Using VFDs as Part of a Net Zero Strategy to Reduce Energy Use

By Fluensys | Sept 3, 2024 | VFD

Variable Frequency Drives (VFDs) are used on motors to control pump speed to adjust flow rate and reduce power consumption.

Figure 1: A Basic VFD controlled Pumping System

Operating a pump at 80% of its rated speed can halve power consumption. This has a direct impact on energy and operating cost (OPEX) and also improves equipment longevity and system reliability, with reduced wear in components.

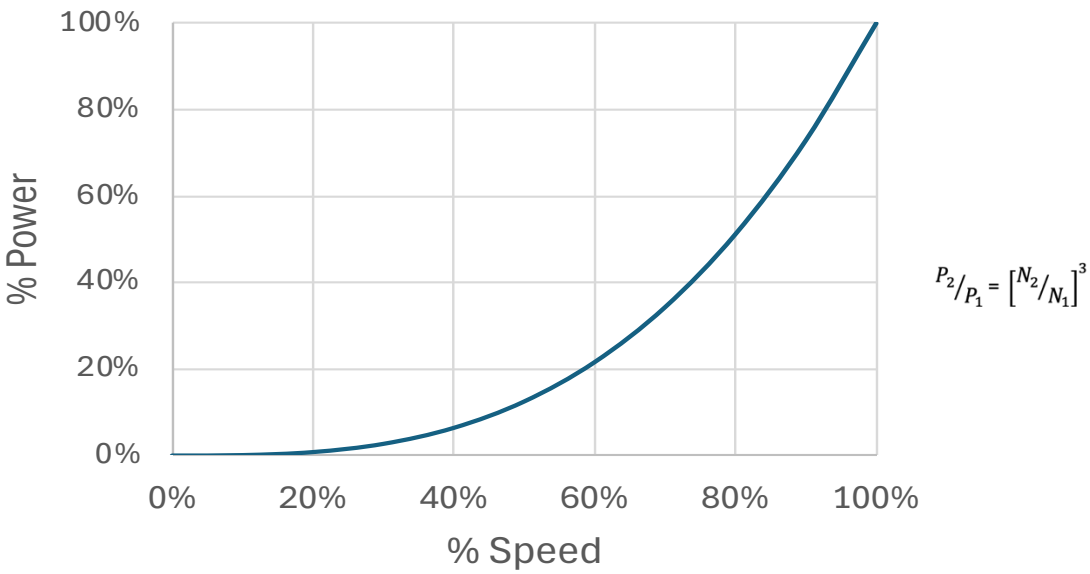

Figure 2: Power Consumption versus Pump Speed

Pumps are rated to operate at or near their best efficiency point (BEP) at the maximum flow required but may seldom operate at that point due to design margins and varying operating conditions. Hence, some kind of process control is always required. Operational control can be done in many ways, with valve throttling being the traditional means. Other options are, using a

recycle line or variable speed drive (VSD). VSDs include magnetic and fluid couplings as well VFDs.

Amongst all options, VFDs provide the highest potential reduction in energy consumption and efficiency gain. However, VFDs are expensive and require additional design and space considerations. They can add complexity to the design when compared to using a standard soft starter system. They generate harmonics and can interfere with control systems; hence, they may need EMI/RF filters and more expensive VFD-rated cables. All these factors make that VFDs increase project CAPEX.

VFD considerations must be handled on a case-by-case basis when determining financial justification for extra investment. A financial analysis (NPV, ROI, Payback) shall be made for options with and without a VFD and the cost-benefit outcome varies based on size, operational scenarios and system curve characteristics.

As the key operating scenarios dictate energy saving potential, it is a better approach to use the non-dimensional factor *energy intensity* in calculations.

$$\text{Energy Intensity} = \frac{KWh}{m^3}$$

Non-financial factors, such as the regulations, the organisation's Net Zero ambitions and stakeholder pressure, may also entice plant operators to use or retrofit VFD drive systems.

