ENGINEERING REPORT

In 1999 many states began enacting legislation to reduce mercury in products. The various legislations are designed to dramatically reduce the possibility of mercury release into the environment. Mercury is a toxic substance that the human body cannot breakdown. The FDA has warned consumers to limit or not eat certain types of fish because of mercury contamination. There are member states in the Interstate Mercury Education and Reduction Clearinghouse (IMERC) that have enacted legislation to ban mercury and mercury added products. As of June 2008 there were 14 member states – California, Connecticut, Illinois, Louisiana, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Rhode Island, Vermont, and Washington. More states will be joining and legislation will become more stringent.

There are many millions of mercury float switches in use in the world today. The mercury float switch has been the standard for decades. Until now the only replacement for mercury float switches were mechanical float switches. Mechanical floats have a very short life, much shorter than mercury floats due to the heavy mechanical and delicate electrical components used inside of the float housing. The life-limiting factor in mercury floats is the metallic electrical cable, many breaking due to fatigue after less than 90,000 operations. The life-limiting factor of mechanical floats are the individual internal components as well as the electrical cable.

Many users are replacing their mercury float switches as they break (or as may be legislated) with mechanical float switches, which are much less reliable. This causes a much higher maintenance cost, especially to an owner that has many pump stations in their system.

The best solution to this problem is the newly developed float switch that uses fiber optics instead of electricity. It is mercury and lead free and has been tested to over 1,000,000 operations. This could be 10 or more times that of existing float switches it is designed to replace. It is built for durability and has been high impact load tested without failure.

This float uses advanced, very flexible, plastic fiber optic cable to transmit a beam of light from a light source in a remote transceiver to the float where the beam makes and breaks depending on the tilt of the float. The transceiver then detects the presence or absence of light and operates a relay in the transceiver, which in turn can then operate other devices. Since the float does not have any electrical parts or wires, there is no chance of an explosion in a wet well. For the first time floats can be used without the admission of electricity into an explosive area.

The float switch is the least expensive method of level detection in wastewater pump stations and systems. There are other commonly used types of electronic level detection systems such as bubblers, which use compressors and an air tube, submersible transducers, which have the pressure sensor located near the bottom of the wet well, ultra sonic systems, which use an ultrasonic sensor located near the top of the pump station to detect the water/air interface. In all of these other technologies, nearly all system designs have back-up float switches for use in the event of failure of these various types of equipment.

All wastewater systems should be designed in accordance with NFPA® 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities and referred to in NFPA® 70 – National Electrical Code (NEC). The purpose of this standard is to safeguard against fire and explosion hazards of wastewater treatment and associated collection systems and in pump stations. This document includes the hazard classifications of specific areas and processes. The hazards are produced typically by decomposition of organic compounds that produce, for example, methane gas and also from spills or illegal dumping of flammable substances that make their way into the wastewater system. This NFPA® document is an invaluable tool to the owner and engineer that use and design wastewater systems. The most common location of float switches in a wastewater system is in the wastewater pumping stations, which, according to NFPA 820, nearly all are considered Class 1, Division 1. This class and division is the highest category of a hazardous, explosive area. It requires the use of special interface equipment where electrical float switches connect to the control panel. The interface equipment is called barriers or intrinsically safe relays. These special devices limit the amount of voltage and current that can be produced when an electrical float switch fails, so that an explosion is less likely. When these intrinsically safe relays fail or if they are bypassed, then the system becomes unsafe.

The fiber optic float is an inherently safe device in that it has no electrical current passing through the cable. It cannot under any conditions produce arcs or sparks and cannot cause an explosion. Since it is non-electrical, it is also safe to handle and easier to install than conventional float switches.

The Opti-Float® level switch by Cox Research is very conservatively rated. It has been tested to 1,300,000 operations directly connected to a size 2 motor starter without failing. The relays in the UL Listed controller have10 amp contacts but, the controller is conservatively rated at 3 amps. The maximum cable length successfully tested has been over 60 meters (200 feet) but it is conservatively rated at 30 meters (100 feet). Other aspects of the float is that the cable is made with plastic fibers which have a very small bending radius of less than 1/2”. The cable is very flexible and although not recommended, can be tied in knots without breaking. It can be installed in conventional conduit systems even with powered wires. No separation between electrical cables and optical cables are required. No special tools or experience are required for installation. The cable can be cut with a razor or other sharp instrument and connects to the transceiver with thumb screws. Retro-fit kits are available for easy replacement of conventional floats.

SUMMARY:

1. Mercury floats are being legislated out of existence.
2. At least one state is requiring the removal of all existing in-service mercury floats from wastewater and water systems.
3. Mechanical floats are very unreliable and have a short life.
4. Both mercury and mechanical float switches require intrinsically safe relays inside of the control panel for them to be used in hazardous areas such as wastewater pump stations.
5. The cost of optical float systems are about the same as that of electrical float systems properly designed for use in the hazardous atmospheres of wastewater pump stations.
6. Opti-Float® level switches are “Green” with all recyclable components and are RoHS compliant.

7. Opti-Float® level switches have been tested, without failure, to over 1,000,000 operations, which is as much as 10 times that of many electrical float switches.
8. Retro-kits are available for easy conversion of electrical float systems to optical systems.

NFPA® 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities is available from NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471.
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RoHS represents the European Union "Restriction of Hazardous Substance Directive" which took effect July 1, 2006.
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