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Today's society places a strong emphasis on continuous improvement. Paralleling this ideal, Process Technology has made efforts in electric immersion heating technologies to improve safety processes and avoid costly downtime.

Recognizing the necessity for product refinement, Process Technology developed an advanced immersion heating line called SmartOne® that offers inherent safety and improved functionality over typical resistance-wire heaters. The technology utilizes PTC chips as the heat source – this offers a self-limiting capability previously unavailable, and eliminates the possibility of overheating when used properly. This advantageous concept represents a major milestone in wet process heating.

Electric heaters made with resistance wire

Traditional immersion heaters use “resistance wire” as the source of heat. Resistance wire is commonly used in toasters, electric space heaters, electric water heaters, and electric ranges and ovens. When voltage is applied to the resistance wire, it heats up. Industrial heaters designed to heat water typically operate around 900°F (482°C) internally. The heat output is a function of the supply voltage and the heater resistance (Watts = Voltage²/Resistance). Since the heater's resistance measurement is constant, the heat output will be constant regardless of the surroundings/environment/application.

When an electric immersion heater using resistance wire is subjected to less than ideal operating conditions such as solids buildup or operation in air due to a liquid level drop, the

heat generated by the wire is not able to dissipate quickly enough. This results in a rapid increase in surface and internal temperatures. These elevated temperatures shorten the heater service life and can damage surrounding material such as a plastic tank or piping.

To protect surrounding materials from high-temperature damage, electric immersion heaters are required to include a built-in heater sheath overtemperature cutoff device (a “protector”). The protector is designed and located to detect the surface temperature of the heater and trip if the temperature exceeds a predetermined value. Protectors are most often wired into the temperature control circuit, but some may be wired directly in series with a low wattage heater operating below 240 volts. If a properly wired protector trips, the heater will shut off to prevent overheating and the possibility of starting a fire. The downside is that once the device trips, the heater remains shut down until the protector is replaced.

Electric heaters made with PTC chips

Electric heaters using PTC chips do not use resistance wire as a source of heat. Instead, they use

a number of ceramic PTC chips as the heating source. PTC is an acronym for **Positive Temperature Coefficient**, meaning that when the chip temperature increases, its electrical resistance value also increases resulting in decreased heat output. This resistance change is not linear.

PTC ceramic chips have been available for many years as low-wattage sources of electric heat. They are manufactured from a barium-titanate material plus a few key doping materials to provide the desired resistance/temperature characteristics. When electrical voltage is applied to a PTC chip, heat is NOT generated at a constant rate. Rather, as the PTC chips heat up they reach a designed temperature at which the heat output decreases drastically and prohibits the heater from getting hotter. Thus, PTC chips have a designed temperature limit (see graph below).

