The Next Generation for Level Control

By Ryan Spooner, Singer Valve

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Water is an essential resource to everyday life and therefore having a way to store and distribute water is very important. Water storage tanks have been designed to compensate for varying water demands during high and low peak periods, as well as for firefighting, power outages and other emergency demands. There are many ways to store water in a distribution system, but what it all boils down to is the importance of the control system that ensures the water storage is done right. Common practise is to use different forms of hydraulic altitude water control valves. These control valves use different hydraulic control pilots, depending on application, to measure the tank levels and maintain or adjust the water storage levels.

Figure 1: Singer Hydraulic Altitude Water Control Valves

The two key factors for water storage are to ensure the tank maintains the correct level and that there is water turnover. Water quality deteriorates with water age so stagnant water in tanks severely reduces the quality of the water. Water quality deterioration can give rise to various health risks. Poor water storage can have both chemical and biological impacts such as, disinfectant decay, microbial growth, tank corrosion, chemical contaminants, nitrification, pathogen contamination and sediment build up.

Another issue, less common but still a factor, is in colder climates where low tank turnover can lead to water freezing within the tank. Water in motion due to tank turnover is far less likely to freeze. Freezing can cause the altitude water control valve to lose the capabilities to sense a full tank and therefore can cause the storage tank to overflow. Freezing can also causes structural concerns internally as well as externally with concern to the ice pressure expansion on rivets, bolted or welded seams. Additionally, freezing can also lead to pipe breaks and cause leaks where corrosion has previously been formed when the additional pressure on the system is produced.

In an ideal case the altitude water control valve would control the tank water level to the set maximum of a hydraulic control pilot. Following this, the altitude water control valve closes and then the distribution line is opened. This allows the tank to drain down to a satisfactory level where enough water turn over has been accomplished before the altitude water control valve opens again to fill the tank to the set maximum.

In a two way altitude water control valve situation the same is true, except the distribution is through the same valve as the filling cycle. In this case, the altitude water control valve would still close when the maximum of hydraulic control pilot is met, but then re-open when the differential pressure in the line is reversed, allowing the water to distribute in the opposite direction.

Ideal operation is not always easily achievable as system characteristics can change continuously and affect the system. As system demand changes so does the pressures in the system. It's not uncommon for the incoming pressure to an altitude water control valve to drop off, or for the demand on the distribution system pressure/flow demands to change.

Altitude water control valves operate off differential pressure of the inlet of the valve to the tank level head pressure. Consideration needs to be taken to ensure that the inlet pressure of the altitude water control valve is always greater than the tank level head pressure. If the system fails to have a greater inlet pressure the system essentially equalizes the inlet pressure of the altitude water control valve and tank level head pressure. With zero differential pressure the altitude water control valve will essentially sit floating open trying to fill the tank but never reaching the maximum level setpoint. With zero differential pressure, the system is essentially sitting at a static flow and pressure and therefore no water will flow in or out of the tank which means there would be no tank turn over.

To fix this situation, the set maximum of the hydraulic control pilot needs to be adjusted and set to the correct tank level or the system inlet pressure needs to be increased above the desired tank level maximum setpoint. Adjusting the hydraulic control pilot entails a site visit to adjust the set screw of the altitude water control valve, which can be quite cumbersome in remote sites when many changes are needed to facilitate for system changes. Increasing system inlet pressure entails either ramping up pumps in the system or adjusting the feeder zone pressures higher. Both situations add time and cost, but can also increase water loss and add strain on the system due to extra pressure, which could result in additional pipe breakages.

Figure 2: Water Storage Tank, New Orleans LA USA (PICK 1 OF 2)

Figure 3: Water Storage Tank, New Orleans LA USA (PICK 1 OF 2)

Automation and instrumentation is a huge growing market in the water industry and for good reason, as many systems move towards full remote autonomy and control. Hydraulic altitude water control valves have controlled tank levels for many years, but now the same control can be done with control panels and instrumentation. By switching out the hydraulic control pilots, traditionally used to sense level, and instead using electronic tank level/pressure switches or sensors paired with a control panel, the level control process can be achieved electronically. The hydraulic water control valve still remains, however there is no longer the need for a complex hydraulic pilot system as mentioned above, just a simple single solenoid.

Once automation control is installed, one of two operational sequences can be used to achieve the level control process. The first sequence entails using one level/pressure switch located at the maximum level setpoint and a secondary at the tank drawdown setpoint. If the water level is located below the tank drawdown switch then the panel will open the control valve via the solenoid and allow the tank to fill until the maximum level switch is contacted; the panel will then close the control valve using the solenoid. The control valve will remain closed until the tank level is drawn again below the drawdown switch. Although this is an effective technique and provides more flexibility than the basic hydraulic altitude water control valve, the maximum level and drawdown switches are still sitting at a constant level. They would need to be adjusted accordingly on site to allow for variations of the setpoint which as mentioned above is sometimes needed to adjust to system changing pressures.

