that is being pumped. Pumping water in below-freezing conditions will likely require a heating blanket or insulated wrap be put on the pump to help prevent freezeups. In the hot sun, or in atmospheres that feature blowing dust or sand, you can build what is called a "doghouse" around the pump to protect it. Also, some products will change characteristics when the temperature rises or drops. A resin that flows nicely at 80ºF (27ºC) may thicken up at 20ºF (-6ºC) and be hard to pump. That is another instance where you might consider an insulated wrap for the product line.

You must also take into account the type of elastomers that are being used in the pump in extreme conditions. For instance, Teflon® is not a good cold-weather diaphragm, but EPDM (synthetic rubber) makes for a very good cold-weather diaphragm, while Teflon® does not operate well in extreme heat (over 220ºF/104ºC), but Viton® is very effective in extremely hot conditions.

There are also internal atmospheric conditions to consider, as well. If a plant has a vaporous environment – if you can smell chemicals in the air, for example – you have to make sure that the pump's non-wetted and body parts are compatible with what may be in the air.

Another consideration is how the conditions will affect the performance of an AODD pump's air-distribution system (ADS). The warmer the air is, the more moisture it holds. That means that when warm air is drawn into the intake of the air compressor the moisture contained in the air is also drawn in However, when the air is expelled from the equipment it expands and drops in temperature, sometimes getting as low as -7ºF (-22ºC). At this temperature, any liquid in the exhaust will freeze, which is why it is critical that the compressed air be dried before it enters the pump.

For example, typical climactic conditions on a hot August day in Louisiana can reach 100ºF (38ºC) with a relative humidity of 90%. In these conditions a 1,000 standard cubic feet per minute (SCFM) compressor will pump 460.8 gallons (1,744 liters) of water through the air lines in 24 hours. To combat this condition, the operator should have a properly operating refrigerant/desiccant dryer system working in conjunction with the air compressor unit (as a whole) to minimize moisture issues. The addition of a dryer will assist with removing the moisture which can cause equipment to freeze-up and seize. Note: For the dryer to work effectively, the dryer must be set at the proper operating settings which could change depending on different climatic conditions.

Proper Selection Is Key In Any Condition:

Now that we've identified the harsh conditions – both in terms of product and of operating environment – that can affect the performance of a pump, let's look at some of the problems that can occur when the proper pump for the conditions is not chosen. When sizing AODD pumps, it is best practice to slightly oversize the pump and run it slower, when applicable. By doing this, it will increase parts life, decrease downtime and repair costs, decrease air consumption and increase the overall pump efficiency.

The overreaching problem is a decrease in pump efficiency and performance. This can run the gamut from lower flow rates brought on by insufficient operating pressures to product incompatibility that can result in a number of expensive product-related issues. The bane of any pumping operation is downtime, meaning that if the pump is not operating, product is not moving and money is being lost.

In addition to costly breakdowns and repairs, choosing the incorrect components for the application will result in increased maintenance costs. ***For example***, if the elastomers in a given pump do not deliver the abrasion resistance that is required, they will wear prematurely. This premature wear will not only affect the pump's performance and output, but also require that these elastomers be replaced sooner than expected.

In the end, a plant operator wants to install a pump and then forget about it until some predetermined maintenance schedule requires that he give it a once-over to see if it is still meeting his operational parameters. This means that the operator wants a pump that can operate efficiently and cost-effectively in a wide range of harsh conditions – no matter how you define them. That's why savvy operators turn to AODD pump technology. The advantages of AODD pumps are many, such as:

- **Seal-Less technology**
- **Run Dry capability**
- **Deadhead capability**
- **Suction Lift capability**
- **Can pump Viscous / Thin fluids**
- **Can pump Solids / Abrasives**
- **Infinite turndown for Flow & Pressure (no expensive VFD required)**
- **Easily portable**
- **Can operate in classified areas / pump flammables (no explosion proof wiring needed)**
- **Good for Shear Sensitive Gentle products**

Taken together, by any definition, AODD pumps are the ideal solution for applications that require their use in harsh conditions.

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