NCPC
NATIONAL CLEANER PRODUCTION CENTRE
SOUTH AFRICA

BEST PRACTICE GUIDE

Pumps

Pumps generally are a component in a system of pipes, valves and other equipment such as heat exchangers. The performance of a pump is dependent on the system in which it is installed. Changes in the system affect pump performance and any change in pump operation affects how the system works.

When a system is first designed, a pump is selected to meet the given system's operating conditions. These conditions cannot be determined precisely beforehand and pumps are usually sized to operate at the most demanding condition that the designer reasonably thinks may occur. This is done by adding a performance margin to each element in the system, and the pump is selected against this 'worst case' total. In most installations, these 'worst cases' do not arise and the pump is thus oversized for the actual, and not the estimated, performance required. As a result, many pumps operate short of their best efficiency points and waste energy while doing so. If possible, pumps should be operating at approximately 70%.

It is a good strategy to assume that most pumps in a plant can be replaced or altered in some way to ensure greater energy efficiency. Start the assessment with the largest pumps first as this is where the most gains are likely to be made.

Centrifugal pumps abound and this advice relates primarily to such pumps, although these are general principles.

CONSIDERATION	GOOD PRACTICE
Plant has a significant number of pumps or pumps of significant power	• Make a record of all the significant pumps, including their drive motors. Leave the ones with variable speed drives for another time, unless you suspect they only run at a single speed. • Check that the pumps only operate when required by the process. • Ensure that the process demand on each pump is at a minimum. Don't pump more fluid than minimally required by the process.
Measure operating performance of each pump	• Engage a pump specialist to measure the performance of the pumps found on-site. • This involves measuring, and not assuming, all the operating parameters for each pump. • Calculate the pump efficiency for the installation.
Measured operating efficiency	• If the measured efficiency is significantly (>15%) below the maximum possible for the pump type, there are some options for improvement below.
Pipe configuration	• Replacing excessively small pipes and/or tortuous routes should be considered. The additional loss of pressure that this produces may be costlier because of the additional electricity charges after a few years as compared with the replacement price. • Mark fixed position valves, i.e. throttling devices, for removal once the pump has been replaced or modified. • Mark control valves that are necessary for process flow control, and retest the pipe flow and pressure conditions over the range of valve operation.

Pump changes	• Engage a specialist (preferably a reputable pump supplier) to comment on the suitability of the installed pump for the operating conditions. A simple 'fix' is to reduce the speed of the pump to meet the required operation. However, it may be possible to modify the impeller and/or the casing. Should the 'fixes' not be sufficient in increasing the new efficiency to the maximum, the entire pump will have to be replaced with an appropriate one. • This is not a 'trial and error' process as the effect of each proposed change can be calculated before any equipment is bought.
Pump drive	• If the assessment above shows that a slower pump speed is all that is required for improved efficiency, this can often be achieved simply by changing the V-belt pulley ratios. • A single-speed motor manufactured for a lower speed may be possible if the motor and pump are coupled directly. If not, try to convert the arrangement to the V-belt and pulley drive. • Where there are process control valves, these can be removed and replaced by a variable speed drive to the motor to achieve better running costs. However, not all motors can be converted to VSD. • The previous point applies to a single control valve in a circuit. Multiple circuits, each with a control valve, could be supplied from one primary circuit served by the pump. In this case, the VSD would respond to the pressure in the primary circuit.
Variable speed, multiple pumps	• Continuously varying process loads are best met by using variable speed pumps or motor drives as these are more energy efficient than controllable valves in the pipes. • VSDs also can start a pump slowly which reduces the electrical load. • For a two-speed process flow requirement, two pumps can be connected in parallel to be used one at a time, according to the process demand. Non-return valves must be used to ensure that the pumped fluid does not short circuit through the idle pump.
Financial evaluation	• Using the power requirements, the running hours and the appropriate electricity charge(s), compare the running cost saving between the existing and proposed against the cost of providing the new installation. If the internal rate of return is higher than the business requires, replace the existing arrangement.
Motor	• If a motor is to be replaced, use only the highest available efficiency model of the correct power (not greater).
Maintenance	• Vibration, noise and heat are indications of wasted energy. Maintenance reports should report these for early investigation and action.

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