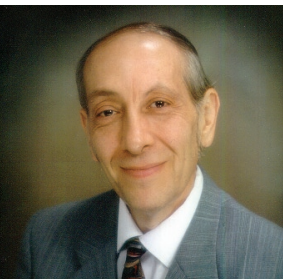




Identifying Sources of Oil Quench Fires

Oil quenching presents some of the greatest safety hazards in heat treating, and often results in personal injury, equipment damage, business interruption, environmental clean-up, and possibly litigation expenses. The heat treater needs to know some of the most common sources of a potential explosion or fire. Let's learn more.



Presence of water

One of the most dangerous types of industrial fires can occur when the quench oil contains water. Even minute amounts of water (0.10%) are cause for concern. Quench oil should be continuously monitored and routinely checked for the presence of water, and contaminated tanks should be pumped and separation techniques used. Because water will accumulate in the bottom of the quench tank, the sampling method must take this into account.

Integral quench and pusher furnaces are especially vulnerable to this problem, but it is also seen in open quench tanks. The source of water contamination may come from a leaking water-to-oil heat exchanger, from a leaking jacket in the atmosphere cooling section if this is water cooled and any other area that is water cooled. Furnaces down for maintenance can easily be contaminated if the quench tank area is open.

Oil drag out

Most furnace loads are allowed to drain over the oil prior to being removed from the quench tank. However, insufficient drain time or part/workload geometry may be such that a significant quantity of oil remains on the parts. This is called drag out. When the load passes through the door flame curtain it could ignite, and the resultant fire is extremely dangerous to personnel trying to extinguish the fire and close the front door. In rare instances, insufficient quench time results in a load that is still above the self-ignition point, and upon removal of the furnace, a fire will result.

Load hang-up

One of the most dangerous types of furnace related fires occurs when a load being transferred to the quench "hangs up," or becomes stuck partially in and partially out of the oil. The oil at the interface between the hot load and the surface generates huge amounts of oil vapor, and in many furnaces these fumes are carried out with the furnace atmosphere and ignited by a pilot. This results in a large flame, or torch, condition that exists while the workload slowly cools. This type of phenomena can also occur when the quench elevator jams, or in other words,

when its travel is restricted due to a critical failure of plant air pressure, hydraulics, or when mechanical malfunction occurs. In some designs, low air pressure can cause the elevator to slowly lower into the quench oil resulting in an unsafe condition.

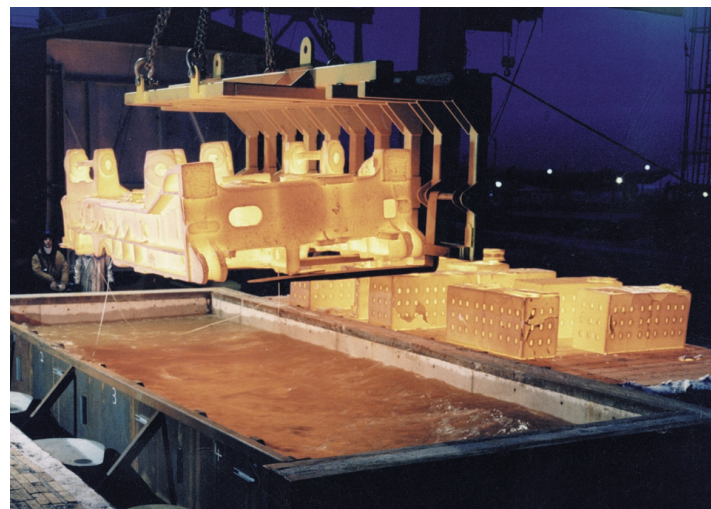
Even the presence of a nitrogen safety purge system does not guarantee that this situation can be controlled. In one instance, an integral quench furnace was responsible for burning down an entire plant when the initial fire spread to the adjacent plating department, igniting its fiberglass ventilation system. The operator was told to turn the furnace and nitrogen purge system off because the fire would burn itself out, an action that resulted in a catastrophe.

