Enhancing Cooling Solutions Performance with Centrifugal Pumps

Overview

When mechanical engineers are designing systems, their goal is to create the best possible combination of components based on the needs and limitations of the application. They will run models researching and analyzing performance criteria until they find the right solution for each piece of the system.

In systems engineering and design, we must be aware of confirmation bias and the potential for designs to follow the, “this is the way we’ve always done it” mentality. This could lead to selecting materials that might not produce the best outcomes for the job at hand.

Take compact cooling systems for high density applications like CT scanners for medical imaging and IT server cooling for data centers as an example. Sometimes, engineers and designers may choose to take the path of positive displacement pump instead of centrifugal pumping technology. While positive displacement pumps are a solid choice, they may be leaving opportunity for future upgrades and system performance on the table.

A centrifugal pump that is sized in the “sweet spot” of the performance curve can be a game-changer for cooling systems across a wide variety of industries. When the required motor power is one horsepower or less, choosing a centrifugal pump rather than a gear, lobe, or positive displacement pump makes sense from an efficiency and cost effectiveness standpoint. In addition, centrifugal pumps offer more flexibility for customization and future enhancements.

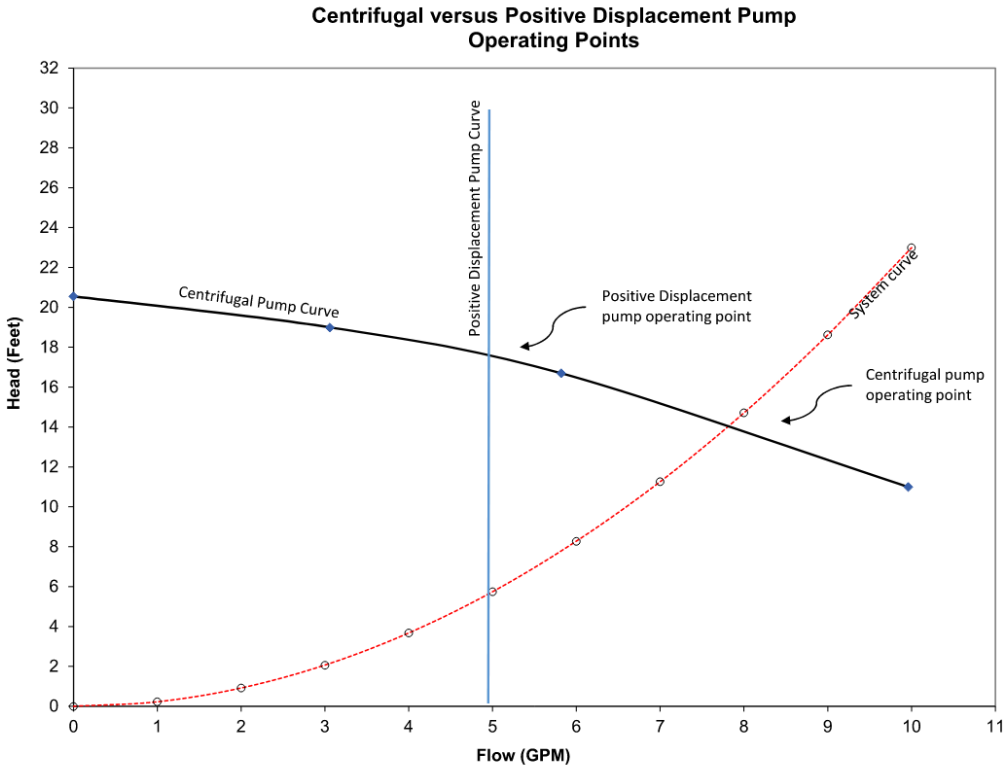
Why Centrifugal Pumps?

What makes a centrifugal pump an excellent choice? The answer is open clearance between the spinning impeller and the volute housing surrounding it. The clearance around the impeller allows for it to continuously spin, regardless of the back pressure obstructing flow at the pump outlet.

The back pressure of the pump works against the overall system pressure in the fluid loop. This allows for the design to focus on minimizing the pressure drop and maximizing the flow rate and heat transfer in the cooling system. This is a different approach than an engineer would take with a positive displacement pump technology.