As mentioned, the pump's system curve dictates the energy saving potential of VFDs. Friction dominated curves have the highest potential (red striped box) in energy saving, when compared to static head dominated ones. This is due to the fact that the pump is able to operate at lower pressures and maintain a high efficiency, as shown below.

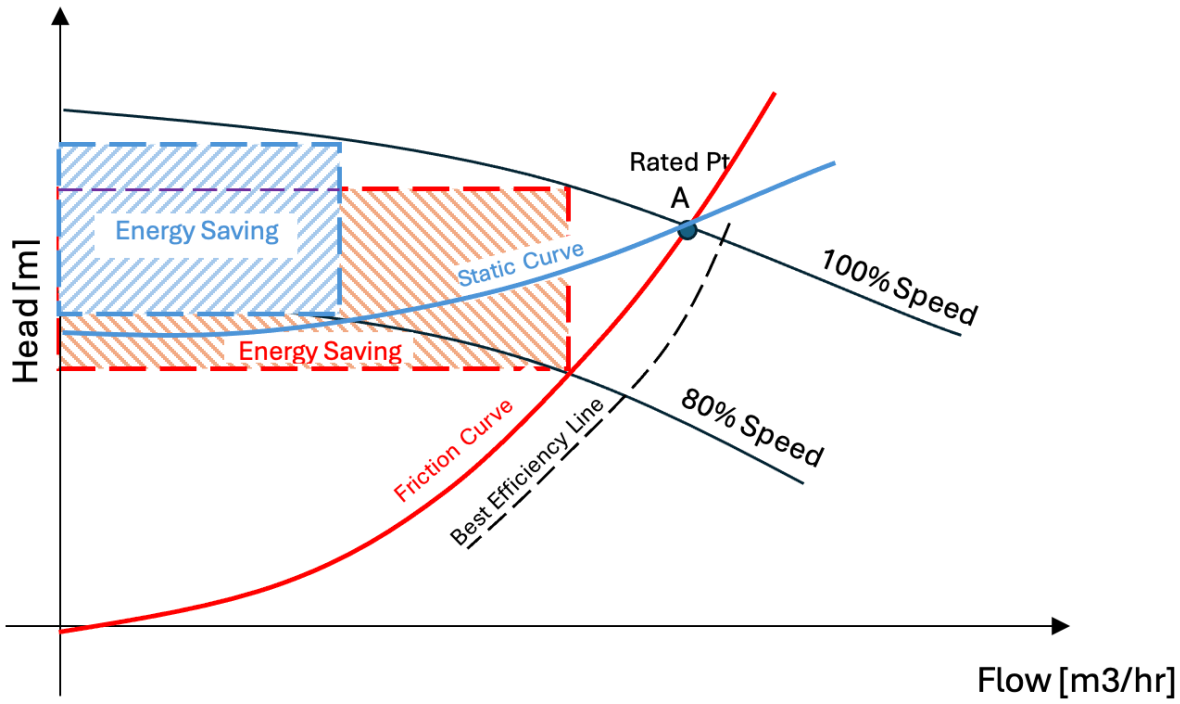

Figure 3: Power Consumption versus Pump Speed

Static head dominated systems have flatter curves which constrains the gain in energy saving when reducing speed.

It is worth noting that most systems are a combination of both friction and static head.

Summary

VFDs provide a solution to reduce energy consumption in pumping systems and are commonly prescribed as part of a Net Zero Strategy. They offer significant advantages in terms of energy efficiency, equipment longevity, and process control, but they also come with challenges such as higher initial costs, increased system complexity, and can affect control systems.

Careful consideration and proper management are essential to maximize the benefits of VFDs in pump applications. It is important to understand that it might be difficult to financially justify its use in some applications, but the regulatory landscape and corporate sustainability strategy may be the guiding arguments for adoption.

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