Exhaust stacks

Fires in exhaust stacks are all too common occurrences. This may be due to improper design of the stack itself, improper airflow and improper maintenance. Oil fumes carried out of the furnace accumulate in the exhaust stacks. Several ignition sources, such as the rapid evolution of furnace gases, can trigger a fire that is not easily controlled because of its ability to spread quickly in areas that are difficult to access with fire suppressant materials. Awareness of the potential for a fire and adequate maintenance steps are important in avoiding this situation.

Inner door open during quench

To speed up transfer time from the heating chamber to the quench, especially for thin parts that are prone to heat loss, some furnaces allow quenching to take place while the inner door between the heating chamber and the quench tank is still open (or is being closed simultaneously with the lowering of the





furnace elevator). Some of the most devastating plant fires have occurred in just such a manner. The evolution of gas during the transfer in combination with the oil volatilization on quenching can combine to shoot flames up and out of the furnace.

High surface area loads

In certain circumstances, it is impossible to avoid running a workload having high surface area. Fasteners and other small components that tend to “nest” very densely present the potential to volatilize a large amount of oil when quenched. These oil fumes can be carried out of the furnace and ignited. Even when precautions, such as positioning and manning fire extinguishers, have been taken, the unexpected can happen. In one particular industrial fire, flames shot over 30 feet in the air, igniting the supposedly fire retardant roof insulation and overwhelming the fire suppression equipment on hand.

Oil characteristics

Depending on the heat-treating requirements of the parts, quench oils are used over a wide range of process variables including temperature, agitation, viscosity, quench speed and contamination. All of these variables affect oil vaporization, oil drag out and oil-quench characteristics. In extreme cases where the variables are



not properly controlled or are allowed to change over time, what was a normal, safe quenching operation may turn into a potentially hazardous operation.

Inadvertent oil discharge

When “burning in,” or introducing furnace atmosphere, into the quench areas of an integral quench or pusher furnace, pockets of air may remain, and as they suddenly ignite, result in a pressure buildup on the surface of the oil. This presents the real danger of an oil “burp,” or discharge, out of the quench tank. Even overflow pipes that discharge to containment drums may suddenly be over capacity and spill oil out into the pit area. In rare cases, the pressure buildup is so severe that oil is dumped out the front door often igniting if a pilot has been lit or another source of ignition is present.

One particularly damaging plant fire was due to a relatively small floor fire spreading into a pit area that contained an estimated 3 to 4 inches of oil from repeated (and ignored) oil discharges from the quench tank. Extensive equipment and building damage resulted.

Irregular parts

When quenching irregularly shaped parts or loads, such as long tubes having hollow internal diameters, from pit furnaces into open quench tanks, oil “spouts” and flames can literally shoot up and out from the inside of the tubes forming an oil fountain in a spectacular, albeit dangerous, display. Factory ceilings have been known to catch fire due to the height and internal pressure developed. Extreme precautions are needed, paying particular attention to areas immediately adjacent to the quench tank.

Oily parts in washers

Successful cleaning involves the choice of the correct cleaning solution chemistry together with the correct use of time, temperature and energy. Equipment design, age and use, and ancillary devices such as oil skimming are important to ensure that a minimal amount of oil will remain on the



parts when they are transferred from the washer into the tempering furnace. In some cases, such as with powder metallurgy parts, due to their inherent porosity, they can retain up to 3% (by weight) oil despite the best washing practices available.

Oily parts in tempers

If the tempering furnace or oven is operating above the flash point of the oil, introduction of an oily load can cause an immediate and uncontrolled explosion. Even if the unit is operated below the flash point, oil can accumulate over time, and raising the operating temperature for another process or attempting to perform an elevated temperature “bake out” can result in a fire or explosion. This is one of the most common hidden dangers of oil quenching.

While these dangers exist in oil quenching practice, the potential hazardous conditions can be minimized through clear, concise safety training. **IH**

Additional related information may be found by searching these (and other) key words/terms via BNP Media LINX at www.industrialheating.com: oil quench(ing), quench oil, oil drag out, oil self ignition, oil volatilization, oil vaporization, oil flash point, water contamination, parts cleaning.