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Dura Pump

A basic guide to pump control systems.

This is an introductory guide to the basics of pump control systems. We will look at:

- Why pumps need a control system.
- The components of a control panel.
- Control starters.
- Controlling discharge pressure.
- Inverter v no inverter.

What is a pump control system?

A pump control system is the electrical or electronic means by which the pump is controlled. This could be to control level pressure temperature or some other variable to deliver the required pump solution.

Why do pumps need a control system?

A pump by itself can only be either on or off. The pump has no way of knowing that it needs to turn on or turn off.

The control system gives the pump a level of intelligence. This may be a very basic switch through to a very advanced PLC (Programmable Logic Controller) and inverter control system. This device allows us to programme a series of sequences or events to be monitored.

We can then control the outputs from the PLC to operate the pump-valves and other components within the pumping system. The standard controls connected to a pump are normally related to either the pressure in a system, or to the level in a tank.

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Control panel components.

The basics of a control system will include a control circuitry and a power circuitry. The control system takes the signal from the external device. This could be a pressure switch, pressure transducer or a float switch. Depending on the signal, this will either energise or de-energise the pump using the power circuitry. Energising simply means turning the pump on and de-energising means turning the pump off.

A very basic example of this is a single cold water booster pump. When the pressure in the system drops below its set point the pump will turn on. When it reaches the required pressure, the system will turn off.

Starting a pump - control starters.

There are four common ways to start a pump:

1. Pumps typically below 5.5 kilowatts will be started by a direct online starter, commonly known as DOL (Direct On Line). This is activated by the control circuitry to turn the pump on.

2. For pumps larger than 5.5 kilowatts a star delta starter would normally be used. This allows a smaller current surge during start-up.

3. The third alternative to this is the soft start. This prevents power surges when starting that can cause wear and stress.

4. An increasingly common method is the inverter, also known as the Variable Speed Drive (VSD). This has many advantages as it gives full-speed control of the pump. This provides a more consistent pressure and reduces the power consumption. The inverter also has the advantage that it can monitor the condition of the motor.

Control starter costs.

In terms of cost, the DOL option is the least expensive, with the inverter option being the most expensive. There are however significant savings to be made in the running costs by using an inverter. These savings would not be made with the other options.

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Controlling discharge pressure.

The most common form of pump control is seen on a cold-water booster set. This is where we are pumping water under pressure into a building or a process. Take a block of flats, ten floors tall - this would require a water pressure of five bar to provide sufficient water pressure at the top of the building. If the water pressure drops below five bar, we need to turn the pump on to pressure the water to reach the top floor. Once we have achieved five bar pressure the pump can switch off. We then need to consider the volume that is going to be needed. If we only have one tap running on the top floor, there will be low demand and a pump running at full speed will very quickly achieve the required pressure. If however there are multiple users throughout the building using water, the pump will have to run continuously to provide sufficient water.

System with no inverter control v inverter control.

If we have a system with no inverter control, we will require a large pressure vessel to absorb the excess flow provided by the pump. This would mean when there are small demands, the pump may not start, and the system supplies water from the pressure vessel. If we had the same system with an inverter control on the pump, it will run as fast as necessary to achieve the required pressure and therefore required flow. This typically can represent a 35% power saving on the system. It also provides a better user experience as the pressure is more consistent than when the pump is only turning on at full speed.

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Level control system.

The second most common control system is related to level. This comes in two forms. Either we are trying to empty a tank or vessel, or we are filling a tank or vessel. In both cases, we have a level control device which could be a float switch, a level probe, a level transducer, or a radar. This feeds the level information back to the control panel. If we are considering a tank which is to be emptied it will detect when the level reaches an upper limit. This will then turn the pump on to discharge the contents of the tank. Once a lower level is detected, the pump will turn off. An example of this is a wastewater pumping station. If we consider the converse where we are trying to fill a tank when the lower limit is detected, the pump will turn on to transfer fluid into the tank. Once the upper limit is reached the pump will switch off.

On larger systems, the level will be monitored using a radar or level transducer this will feedback to an inverter control. The inverter will run the pump at a varying speed to maintain a consistent level in the tank. This is a more energy-efficient way of filling a tank.

Systems with more than one pump.

It is important that all pumps are run equally to spread the wear and tear across the pump system. It is also essential that all pumps are run at least once a week. The control system will alternate which pump runs. Typically, this changes duty after each cycle or every 24 hours. The system will also monitor the pumps and if one should trip, it will swap duty to another pump. Multiple pump systems normally have a cascade feature. This enables further pumps to be switched on to maintain the required level or pressure. Using this cascade feature allows us to split the duty over the pump system. This results in a more efficient reliable pumping system.

An example of a cascade pump system is a cold-water booster set. If each pump can deliver five cubic meters per hour and we have a four-pump system, this system could deliver 20 cubic meters per hour. If the demand is seven cubic meters per hour, two pumps would run. There would be an excess of three cubic meters per hour. On a traditional system, this is where a large pressure vessel would absorb this extra flow. By using an inverter control system, we can slow the frequency of the consumed pump so that it only delivers the additional two cubic meters per hour. This reduces power and provides a more consistent pressure. It is normal for all pumps on the system to have inverter controls. These will communicate with each other to deliver the required pressure, flow of water and alternate the duty pumps. Many inverters also have the facility to detect dry running. The latest generation can also monitor the vibration from the pumps to provide alerts of bearing failure and other issues. This can include cavitation, worn components and loose couplings.