

Pump Performance Bands (Part Two)

Wallace Wittkoff

Second of Two Parts

Last month, we looked at tight versus loose pump performance. This month, we will consider additional factors that influence pump performance.

The Effects of Pump Component Wear

Pump component wear invalidates most pump-performance curves. In highly variable conditions, wear cannot be accurately modeled or predicted. For processes that require tight and predictable performance over time, the solution is pumps that have tight performance ratios to begin with and are either immune to wear or can compensate for wear. Pumps can also be repaired to like-new condition. In doing this, there still remains the risk that the pump's performance will degrade before the anticipated rebuild point and cause production issues. Repair or replacement to regain proper pump performance can result in high costs for rotary PD pumps. In other words, the pump works mechanically just fine, but needs to be repaired to regain performance, which can be costly.

Loose pump performance also has associated side effects. These include an increased amount of shear imparted on the fluid, greater power requirements (and reduced efficiencies) of the pump and heat generation.

Narrow Versus Wide Performance Band

This is not to be confused with tight and loose. In fact, in many cases a pump with a tight performance band gives it the ability to handle a wide flow performance range. The width of the pump's performance band describes the range of speeds in which the pump can produce acceptable flow for the application. This is also sometimes referred to as the effective turn-down ratio of the pump, borrowed from terminology used in

conjunction with motors or variable speed drives.

In Figure 8, notice the point at which the green or yellow pump curves are at greatest slip point and cross the zero/no flow (x axis line). These are points (A) and (B), respectively. These are points in which the green and yellow bands, representing respective pumps, begin to produce flow under the greatest slip condition possible for the process. The pump that starts to produce flow at point (A) will use the total range of pump speed more effectively (revolutions per minute) than the pump starting at point (B).

The performance band width of a pump is also affected by the ability to drive the pump at low to high speeds. Torque requirement, gear reduction, motor cooling and variable speed drive capabilities all play a part and are not in the scope of this article. Motor and variable speed drive capabilities, for example, set lower and upper limits.

For an actual illustration of performance band width, refer back to Figure 6 (see "Pump Performance Bands (Part One)" on www.pump-zone.com). Notice that a pump, in this case a typical lobe pump with a 0.153 gallon/revolution theoretical displacement, effectively has a narrow performance envelope. That is because under an arbitrary worst condition—in this case pumping 1 cps (water-like viscosity) fluid against 75 psig—the pump only begins to produce flow at 185 rpm. This means that speeds between 50 rpm to 185 rpm, which are considered good speeds for ensuring the long life of rotary PD pumps, are not available to the pumping process. The performance band is therefore narrow as it ranges from 185 rpm (instead of 0 rpm) to the maximum mechanical speed capability of the pump, or some other process limitation like NPSHR versus NPSHA, or the abrasiveness of product.

