Innovatively saving resources and energy

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Energy is one of the factors which sends industrial costs sky-high. Research shows that electric motors account for around 70 percent of the power consumed by industry. Process equipment and pump systems in particular offer huge potential for energy savings: If you consider all the energy used by process equipment, up to 50 percent can be saved by making various adjustments and optimising components and systems. Taking the example of oscillating diaphragm pumps and metering pumps, the potential offered by individual components is huge.

Most of the liquid pumps used in the chemical industry are rotating pump systems, for example centrifugal pumps. Under partial load, their efficiency is often way below 50 %. One way to improve efficiency is to use speed-controlled pump drives and/or highly efficient drive motors in accordance with IEC 60034 or to replace them with say oscillating diaphragm pumps. Their hydraulic efficiency is usually in excess of 90 percent.

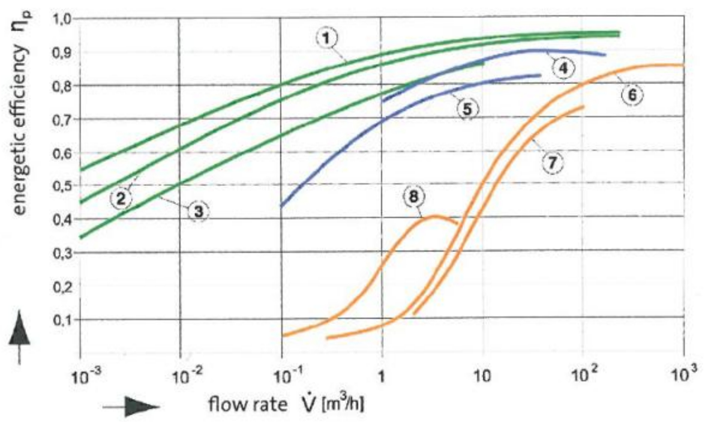
While replacing centrifugal pumps with process diaphragm pumps for transfer and conveyance work may not be cheap up front, it is usually a much more energy-efficient solution with a ROI (Return On Investment) of the additional costs after approx. 2 to 4 years, depending on the application.

Optimum drive concept for large process pumps

Triplex pumps are usually used for high performance targets. They are equipped with classic crank drives. When developing a new process metering pump, we were tasked with producing a design to save material and space and if possible to also improve energy efficiency. The result was an oscillating diaphragm pump with a very unconventional design. A pump with diaphragm dosing heads and hydraulic ends arranged in a star shape around an eccentric slider drive mechanism. This arrangement not only gives this pump fewer bearing surfaces than conventional Triplex pumps, it also means that the bearing loads are considerably lower than with crank-driven pumps. The same applies to the bending torques on the eccentric slider drive mechanism of this pump compared with those of the eccentric shaft of the crank drives. A design which permits high pressures and capacities coupled with good efficiency yet requires significantly less material and drive power is therefore possible.

Energy saving of up to 30 percent

An innovative drive and control concept was also developed for a low-pressure motor driven metering pump in the output range of up to 1,000 l/h.



1. Diaphragm pumps with hydraulically driven diaphragm
2. Piston pumps
3. Diaphragm pumps with mechanically driven diaphragm
4. Screw pump
5. Gear pump
6. Rotary pump (standardized chemical pump)
7. Leakage-free rotary pump
8. Side channel pump

