HYDRAULIC SAFETY
in Permanent Mold Casting Machines

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ARTICLE TAKEAWAYS:

1. Understanding analogies between pressure & voltage
2. The term "ground" has evolved and means any common point in a circuit to which all circuits return

According to OSHA, hydraulics and electricity are both methods of transmitting and storing energy. In many cases hydraulics is comparable to electricity in regards to operator risk level and operator safety procedures.

Analogies between hydraulics and electric:
The molecules of fluid in a hydraulic circuit behave much like the electrons in an electrical circuit. It is important that the foundry maintenance manager understand the analogies between pressure and voltage and between ground and the hydraulic reservoir.

When a valve shifts to power a hydraulic actuator, the actuator does not react instantaneously, but shortly after the valve is shifted. This is because the molecules within the actuator start moving with a time delay governed by the speed of sound and the physical dimensions of the circuit. On the other hand, an individual molecule of fluid inside the pump when the valve shifts may require seconds, before it actually passes through the actuator — well after the actuator started moving.

Similarly, it can take minutes, or even hours, before an individual electron inside a generator makes its way into a load, such as an electric motor. Yet, the electric motor reacts to the closing of a switch with a time delay that is governed by the speed of light. These concepts are useful because they lead to an understanding of why electronic and hydraulic devices do not always appear to react instantaneously.

Pressure is what drives the movement of fluid molecules from a region of high pressure to a region of lower pressure. The hydraulic pump raises the energy content of the fluid in the form of elevated pressure, and the higher pressure at the pump sends energized fluid into the load to do useful work (move ram or tilt machine). The fluid particles experience ever-diminishing pressure as they make their way around the circuit and ultimately back to the reservoir. Voltage is analogous to pressure, and it is what drives the electrons to migrate from regions of high voltage to regions of low voltage.

Ground is a term that can lead to confusion because of the way it is used, especially in electronic control systems. The term ground derives from the fact that mother Earth is used as a conductor by the electrical power industry. In the wiring of your house, for example, electrical codes require that part of your house wiring (the green wire) must be connected to mother Earth. That wire eventually leads to a stake driven into mother Earth or a physical connection to a water pipe that is buried underground. The term ground has evolved into one that means any common point in a circuit to which all circuits return, which may not necessarily be mother Earth.

The ground is similar to how the reservoir is connected in the hydraulic circuit. Ground and reservoir are analogous terms. We could define the reservoir as that point in the circuit to which

all fluid must return. However, designers of electronic circuits have more flexibility in defining ground than hydraulic systems designers have in defining where the reservoir is located.

Improper return to tank creates a potential for cavitation because no means has been provided to keep the lowest pressure above that which will result in cavitation. An electrical circuit cannot cavitate. Voltages can go as far negative as is necessary to satisfy the laws of electricity, and there is no such thing as absolute zero voltage. However, there is an absolute zero pressure: a perfect vacuum. Even though a perfect vacuum cannot be achieved, if the pressure in a hydraulic system falls a small amount below atmospheric pressure, dissolved gasses come out of solution (outgassing), which leads to cavitation damage. Unlike ground location, which might be anywhere in the circuit, only one reservoir location can be chosen, Such is not the case in placing the reservoir of a hydraulic circuit. The reason? Pressure anywhere in the system cannot be allowed to fall below atmospheric, otherwise cavitation may occur.

Other hydraulic to electric analogies include:

- Electric
- Hydraulic
- Amperage
- GPM
- Switch
- Valve
- Wire
- Hose
- Pump/Accumulator
- Power Source (generator, alternator, battery, solar cell, transducer)

Hydraulic safety and electrical safety procedures also have a strong analogy. Hydraulic systems are mandatory in gravity die casting because there is no more cost effective method to provide linear mold clamping pressure. Since molds are clamped together with stored hydraulic pressure, many types of injuries can occur. These include soft tissue injury or crushing, burns, fractures, dislocations, lacerations or shin punctures/fluid injection. Not only can injury or death occur but also environmental damage property/ equipment loss.

The most common problem associated with permanent mold casting machines in the high temperature foundry environment is pinhole leaks in hoses. If atomized oil comes in contact with an open flame or extreme heat source an uncontrollable fire will result. In order to bring the fire under control the fuel source must be stopped by turning the pump off. Once the fuel source has been terminated the fire can be brought under control with an ABC rated fire extinguisher. Water is not recommended because of the explosion risk of water coming in contact with liquid aluminum.

Pinhole leaks are difficult to locate. When an oily spot is noticed do not run your hand or finger along the hose. The oil can be injected directly under the skin. If hypodermic injection of oil does occur it may not be immediately recognized but hours later throbbing and severe pain will occur. If untreated, amputation may be required. In order to prevent hypodermic injection use a piece of wood or cardboard to locate leaks.

Another hydraulic hazard is improper coupling. Do not cross a pressure hose with a tank circuit as a high-pressure rupture can occur. CMH includes a pressure relief valve on each machine to avoid pressure spikes. Keep them clean and periodically test them for correct operation.

All permanent mold casting machines must be properly maintained for safe operation. Always refer to the CMH handbook for that serial number. Items to ensure include:

- Power off pump and lock out tag out
- Relieve all stored energy
- Block up any over hung loads (ram) prior to reaching inside mold
- Ensure fittings are tight and hoses are not damaged
- Maintain fluid cleanliness at the rating for proportional valves
- Change filters as indicated on gage
- Do not exceed recommended operating pressure

When properly maintained, a permanent mold casting machine and its hydraulic system is not dangerous. Tilt pour hoses are flexing hundreds of time per day and hoses have a shelf life. Maintenance is the key to safe operation and increased profitability.

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