A more versatile option, which is the second operation sequence, is to use a level/pressure transmitter. These are available in all shapes and forms to fit specific tanks. These level/pressure transmitters offer a 4-20mA feedback signal to the control panel that gives the panel the exact tank level. Having a live feedback signal allows the panel to offer up a lot more options in the way the tank level setpoints are set. The level control panel can then offer a variable setpoint for both the maximum level and drawdown that can easily be changed via a user interface on the panel. This eliminates the need for site visit to change any setpoints and allows the systems setpoints to be changed as needed to ensure optimum operations.

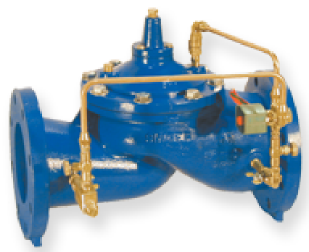

Figure 4: Singer Solenoid Operated Control Valve

Figure 5: Singer Level Control Panel

The Level Control Panel with Touch Panel (LCP-TP) interface designed by Singer Valve was created to accomplish optimum level control feasibility and flexibility. This Level Controller is designed to complement a single solenoid operated/override control valve and 4-20mA level sensor or high/low level switches. This combination package is ideal for filling any kind of tank with water that requires filling to a level setpoint and then drawing down the level of the tank to a secondary setpoint before activating the fill cycle again thus ensuring tank turnover.

The LCP-TP is quick and easy to configure to read and compare the level 4-20 mA signal to the desired setpoint. The setpoints can be set locally via an interactive button display screen or remotely via either SCADA Modbus or hardwired 4-20 mA remote set-point signals. If a High/Low level switch system is preferred, the LCP-TP can switch configuration to allow for level switch inputs and regulate the control valve accordingly. Data logging is also a useful feature to log sensor feedback and setpoint data with a time stamp, allowing for system analysis.

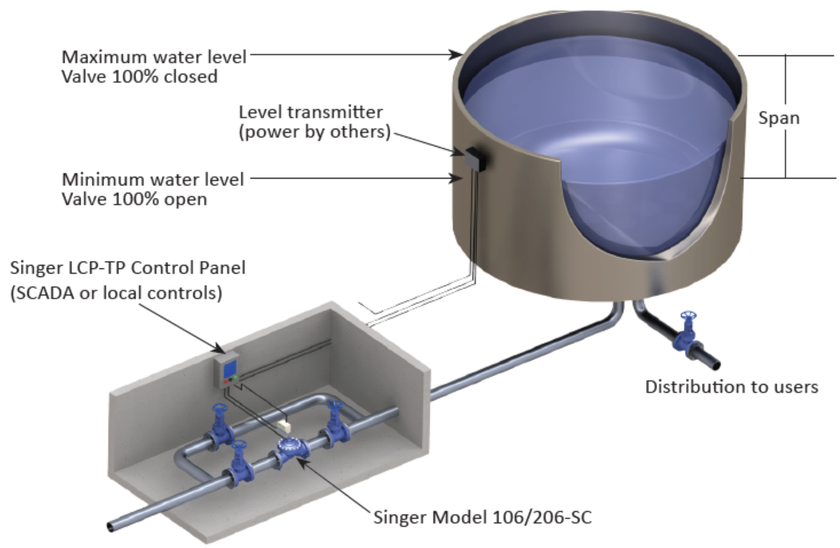

Figure 6: Tank Application Example

The biggest value of this automated level controller is flexibly and readability of control. For the user who wants to setup a full communication network that has access to all storage tanks and controls them remotely, it's easy to do with Modbus and remote 4-20mA communication options. For the user that has a remote site, but wants to be able to data log and analyse the tank turn over, the LCP-TP offers the data logging feature. Either option offers lots of feedback and traceability of the system operation. Based on this information, the tank level setpoints can be adjusted to match the needs/demands of the system with simple interaction to ensure the system can function at its optimum. This ability to take all the information and then easily adjust the tank setpoints is a huge benefit.

Although the LCP-TP itself does not eliminate tank turn over issues, as the system still needs to be operated correctly, having access to all the feedback information should allow insight into setting the system to run correctly. For example, the live level feedback lets the system know when it's sitting static, which allows the user to easily rectify the issue and regain control of the system, thus not allowing the water to sit static in any tanks.

A remaining feature that fits into the readability of the system is alarm/notification output. Instantly knowing if something goes wrong with the system allows procedures to be set in motion right away to rectify the problem. Not having access to these alarms could mean the system is assumed to be operating correctly till closer inspection or, worse yet, something is drastically going wrong such as tank over flows, pipe breaks, system being over pressurized and the common theme of stagnant water contamination.

Electronic automation of level control means that gone are the days of relying on remotely located hydraulic pilots with no way of telling what the system is doing. The level control process now sits at your fingertips delivering accurate and safer water storage.

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Ryan Spooner is an Engineer and head of Automation and Instrumentation for Singer Valve. Ryan has a degree in Mechatronics Engineering from SFU and a deep understanding of electronics with a solid background in valve mechanics. He designs and builds customized control panels and does commissioning and valve integration. Ryan also runs operator training session's onsite as well as lab demos at the manufacturing plant.

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