Colfax White Paper

The Right Pump Lowers Total Cost of Ownership

Edwin Braun, director of business development / dipl. ing.
Wolfgang Leiber, director of Research and development
Allweiler AG

In mechanical engineering, like in other fields, the total cost of owning and operating a pump unit or installation is the focus of increased attention. When considering the purchase of a pump unit, customers consider not only the initial cost of investment, but also life cycle costs (i.e., operational costs like those related to energy, downtime, maintenance and spare parts). All of these items together are referred to as the total cost of ownership (TCO). Certain types of pumps and, therefore, specific pumping principles are most ideally suited to minimizing total cost of ownership for particular pumped liquids and pumping processes. Having the proper dimensions is also of critical importance. In each case the objective is to achieve a pumping process with the lowest possible TCO.

Several factors determine the composition of the costs and how high they will be. The following describes in greater detail the major factors that the operator can control:

– Optimization of components within the pumping process
– Optimization of pumps for the pumped liquid and its viscosity
– Optimization for the requirements of the pumping process
– Optimization of the pump drive
– Optimization of installation
– Optimized dimensions

Optimization of components

These are fundamental considerations, some of which appear to be straightforward; however, it is very common for components to be oversized and consequently make procurement unnecessarily expensive. On the other hand, it makes good sense to select the highest possible drive speeds, because then you can use smaller pumps. Lower procurement costs will be the result. Drive equipment with high levels of efficiency reduces energy costs. Finally, make sure to choose components that will not be operating at the limits of their capacity, in order to keep maintenance costs low. The same applies to pumps with even pressure progression. They will extend the service life of the piping, by subjecting it to only very low pulsation. Screw pumps are particularly well suited for these situations, while external gearwheel pumps are poor choices.

Optimization for the pumped liquid

The total cost of operating a pump is strongly dependent on how well it is adapted to the properties of the liquid you wish to pump. This starts with the materials used to construct the pump, which must be appropriate for the liquid's chemical and physical properties, such as its pH and vapor pressure. Gaseous components, solids and abrasive components in the liquid are also important. Other characteristics, like flow behavior, viscosity and sensitivity to shearing forces, result in special requirements that can be met most economically by certain pump types. Finally, environmental and worker-safety regulations may actually make it more economical overall to use magnetically coupled (leak-free) pumps, despite the higher procurement cost.

Viscosity plays a critical role in determining the costs for maintaining pumps of various types. If liquid viscosity falls below the minimum values for a particular pump type, significantly higher maintenance costs will result. The same applies if viscosity significantly exceeds the maximum level.

Optimization for requirements

Generally speaking, there are two different pump types for every pumping task: displacement pumps and kinetic machines. The specific hydraulic characteristics of these two types lead to clear recommendations for keeping TCO as low as possible:

– When delivery head is subject to change, a displacement pump is needed, because it will retain its efficiency even when pumping to varying heights. Kinetic pumps, such as centrifugal pumps, have good efficiency within a relatively limited range of delivery heads, but their efficiency deteriorates rapidly if delivery head is too low. Efficiency suffers even more when delivery head exceeds the ideal range.

  Displacement pumps are, therefore, usually the most economical choice when medium viscosity changes, but flow volume remains constant. Here as well, the efficiency of kinetic pumps will drop rapidly when viscosity is outside the narrow optimal range. Displacement pumps are less susceptible to these fluctuations.

Therefore, displacement pumps are usually the right choice when the mode of operation and operational conditions will change significantly. This may be a situation in which flow volume remains constant, but pressure or delivery head changes.

– In contrast, kinetic machines are particularly efficient when operational conditions and the liquid's flow properties remain constant, thereby making it possible to adapt the pump to the exact requirements.

Costs can be significantly reduced by operating a pump close to its most efficient range. Efficiency is not the only factor to consider. Once flow volume varies beyond a certain range, kinetic machines will also incur noticeably higher costs for spare parts, maintenance and downtime.

Regardless of pump type, performance losses must be calculated properly in order to find the most ideal dimensions. Calculation mistakes will make themselves noticeable in the form of decreased efficiency.

Optimization the drive

Here as well, we can make a general point: The higher the rotational speed, the smaller the pump and, therefore, the lower the procurement costs. Specifically, it should be obvious that a high-efficiency motor will incur much lower energy costs. This is particularly true when shaft output is low (below about 50 percent), with efficiency increasing by as much as eight percent.

Optimization of installation

When it comes to installation, there are two factors that must be optimized. First, pumps designed to be compact will require less room for installation. This will not always result in lower costs; but wherever space is at a premium (like on ships) or when pumps must be integrated into existing installations, compact pumps will save money, because they are easier to install. In any case, compact pumps are lighter and can usually be obtained at a lower price.

Optimized dimensions

A pump's exact dimensions are inseparably linked with the pumped liquid and the pumping task itself. When the impeller is properly dimensioned, efficiency of up to 85 percent can be achieved. Even minor deviations in the impeller's diameter can result in efficiency losses of 10 percent or more.

Summary

To achieve the lowest possible total cost of ownership, it is essential to consider how all of the factors described above are interrelated. Pumps that are properly adapted to the overall system and facilities, are constructed of materials that reflect the properties of the pumped liquid, and whose pumping principles fit well with the operational conditions will reduce overall costs. Allweiler AG supports pump operators two ways in their efforts to minimize TCO. First, Allweiler offers a very wide selection of pump types employing many different pump principles. Second, Allweiler focuses consistently on the TCO of every pump. This begins with the initial design, but continues with production methods, as well as programs for maintenance and service.

Colfax Corporation
8730 Stony Point Parkway
Suite 150
Richmond, VA 23235 USA
T: 804.327.5689
F: 804.560.4076

www.colfaxcorp.com

Colfax Americas
1710 Airport Road
Monroe, NC 28110 USA
T: 704.289.6511
F: 704.289.9273

Colfax Asia Pacific
Suite 1708 Universal Mansion
168 Yuyuan Road, 200040
Shanghai, China
021-62481395
021-63737422
021-63868183

Colfax Europe, Middle East, Africa
Allweilerstr. 1
78301 Radolfzell
Germany
+49 (7732) 86-0
+49 (7732) 86-436