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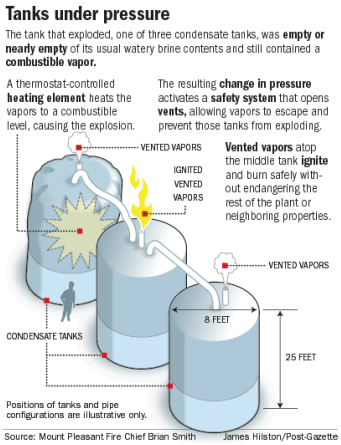
Electric Tank Heater Explosions: Risks to be Aware of

Safety Note

There have been several recent incidents that illustrate possible dangers related to electrical tank heaters. One at an oil and gas processing facility and another at a manufacturing facility.

The manufacturing plant incident was on a hydraulic oil storage tank similar to thousands in use all over the world. Because of the commonality of these systems and the prolific use of electric tank immersion heaters, this story is important to highlight.



The other explosion occurred at an oil and gas processing facility outside Pittsburgh. There, a fire broke out at a complex of three storage tanks, each about 25 feet tall and 8 feet wide. The natural gas is pressurized within the tanks and moved along a pipeline to a processing plant, leaving behind a briny fluid made up of liquid hydrocarbon waste called condensate. The tank's electric heaters are designed to keep the liquid mixture from freezing.

The local fire chief explained that the tank was empty or nearly empty, but still contained gas vapors. When the liquid mixture is low, the heating element is designed to shut off. But in this case, the electric heater continued to operate, warming the vapors to combustible levels and setting off the explosion.

(For more information, see the story in the Pittsburgh Post-Gazette: http://www.post-gazette.com/pg/11061/1128965-503.stm)

We suggest you immediately review any electric tank heater installations for design and installation issues that can lead to explosions and take prompt action.

What to Look For

How would someone know that they might have a problem? Let's review electric tank heater design and installation issues that could lead to fires or explosions if left unchecked.

Electric Bayonet Immersion Heaters

The electric heater designs to be concerned about typically extend into a tank through the sidewall. They might be 12" to 36" long or longer. They are typically in the form of a bundle of elements – such as a coil, wire or other shape – which resist the electric current, causing it to give off heat. It's the same concept used in an electric stove or toaster.

Watt Density and Protection

The watt density is the number of watts per square inch of heating surface or element that the designer planned for the unit selected. If you squeeze a lot of watts through a small heater, the heater elements can get very hot. The free air temperature of these elements can be over 1,000°F. Remember, the flash point of many hydraulic oils is only 400 to 600°F.

It is not just oil tanks that are an area of concern. Any tank that accumulates flammable elements must be considered. For instance, a wastewater tank that drains machining fluids may primarily contain water. But a small amount of oil mixed in can still cause a problem. The oil can be thermally cracked or broken down under certain conditions, filling the vapor space of the tank with hydrocarbon fumes. When the level changes in the tank and air is brought in, a flammable mixture can be created. Consider also the case of a wastewater tank that is part of a sewage system or even a food process. Whenever biological activity consumes organic materials, methane can be released. If the elements become exposed and there are no protections in place, you can create an ignition source directly in the tank.

The Fire Triangle

The fire triangle concept is when fuel, oxygen and an ignition source are brought together, creating the elements needed for a fire. When a flammable mixture is confined and ignited, you have everything you need for an explosion. The flammable materials try to expand to many times their volume in fractions of a second. When they cannot escape, whatever vent is provided in a timely manner the vessel or tank is pressurized and usually comes apart at a weak point. In cylindrical tanks, this weakest point is often at the top of the container. If an explosion does occur, the flying metal and resulting fireball can be deadly and destructive.

Strategies for Safety

You must verify that you have minimized risks related to electric tank heaters wherever they are installed. Methods to minimize risks include the following:

1. **Verify watt densities and maximum temperatures**
   There are many options available when buying electric heaters. You can purchase heaters that have features to minimize the maximum temperature, or you can specify lower watt densities.

2. **High temperature limit controllers**
   There are operating temperature controllers and high temperature limit controllers. Operating controllers are similar to thermostats in your home. They seek to provide the right temperature on a routine basis. High temperature limit controllers are a special separately installed control that has a manual reset feature once exceeded. In this case, the device shuts the unit off until a person manually hits a button or takes some action before the unit will run again. This feature forces someone to investigate and hopefully understand that am unusual event occurred and that an unsafe condition was reached. If a high temperature limit is installed, the setting has to be well below whatever flash point could be reached.

3. **Level controller/low level shut offs**
   There are level controls available that help ensure minimum levels are maintained in tanks for the heaters to operate. Level controls, however, are sometimes difficult to maintain. There are many things that can fool them. In the case of boilers there are usually two level controllers: one as a primary and one as a back-up. It would never be a good idea to just rely on level controls for the safety of your system, but it would provide an extra layer of protection over and above a high temperature limit device.

ABOUT US

Honeywell Combustion Safety is a part of Honeywell Thermal Solutions, an industry leader in commercial and industrial combustion solutions. Honeywell Combustion Safety, formerly known as CEC Combustion Safety, has been in business since 1984. With engineers and staff members that sit on Code committees such as NFPA 56, NFPA 85, NFPA 86, and NFPA 87, our inside expertise is integrated within all of our practices, and our global reach ensures that customers around the world are kept safe. Honeywell offers testing and inspections, engineering & upgrades/retrofits, gas hazards management, training, and field services for all industrial facilities and different types of fuel fired equipment. By assisting organizations and their personnel with the safe maintenance and operation of their combustion equipment, Honeywell aims to save lives and prevent explosions while increasing efficiency and reliability of combustion equipment.

4. **Tank design and maintenance**

   Tank system design also needs to be considered. There are several national safety code standards for fuel oil tanks that call out venting requirements. In some cases, relief valves might also be required. In most cases the vents for oil systems are larger than one might otherwise consider. Remember that when replacing elements, care must be taken to consider watt densities and safety controls. There also needs to be consideration for how safety devices might be wired. In all cases, safety devices should be re-checked whenever elements are replaced. The National Fire Protection Association's (NFPA) are a good starting point for investigating tank issues. NFPA 22 in particular has information about tank heating systems that might be helpful.

5. **Preventive maintenance/safety device testing**

   There was a tank explosion in an offshore facility in 2009 that occurred because of the corrosion of a protective sheath on an electric heater (http://www.hse.gov.uk/offshore/notices/sn_01_09.htm). This incident illustrates the need to conduct periodic inspections of "at risk" electric heating elements and for testing of level controls and high temperature limits.

   There are no published guidelines that we are aware of regarding the testing and inspection of these devices. However, most combustion equipment codes and standards call for at least annual testing of safety interlock devices. The implementation of a testing and inspection program for electrical heaters in tanks needs to be risk based for the application and should consider what is installed, the watt density, the materials in the tank, and other factors such as operating levels versus tank volume.

How We Can Help

We can review immersion heater installations and help to provide a testing protocol. We can also assist in the design process for new installations.

For more information

Learn more about Honeywell Combustion Safety, contact info@combustionsafety.com, visit www.combustionsafety.com or contact your Honeywell Sales Engineer.

Honeywell Process Solutions

Honeywell Combustion Safety
2100 Apollo Drive
Brook Park, OH 4 4142 USA
Tel: +1 216-749-2992

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