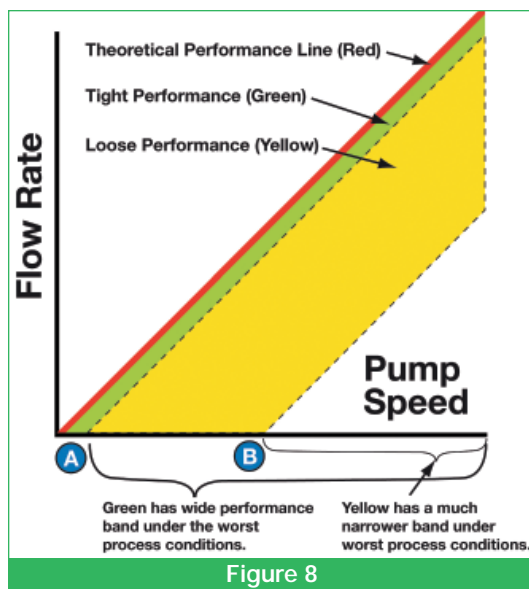


Table 1

Rotary Pump Type	Tight performance when new	Tight performance with wear	Dry Priming	Wet Priming Low Viscosity	Viscosity Handling above 15,000 cps	High Pressure Capability >250 psi	Uses Dynamic Seal	Hygienic Design	Large Particulate >1/2"
Progressive Cavity	Tight	No	No	Good	Yes	Yes	Required	Some	Yes
Gear Pump	Tight	No	Poor*	Medium*	Yes	Yes	Required	No	No
Lobe Pump	Loose	No	Poor*	Poor*	Yes	Yes	Required	Yes	Yes
Circumferential Piston	Medium	No	Medium*	Medium*	Yes	Yes	Required	Yes	Yes
Sine style	Medium	No	Medium*	Medium*	Yes	No	Required	Yes	Yes
Vane Pump	Tight	Yes	Good	Good	No	Yes	Required	No	No
Eccentric Movement	Tight	Yes	Good	Good	No	No	No	Yes	No

* Typically will need to accelerate the pump to prime compared to product flow rate

In comparison, refer back to Figure 7 (www.pump-zone.com), which shows the actual performance graph of a pump with a wide performance envelope. Notice that under the same conditions as Figure 6—pumping 1 cps product against 75 psig—flow begins to be produced at 15 rpm (instead of 185 rpm). In this case, on the low-RPM range, the pump in Figure 7 produces flow at a much wider range of RPMs than the pump in Figure 6.

In most cases, pump wear further increases slip, as is the case with lobe pumps (see Figure 6) when new, but not with wear. If wear occurs in this pump, the manufacturer-supplied performance curve no longer applies and actual performance is unknown, unless verified in the field. In Figure 6, the point at which the pump begins to produce flow under wear conditions could be even greater than 185 rpm and prompt repairs.

In sharp contrast, the pump in Figure 7 compensates for wear by maintaining as-new clearances. Therefore, slip does not change, and the pump performance remains tight with a wide range of flow capabilities.

Our example application that exploits these needs—the continuous in-line blending process—benefits from pumps that have a high turn-down ratio. This is because the recipe to produce the final product can be highly variable as far as the content percentage of each ingredient. In other words, the wider the flow rate range achieved by the pump, the wider the variation of recipes that can be produced with the system.

Conclusion

Good flow control from rotary PD pumps offers options for more advanced processes, like in-line blending, that can have far-reaching influence on a production facility's overall capital and operating costs. Respected pump manufacturers offer performance curves that can be evaluated to determine if the performance band is comfortably suitable for the application. If not, alternative pumping technologies should be studied and considered.

Most curves do not show the effects of wear on performance. Therefore, if wear is anticipated during the expected life span of the pumps and their parts, more subjective analysis is needed. Some curves do model wear, so look for those.

Table 1 compares different rotary PD pump technologies and how they compare regarding their performance bands and other important criteria. The most important criteria for the process should be heavily weighted, but none of the criteria cause a disqualification.

In-line blending systems are already common in the beverage industry where the variation of ingredient viscosities can be controlled. Finding examples of more complex in-line blending processes that demand pumps with tight and wide performance bands is more elusive since they have been developed under proprietary restrictions and confidentiality.

P & S

Wallace Wittkoff is the global hygienic director for Pump Solutions Group (PSG™), Redlands, CA. He can be reached at 502-905-9169 or Wallace.wittkoff@PumpSG.com.

WILDEN
A DOVER COMPANY

Air-Operated Double-Diaphragm Pumps
22069 Van Buren Street
Grand Terrace, CA 92313
909-422-1730
wildenpump.com

ALMATEC
A DOVER COMPANY

Air-Operated Double-Diaphragm Pumps
Carl-Friedrich-GauB-Str. 5
Kamp Lintfort D-47475, Germany
49-2842-9-61-0
almatec.de

1461 Ford Street, Suite 205
Redlands, CA 92373
Tel: 909-512-1257
Fax: 909-798-1879
Info@pumpsg.com
pumpsg.com

circle 131 on card or go to psfreeinfo.com