Sewage Lift Stations:
Reducing Maintenance Costs with Level Transmitters

by Rob Knowles

The level transmitter is a small but vital component in a sewage lift or pump station that helps maintain system integrity and avoid unwanted spillage.

There are more than two million sewage lift or pump stations in the U.S. All work on the same principle and with the same objective of moving sewage from one level to a higher elevation.

Their installation costs generally range from $150,000 (20-gpm) to $1.5 million (100,000-gpm), based on capacity and complexity. While pump technology has come a long way in recent years, the level sensor has also developed significantly in the past few years and is essential to the pump control and reliability of the station.

A typical schematic for a sewage lift station featuring the level sensor (pressure transmitter) and its associated hardware is shown in Figure 1.

The purpose of the level sensor is to provide an electrical feedback to the pump to switch on and off. Floats have traditionally been used, which simply provide an on and off signal to the pump at the high and low levels. Bubbler systems have also been utilized, although they create increased maintenance challenges with the requirement of a continuous gas flow.

Today there are many sensor technologies for measuring liquid level, such as radar, ultrasonic and conductive instruments. However, these are either too high in price for a relatively simple lift station or unreliable due to the operating environment.

In recent years, submerged hydrostatic pressure transmitters have been developed to withstand the environmental conditions and provide continuous monitoring for enhancement of the control with increased long term reliability.

A number of manufacturers have developed dedicated sensors for this application. There are many features which have been specifically designed into this level/pressure transmitter to overcome the challenges faced in sewage lift stations.

As many lift stations are located in very inaccessible

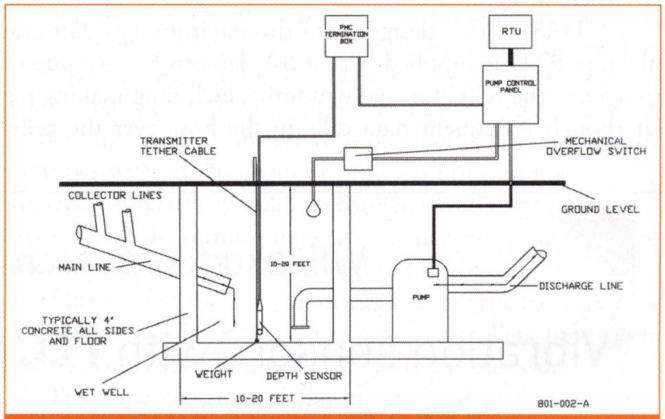

Figure 1. Schematic of a typical lift station featuring the depth/level sensor and control system

places, the overwhelming requirement is for reliability. This requires a clean design with high integrity seals. Due to the nature of the effluent, the sensing element must be exposed to avoid clogging. This problem is also becoming more important due to the increase in FOG (fats, oil and grease) associated with fast food restaurants.

The use of ceramic capacitive sensing technology provides a rugged open face sensor while having the ability to achieve high accuracy, better than 0.1 percent, down to sewage levels of just a few inches of water. The technology also provides a very high overpressure of at least 3X the rated range without any degradation of the sensor performance.

This protects the transmitter against damage due to overflow or back pressures. The laser-welded 1-in diameter housing is generally made from 316L stainless steel, although titanium is often preferred where the effluent is more corrosive.

Another design feature is the electrical connection. Avoiding O-rings is important because they will generally flow over time when sealed against polymer-based materials

Figure 2. A sink weight (bird cage style) incorporating a submersible level transmitter.

like those used in the connecting cable. The most reliable solution is to incorporate a custom molded cable utilizing thick-walled polyurethane, which becomes integral to the transmitter and can be supplied to any length up to 5000-ft.

This cable not only incorporates the electrical connection, but also houses a nylon breather tube and Kevlar strain relief. The Kevlar will support over 200-lbs breaking force and will not stretch until 97 percent of its breaking load is applied – a very valuable feature if the transmitter must be removed and is buried in the sludge at the bottom of the tank.

Various electrical outputs are required, including the most popular 4-20 mA 2-wire loop power. Other outputs include 1-V to 5-V, or even digital like Hart®. In some cases, users wish to adjust the level transmitter. This can be achieved via digital communication featuring a full-scale range turndown to 10 percent of the originally specified range.

