Fine-Tuning Pump Performance Bands, Part Two

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Part 1 of this article can be found here [1].

Last time, we looked at how pump performance can be affected by a number of changing variables and how regulating “tight” vs. “loose” pump operation, in the form of controlling “slip” in continuous in-line blending operations, can optimize a pump’s performance. Today, we will look at how a pump’s “narrow” vs. “wide” performance band can affect pump productivity and energy efficiency.

First, “narrow” vs. “wide” pump performance 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.

For an actual illustration of performance band width, 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 1cps (water-like viscosity) fluid against 75 psig — the pump only begins to produce flow at 185 rpm. This means that speeds of 50 rpm to 185 rpm, which are considered good speeds for ensuring the long life of rotary positive displacement 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 vs. NPSHa, or the abrasiveness of product.

However, the actual performance graph of a pump with a wide performance envelope being used under the same conditions — i.e., pumping 1 cps product against 75 psig — sees flow begin to be produced at 15 rpm (instead of 185 rpm). In this case, on the low-RPM range, this type of pump is able to produce flow at a “wide” range of RPMs, rather than the lobe-style pump that begins to produce flow at 185 rpm.

Additionally, in most cases, pump wear further increases slip, as is the case with lobe pumps. If wear occurs in this type of pump, the manufacturer-supplied performance curve no longer applies and actual performance is unknown, unless verified in the field. This means that under wear, the point at which the lobe-style pump begins to produce flow could be even greater than 185 rpm, and prompt repairs.

In sharp contrast, rotary positive displacement-style pumps compensate for wear by maintaining as-new clearances. Therefore, there is no change in slip 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 that is achieved by the pump, the wider the variation of recipes that can be produced with the system.

Good flow control from rotary positive displacement pumps offers options for more advanced processes, like in-line blending, that can have far-reaching influence on a macro production facility’s 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.

Not shown in most curves are 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.

The bottom line is that rotary positive displacement pump technologies are the best for optimizing production. The different rotary positive displacement pump technologies can be compared and how they compare regarding their performance bands and other criteria is important. Basically, the criteria that are most important for the process should be heavily weighted while noting that none of the criteria cause a disqualification.

For more information on this topic, please visit www.pumpsg.com *[2]. For more information on Dover Corp.’s Pump Solutions Group, please visit* www.pumpsg.com

[3].

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