While the positive displacement pump is a great choice, they have a fixed volumetric flow rate that is limited by the technology selected (gear, vane, screw piston, progressive cavity, etc.), motor RPM, and the size of the pump. Positive displacement pumps will provide greater pressure across the entire system, but this is only valuable if required by the application. The opportunity cost of greater system pressure is the ability to control the flow rate. Positive displacement pumps will only maintain the pressure at a constant flow rate.

The chart below compares the equilibrium flow rates between a centrifugal and positive displacement pump. The equilibrium flow rate of a centrifugal pump is noticeably higher if the system pressure can be minimized during the design phase.



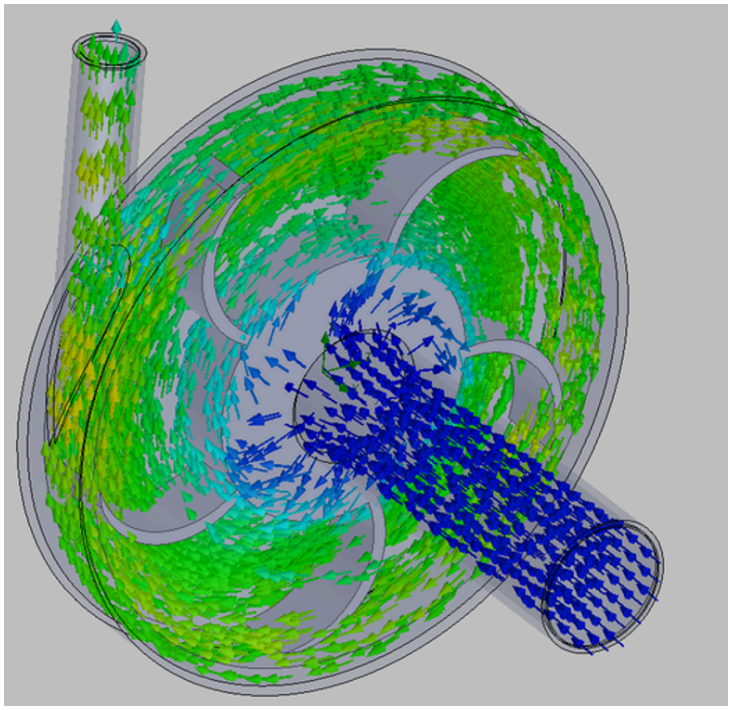
Benefits of Centrifugal Pumps

The selection of a right-sized centrifugal pump may be an excellent choice for cooling systems where the required horsepower is one or less. In addition, niche applications that require customization can be tailored to specifications of your project.

Some of the advantages of centrifugal pumps include:

1. **Whisper quiet operation** – often less than 50 dBA
2. **Higher flowrates** - possible with an optimally designed hydraulic system
3. **Long life** - less wear of components, generally limited by the bearings
4. **More compact** - requirements of cooling system can be achieved with smaller size and weight
5. **Performance-to-cost ratio** - similar or greater performance at a more cost-effective price

Centrifugal pumps provide the above advantages because they utilize an impeller that imparts energy to the fluid through “centrifugal” acceleration. The 3D visualization below shows fluid entering the inlet of the pump parallel to the axis of the pump. The fluid is directionally spun or accelerated by the impeller as it rotates, moving the fluid towards the outer diameter of the component. Once the fluid has reached the outer tip of the impeller, it achieves maximum kinetic energy. That kinetic energy is then converted directly to pressure and flow as the fluid is decelerated at the outlet port of the pump.



Centrifugal pumps have been a staple in the cooling systems industry for decades and are used in a wide range of applications due to their flexibility. For cooling projects that require compact sizes, quiet operation, and reliable performance at an economical price point – a custom centrifugal pump just might be the solution you have been searching for.

Why Tark?

Tark designs and manufactures custom centrifugal pumps for a variety Fortune 500 companies across multiple industries including medical, industrial, and high-technology fields. Think of Tark as a tailor that meets the exacting specifications of your mission-critical cooling system applications.

Many OEMs or Sub-Tier partners share similar challenges:

1) No pump technology experts on their team
2) Limited resources with the ask to do more with less
3) The need to focus on core competencies and growing their business

If any of these challenges resonate with you, Tark is happy to offer a no-strings attached analysis of your cooling system application. Our team will work alongside you to:

1) Ensure the tough regulatory demands are met
2) Increase system efficiency and yield
3) Reduce costs and mitigate risks
4) Uncover ways to increase your profitability

Learn more about our no obligation application review at www.tarkinc.com or by calling the Tark team at (937) 291-5783.