These transmitters can be provided with a full scale preset range to suit any sewage lift station. In lift stations where hazardous gases exist, transmitters can be certified FM intrinsically safe for use in Class I, II & III, Div. I, Groups A, B, C, D, E, F & G.

The cable termination is also important, not only to provide connection to the control system and pump, but also to provide an outlet for the breather tube to the atmospheric pressure. This is vital to ensure the correct operation of the transmitter, which would otherwise be affected by barometric pressure changes.

However, this reference breather tube must be protected from ingress of moisture. Many techniques address this, such as using desiccant within the termination enclosure to enhance the long-term reliability of the transmitter. One manufacturer has developed a sealed Mylar enclosure which requires zero maintenance and does not rely on the use of desiccants or consumables.

Because the transmitter is relatively light in weight, it is preferred to position the transmitter a few inches from the tank bottom and is fairly common to use sink weights. An example of this is shown in Figure 2.

This type of sink weight is sometimes called a "bird cage," and, in the case of one transmitter, can be removed from the transmitter if necessary. In other cases, the "bird cage" is integral to the transmitter.

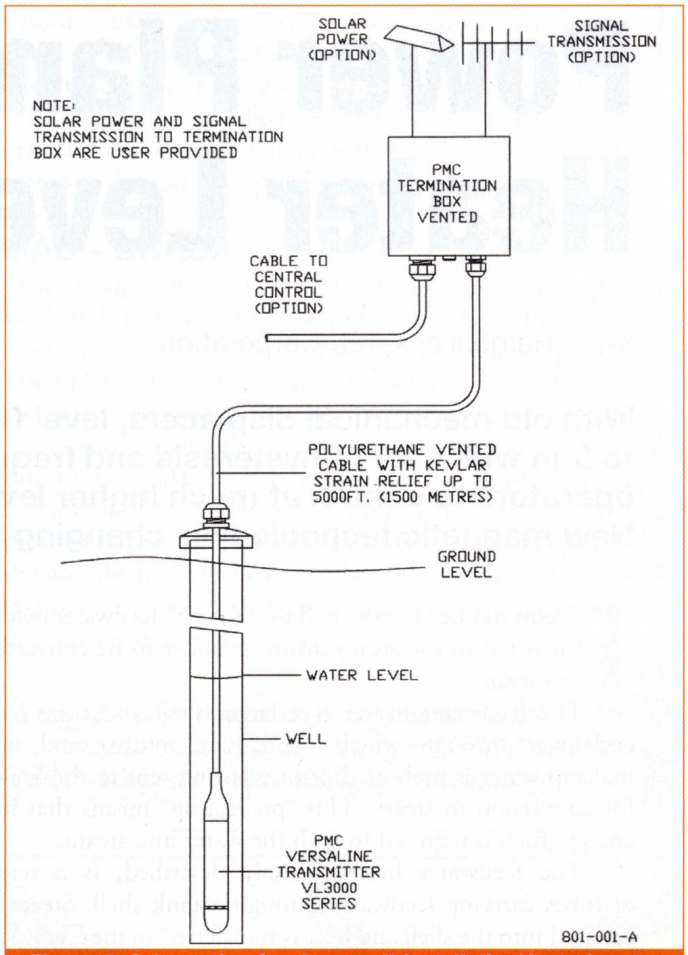

Figure 3. Schematic of a deep well installation featuring the depth/level transmitter and termination.

As a spin-off to the custom designed submersible transmitters for sewage level described above, the same technology can be applied to deep wells for the monitoring of groundwater.

In this case, the transmitter is usually slightly smaller in diameter (¾-in) and more likely to be contained within a titanium housing to protect against the possibility of corrosion caused by brackish water. An example of a typical installation is in Figure 3.

One additional feature of these transmitters is a protective nose cone that not only avoids damage while lowering the transmitter into the well – up to 5000-ft – but also protects the sensor from harm due to water hammer, a phenomenon often created in close proximity to a down hole pump.

The high integrity well-developed submersible pressure transmitters of today provide very reliable, zero maintenance, level monitoring and pump control for sewage lift stations and deep well monitoring.

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