TECH TALK
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ALLIANZ GLOBAL CORPORATE & SPECIALTY®

HEATED PLASTIC TANKS

ALLIANZ RISK CONSULTING

Heated Plastic Tanks

INTRODUCTION

Heated plastic or plastic-lined tanks are often used due to the corrosive nature of solutions used in many different industrial processes, such as cleaning, plating, and etching of circuit boards and components in the electronics industry or in metal finishing and electroplating operations. Plastics most commonly used, such as polypropylene, polyethylene, polyvinyl chloride (PVC) and fiberglass reinforced plastic, have excellent corrosion resistant properties, however, they are highly combustible and tank heaters can present an ignition source. Without proper protection and maintenance, heated plastic tank operations can become a significant fire hazard. Fires involving the tank often spread to associated plastic piping and ductwork used for fume removal and surrounding areas.

The property insurance industry has experienced large losses caused by heated plastic tanks for many years, including the following two recent losses at Allianz Global Corporate & Specialty:

Electronics manufacturer: In May 2011, a printed circuit board washer caught fire in a production area causing $17.6 million in damages. The exact cause of the fire could not be confirmed; however, the washer had three polypropylene water tanks using electric immersion heaters.

Automotive parts manufacturer: In August 2008, a fire on a plating line using a heated plastic tank resulted in a $30 million loss. The suspected cause was failure of the electric immersion heater low liquid level interlock when the tank was empty.

Another global property insurance company reports that during the period from 1985 to 1999, they experienced 52 losses involving plastic and plastic-lined tanks in occupancies involving metal plating, circuit board manufacturing/assembly and semiconductor manufacturing. Electric immersion heaters, which are typically submerged in the processing solution, were responsible for 61% of the losses. Most fires occurred when heaters were either left on during idle periods or were activated by a timer several hours before the beginning of operations. Malfunctioning low-liquid level interlocks and/or high temperature limit switches was a major factor in most losses. Also, interlocks were often poorly maintained and did not function properly.

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TYPES OF HEATERS

There are two main types of heaters typically used to heat fluids in plastic and plastic-lined tanks:

ELECTRICAL RESISTIVE ELEMENT HEATERS

Electric Immersion Heaters: Heating element is submerged in processing solution and protected from corrosion by outer sheathing. The liquid is heated by conduction.

External Heaters: Bonded to the outside of tank and heats liquid by conduction.

Infrared Heaters: Heating element is typically separated from liquid by quartz glass. The liquid is heated by absorption of radiant energy.

Electric Immersion Heater

HEAT EXCHANGERS

Commonly use a separate heating device located remote from the heated tank. The heat source may use a heat transfer fluid that is circulated through tubing (i.e. water, steam, oil, etc.).

FIRE HAZARD

Automatic controllers often fail to shut off the heater due to electric malfunction, corroded or fouled connections, or frayed bare wires on low level interlocks. Automatic controllers are usually installed too close to the heater causing the wires and connections to weld together and short circuit the low level float switch or fusible elements on the heaters. A poorly designed immersion heater installation, such as the heater installed too close to the wall of tank, sludge zone or hi/low controls, can also lead to fire.

The typical fire scenario is when the automatic controller on a heater fails causing the liquid temperature to ncrease. This can increase the evaporation rate causing the liquid level to drop below the heater element.

The electric immersion heater temperature can exceed 750°C (1400°F) when the heater is exposed to air and ignites the wall of the plastic tank or lining. The resulting fire from the burning tank is drawn into the fume exhaust ductwork causing it to travel throughout the area.

Other fire scenarios include leaking tanks or failure to maintain proper liquid level.

Burning plastics create significant quantities of dense, oily smoke that can easily spread to adjacent areas and can be very corrosive to metal surfaces as burning PVC creates hydrochloric acid.

Fire Damage to Plastic Tank

ARC RECOMMENDATIONS

While not all inclusive, the following basic loss prevention guidelines can greatly reduce the potential for property damage and resulting business interruption caused by heated plastic tank fires:

1. If possible, use tanks constructed of noncombustible materials (i.e. stainless steel, quartz, etc.). If plastic materials are required, use plastics that are FM Global Research Listed (Class 4910 Standard) or equivalent.
2. Use the following type of heaters, listed in order of preference:
   a. External heat exchangers using hot water or steam
   b. Low watt density electric immersion heaters (1.3-1.6W/cm^2 (8-10 W/in^2))
   c. Ordinary (high watt density) electric immersion heaters
3. Interlock electric immersion heaters to automatically activate a local alarm and de-energize upon:
   a. Low liquid level when any portion of heater element is exposed
   b. High liquid temperature at 15°C (25°F) above normal operating temperature.

   Note: do not rely on heater thermostats

4. Shut off heaters during idle or unoccupied periods. Do not use timers to turn heaters on/off during unoccupied periods.
5. Inspect, test and maintain heater controls & interlocks at least quarterly in accordance with the manufacturer's recommendations (more often if design and service conditions warrant). An ideal time is when refilling or draining the tank.
6. Establish a detailed maintenance and testing record keeping system. Conduct annual infrared inspections of all heater control boxes and electrical supply wires back to the main control panel to check for hot spots or loose connections. Any deficiencies should be corrected immediately.
7. Discourage operators from operating heaters when any of the safety equipment is out of order.
8. Provide automatic sprinkler protection designed to the latest edition of NFPA 13, *Standard for the Installation of Sprinkler Systems*, using corrosion resistant sprinklers over tank areas and inside plastic ducts greater than or equal to 515 cm^2 (80 in^2) cross sectional area or 250 mm (10 in.) diameter. If contamination of tank contents is a concern, provide automatic carbon dioxide or clean agent fire protection.
9. Provide proper training to all operators on hazard and function of heaters with refresher training at least annually.
10. Perform a hazard process evaluation for each new heated plastic or plastic-lined tank or any modifications to any existing tanks.

REFERENCES

FM Global Property Loss Prevention Data Sheet 7-6, *Plastic and Plastic-Lined Tanks*

Global Asset Protection Services Guideline GAP.9.5.1, *Heating in Plastic and Plastic Lined Tanks*

NFPA 318, *Standard for the Protection of Semiconductor Fabrication Facilities*

QUESTIONS OR COMMENTS?

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Tech Talk is a technical document developed by ARC to assist our clients in property loss prevention. ARC has an extensive global network of more than 100 property risk engineers that offers tailor made, customer focused risk engineering solutions.

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