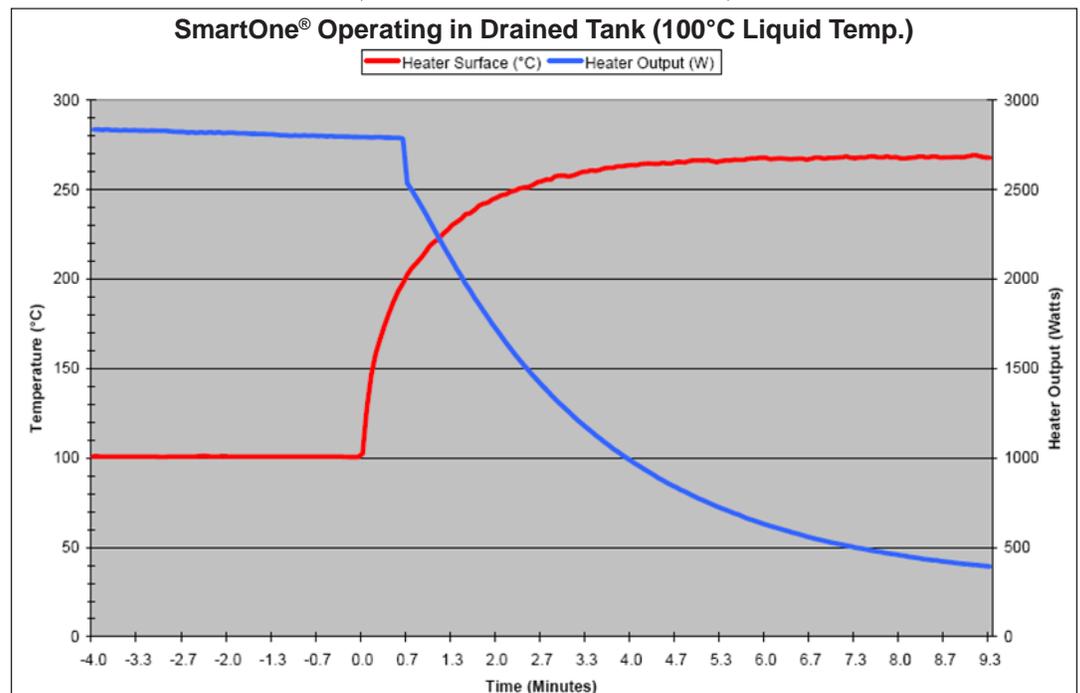
Because the resistance change versus temperature is not linear, the reduction in heat output is not linear. If the hot zone is exposed to air or covered in buildup, the heat generated quickly drops by more than 80% of its normal rate while the internal temperature stays at its designed limit.

PTC chips inherently limit the temperature of the electric immersion heater and thus do not require overtemperature protection. Basically the overtemperature protection is built into the heater core, offering key advantages over traditional resistance heaters.