Fig. 1: Energy efficiency of various pump designs

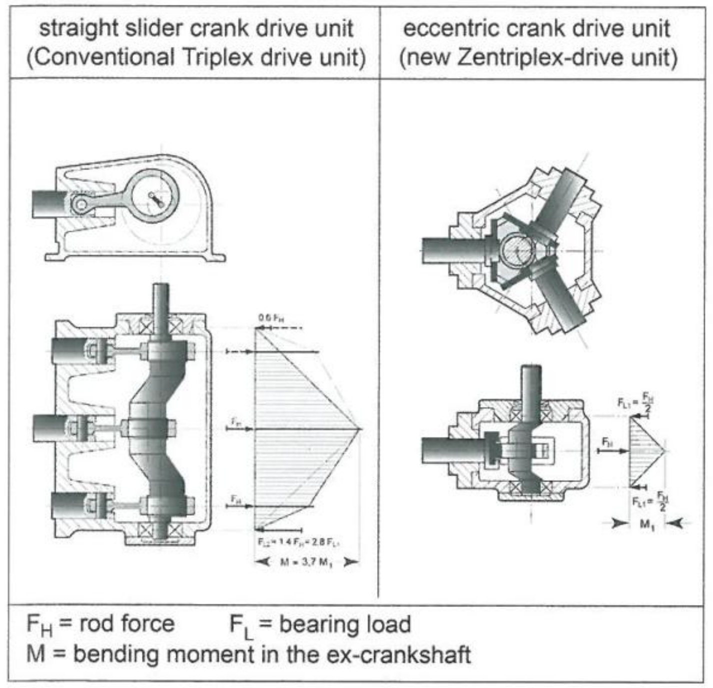


Fig. 2 Construction of standard drives compared with the Zentriplex drive

The integrated microprocessor control of the revamped motor driven metering pump is an optimum combination of speed control and Stop & Go operation. It works in a wide control range with individual fine tuning. Motion and speed profiles are recorded in combination with energy demand for the first time using a vector control, which centrally controls all energy/kinematic processes.

It detects the amount of power needed and controls the supply of energy depending on the prevailing, specific requirements. This leads to a real reduction in the power actually required and results in a significant increase in efficiency. Overall this generates energy savings of over 15 % at full load, and savings of up to 30 % when operated at partial load compared with conventional pump controls.

Process-dependent metering

The volume to be metered must be adapted in real time to the current requirements with varying processes. Process-dependent addition of the chemicals is only then guaranteed.

It is essential that metering errors are avoided as metering volumes outside the permitted tolerance can cause considerable quality defects – for example, in surface technology. This holds true regardless of whether too much or too little has been metered. If volumes are increased, costs rise due to unnecessary chemical consumption and pollution levels rise too.

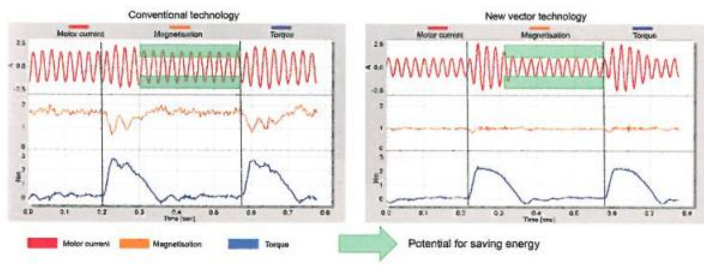


Fig. 3: Vector control
Measured with S2Ca 16130; operation at 160 strokes/min, 75 % stroke length and 16 bar

Fig. 4: The control system variant (S1Cb/S2Cb/S3Cb) of the motor-driven metering pumps is equipped with intelligent features to provide a high level of operating convenience, safety and efficiency.

The intelligent motion guide used with motor metering pumps remedies this. Using the new vector control, optimum metering results can be achieved by adapting the metering behaviour of the metering pump to the application or chemical used. The metering behaviour of the pump is matched to the prevailing circumstances using metering profiles. The speed/stroke motion of the drives is ideally varied by the integrated vector frequency converter control.

The stroke motion of the displacement body is continually recorded and regulated such that the stroke is undertaken in line with the desired metering profile. For example the medium can be discharged more evenly

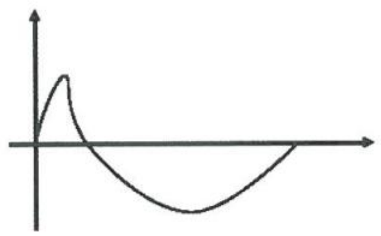


Fig. 5: Short compression stroke and long suction stroke metering profile. With the optimised suction stroke, the suction stroke is carried out as slowly as possible, which allows for accurate and uncomplicated metering of viscous and gaseous media. This set-up should also be selected to minimise the NPSH value.

with a short suction stroke and long compression stroke. With one long suction stroke and one short compression stroke, the metering behaviour of the pump is adapted to the properties of high-viscosity media. The long suction stroke allows the pump head to be filled in an optimum manner.

Summary

Modern oscillating diaphragm pumps meet the process conditions that prevail in the water treatment, chemical and petrochemical industries, for example. Gains in efficiency can also be achieved through developments such as intelligent motion control in motor metering pumps or an innovative process pump design.

Optimised components result in excellent energy efficiency, compact size and low weight. Flexible adaptation to changing processes is also assured.

However, work to improve efficiency isn't restricted to the pumps. More attention needs to be given to their use in process and technical systems. Where do we find avoidable losses due to unfavourable system configurations, e.g. a fitting with unnecessarily high control pressure? Even the most efficient motor is no use if driving with the hand brake applied. We need to optimise the energy use of equipment and systems by considering their configuration as a whole. Ultimately, optimising direct and indirect operating costs over the life of equipment brings the customer cash benefits.

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