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Pumps: HP, RPM and Energy Efficiency

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Several years ago, a golf course community wanted to adorn its entrance with a waterfall. Rocks were arranged to form a wall about 12 ft high, and the water would flow over the wall and into a collection pond for recirculation. The committee in charge of this project, wanting to save money on the equipment and installation, used six swimming pool pumps from the local pool supply. Because 115 volt power was all that was readily available, the 2 hp, 3,450 rpm pumps were provided with single phase motors.

When the job was completed and the pumps turned on, the six pumps did not provide enough flow, so the desired waterfall effect was not achieved.

So what was wrong with the committee's original equipment selection, and what could be done to provide more flow? The specs for the installed pumps revealed that the combined total flow for all six pumps was about 350gpm at 60 ft of head (about 25 psi). The cost of operating the six pumps totaled an annual cost of $10,000 for continuous running. The committee had saved money by purchasing fairly inexpensive swimming pool pumps, but the savings were wasted in operating costs. Much of the power was wasted because the pumps provided more pressure than what was required to lift the water up the required 12 ft. The use of single phase motors required 75 percent more power than what could be achieved with three phase power.

The proposed solution was a single larger pump operating at a lower speed. Affinity Laws reveal that when a pump's operating speed is reduced by half, the flow is reduced by half. The output pressure is also reduced to a quarter and the required horsepower to an eighth of its full speed value. For this particular application, since a high output pressure was not required, the total flow rate was increased at a lower total horsepower requirement. A single, heavy duty 6x4 pump would operate at 1,170 rpm. The pump provides close to 600 gpm with a 7.5 hp motor; initially only 350 gpm was provided with a total horsepower requirement of 12 hp.

This single pump had an initial cost almost four times that of the six swimming pool pumps, but operating costs for this pump were calculated at less than 40 percent of the cost to operate the swimming pool pumps. This provided a payback of less than two years.

There are added benefits to operating at reduced speed. Reduced operating speed translates into less bearing wear and longer motor life. Longer pump seal life is achieved and the damaging effects of abrasives in the recirculated water are reduced. Less wear and longer life means a reduction in maintenance costs and system downtime.

Lessons Learned

First, accurately estimate and specify the head and flow requirements for any given application. There is no need to pay for added pressure that is not required. It is important to provide the required flow to achieve a desired result. These parameters may not be easy to calculate or estimate; however, added time and attention paid at the beginning of a project will ultimately yield results.

Saving money on the initial purchase of pumping equipment does not necessarily save money on the total cost of a project. Consider continuous versus intermittent service, proper selection of materials of construction for a given job and the expected service life of the pump. A pump that breaks down and has to be replaced in two to three years is certainly no bargain.

Pump operating costs are almost always greater than the cost to initially procure the equipment. The cost of electricity, maintenance and repair costs or costs related to downtime and loss of use need to be considered when specifying and selecting pumping equipment for a given application. The proper pump operating speed is one tool that can be used to reduce operating costs.

Many applications today, especially for larger pumps, specify the use of variable speed motors, which allow the user to choose the exact performance required for a given job while not use any more power than is necessary. Not all applications require variable speed motors, but selection of the proper pump operating speed can maximize operating efficiency. Today and in the future, energy efficiency and conservation will be of ever increasing importance.

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