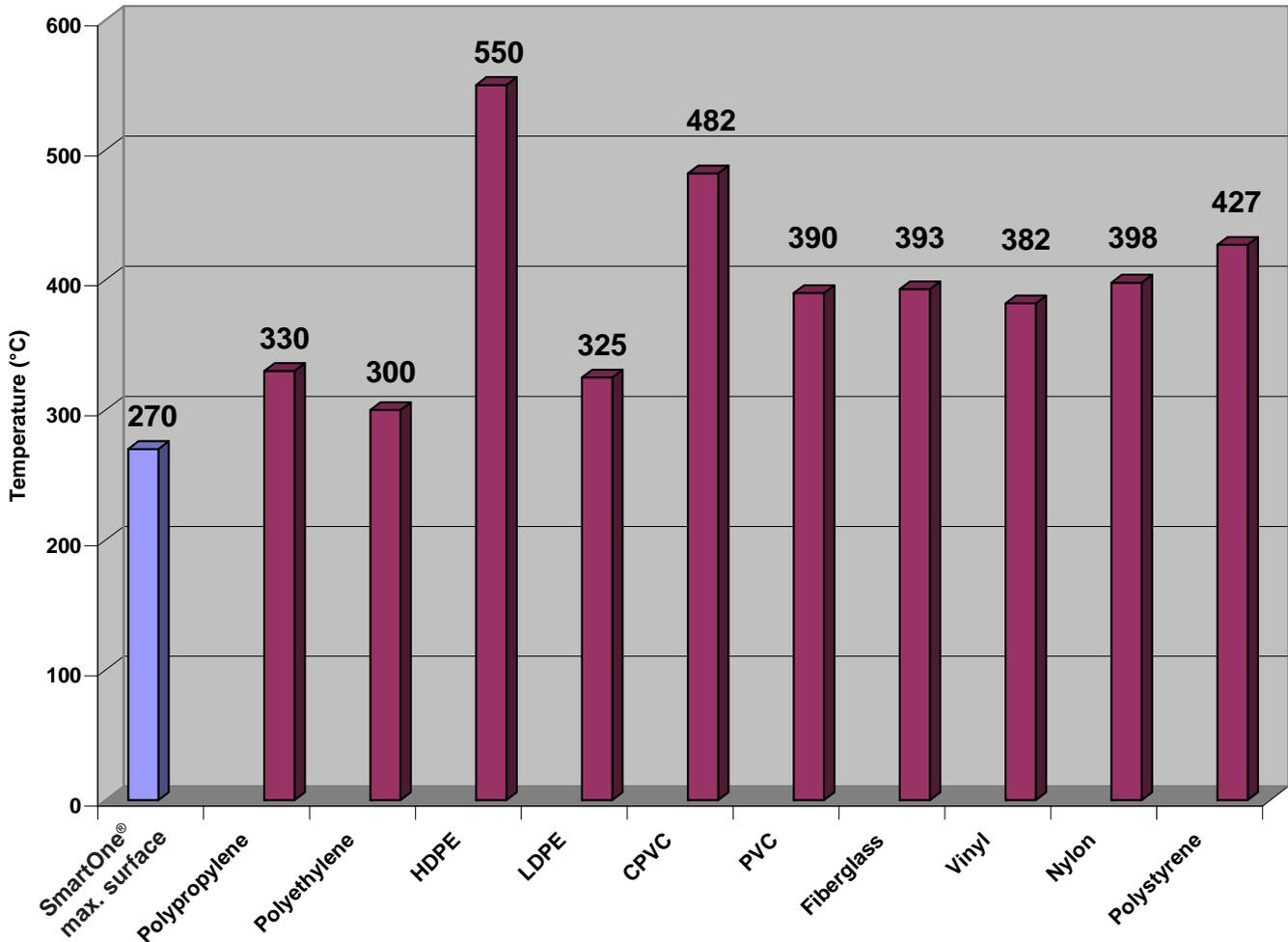
ADVANTAGES OF PTC HEATERS

Increased Safety

The designed temperature limit of PTC immersion heaters results in a maximum surface temperature of approximately 518°F (270°C). This surface temperature is independent of the surrounding environment, even if the heater is operated in air. This temperature is also far below the ignition temperatures of materials used in tank and liner construction. PTC heaters operating in air will not damage tanks made from polyethylene (PE), high-density polyethylene (HDPE), fiberglass, polypropylene (PP), CPVC or PVC when used correctly. The surface of a PTC heater is still hot enough to melt plastic tanks and tank liners if in direct contact with such material. Therefore, SmartOne® heaters are manufactured with minimum 1/2-inch bumpers to ensure the



SmartOne® Surface Temperature vs. Ignition Temperatures of Tank Materials and Plastics



surface doesn't touch surrounding tank materials or liners (see bar graph above).

Longer service life

As discussed, a resistance heater will overheat if operated in air or covered by a layer of scale buildup or sludge. The elevated internal temperature actually shortens the service life of the heater anywhere from a few months to several years. The service life of a PTC heater is not adversely affected by operation in air, scale or sludge buildup because the heat output is reduced in these conditions. PTC heaters only generate enough heat to maintain the designed limit temperature. To restore the heater to normal

operating conditions, simply clean the insulating material from the surface of the PTC heater or raise the liquid level. This will optimize the operating environment and increase the heat output accordingly.

No special equipment needed

PTC heaters are able to be wired into existing temperature control and power circuits based upon the wattage and voltage ratings. Thus, existing resistance heaters can be directly replaced by PTC heaters. (In some cases the overtemperature protector circuit will need to be modified because PTC heaters do not include a separate protector device.)

Reduced Downtime and Lower Cost of Operation (COO)

Due to the fact that PTC chips are self-limiting, there is no need for a separate protector since the function is built in. This eliminates possible down time caused by a tripped protector (which must be replaced when a single use protector is tripped). With the SmartOne®, it is not necessary to stock replacement protectors. When a replacement protector is not stocked on site or easily accessible, an unheated tank may result in longer soak times, slower production throughput on the line, or may even cause the process line to be shut down until the heater is

once again operational. All of these consequences can impact the cost of operation and profitability of the process line.

In order to improve the methodologies of wet process heating, new and "smarter" technologies must be developed to heat solutions with additional ease and safety. The concept of PTC heating has been proven with common items such as curling irons, heated car seats and hair dryers – the time has come to integrate this innovative technology into electric immersion heating. Process Technology is proud to introduce the SmartOne® heating line to meet the challenges of our industry.