TUTCO
HEATING SOLUTIONS GROUP
TUTCONNECT
TUTCO FARNAM | TUTCO SUREHEAT | TUTCO CONDUCTIVE | AUGUST 2024

Electrification and Decarbonization

What You Need vs. What You Use

A tale on converting to electric heat

At TUTCO, we partner with customers looking to enhance their processes by converting from one heating technology to another. Whether it's transitioning from convective to conductive heat or, as in the case I'm about to share, moving from direct-fired natural gas to open-coil electric heat, our approach always begins by understanding the specific needs of their process compared to what they currently use. To illustrate this, consider the analogy: you can tow a small 10-foot aluminum fishing boat with a ¾ ton pickup truck, but that's far more power than necessary. It's just what you're using, not what's required.

One of our clients, a manufacturer of detergent containers, is a great example of this. As their containers moved through the production line, they used an open flame from a direct-fired natural gas heater to dry the printed ink. Determining the flame's optimal position relative to the production line speed was done through trial and error. If the line slowed down and the flame was too close, the containers risked warping due to excessive heat. On the other hand, if the line sped up and the flame wasn't close enough, the ink wouldn't dry properly. Both situations resulted in wasted product.

From a safety perspective, the situation was even more dangerous. If the line stopped unexpectedly, the flame could potentially melt the plastic containers or even start a fire, depending on the heater's position and the duration of the stop.

TUTCO addressed these challenges by providing one of our process heating solutions coupled with a custom control panel solution. We integrated one of our control panels with the production line, allowing for seamless adjustments based on line speed and exhaust temperature. This system enabled the manufacturing engineers to determine and store optimal line speeds and temperatures within the controller, facilitating quick and precise adjustments by operators as needed. In the event that the line came to a complete stop, the process heater would automatically shut off while air continued to flow, ensuring safety and efficiency.

An additional benefit that became apparent once the new system was operational was a significant reduction in energy consumption. The old system generated excessive radiant heat, making the production area uncomfortably hot, particularly during warmer months. The HVAC system had to work overtime to compensate for this, driving up energy costs. The new system not only eliminated this problem but also reduced the overall power consumption of the HVAC system, creating a more comfortable work environment and lowering operating costs.

TUTCO's line of process air heaters are robust hot air components used in industrial and commercial processes. Each model can be paired with one of our control panels to provide the precise and controllable heat for a range of airflows and air pressures.

To learn more about our family of process heaters visit:

TUTCO FARNAM PROCESS HEATERS

TUTCO SUREHEAT PROCESS HEATERS

TUTCO CLOSED-LOOP CONTROLLERS

HEAT AND TEMPERATURE

What's the Difference?

by Ian Renwick

The words "heat" and "temperature" are sometimes used interchangeably, but they shouldn't be. They're quite different and should be thought of as such.

Let's start with temperature because we should all be familiar with it. If you're told that something has a temperature of 300°F, you know it's hot. You know not to touch it, whether it's the size of a marble or the size of a battleship. Don't touch something that hot! Temperature is always measured with a temperature scale like °F, °C, K, or some other exotic scale, and is independent of any of the properties of the material that has that temperature.

Temperature refers to the average energy of motion of the particles that make up a substance. It's an average— and that's a big point. The higher the average energy, the higher the temperature. You might think of that energy as the average speed of the particles in a substance, whether they're whizzing around like in a gas, swirling around in a liquid, or vibrating in place in a solid.

Heat, on the other hand, is the total energy of the motion of the molecules of a substance. We're not talking about averages anymore, but the total of all the energy of the motion of all the particles that make up a substance. The bigger an object, the more particles there are, the more heat energy it holds, and the more heat energy it will take to change its temperature.

Imagine a little cartridge heater the size of your finger creating 500 watts of power. It's going to get very hot; hot enough to glow, probably. That's over 1000°F. The same 500 watts coming out of a ceramic strip heater 180" long wouldn't even be noticed. The heat of an object is not only dependent upon the size of the object and the number of particles that make it up but also the properties of those particles, like their size and how they're locked together in the overall object. Properties like Specific Heat and Thermal Conductivity help describe those characteristics so we can calculate how much heat it'll take an object to get from temperature X to temperature Y.

From a different angle, imagine both heaters at 1000°F. It might take only 500 watts and a few minutes for the little cartridge heater to get to that temperature. The big, long ceramic strip, however, might take as much as 10 to 12 kilowatts and an hour to achieve the same temperature. So, both objects are at the same temperature, but it's very easy to see which one has more heat.

Understanding the distinction between heat and temperature is crucial, especially when considering their real-world applications. While temperature gives us an indication of how hot or cold something is, heat tells us about the energy required to change that temperature. This distinction is not only fundamental in science but also in designing heaters used in any process that involves temperature changes. By grasping these concepts, we can better appreciate the subtleties of thermal dynamics and how they impact the work that we do.

READ MORE ASK IANS

Engineering Talk

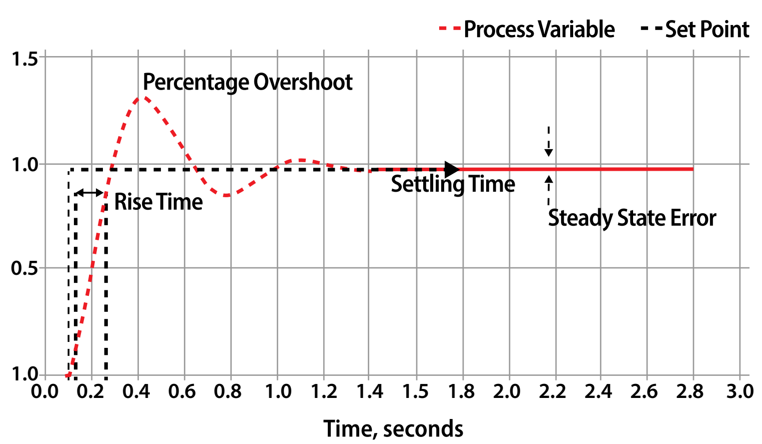
Why You Should Use PID

by Logan Hedrick

In the modern world of industrial control and automation, there are many different ways to control electric heaters. Electric heaters are not a cheap device, and therefore the controls should be robust enough to provide adequate control and safety over the electric heater. The ideal way to control an electric heater is to use a PID controller in conjunction with a contactor and Solid-state device. Unfortunately, though, most companies choose the cheapest option which is on/off or bang-bang control with a contactor. As we dive deeper into why this option is not the best, first we must explore what PID, Solid state devices, and Contactors are.

So, what is a PID controller? PID stands for Proportional, Integral, Derivative controller. Essentially the controller is taking a steady stream of data points and performing proportional, integral, and derivative calculations multiple times a second to ensure that the controller output matches the desired setpoint. So, what does this mean? Well layman's terms, the proportional term of the controller controls how fast the output reaches the setpoint, or the rise time. The integral term controls under and overshoot of the setpoint and the derivative term controls how much the control will "bounce" above and below the setpoint before it settles in on the exact setpoint this is also referred to as the settle time. Figure 1 below depicts a typical PID closed loop response.

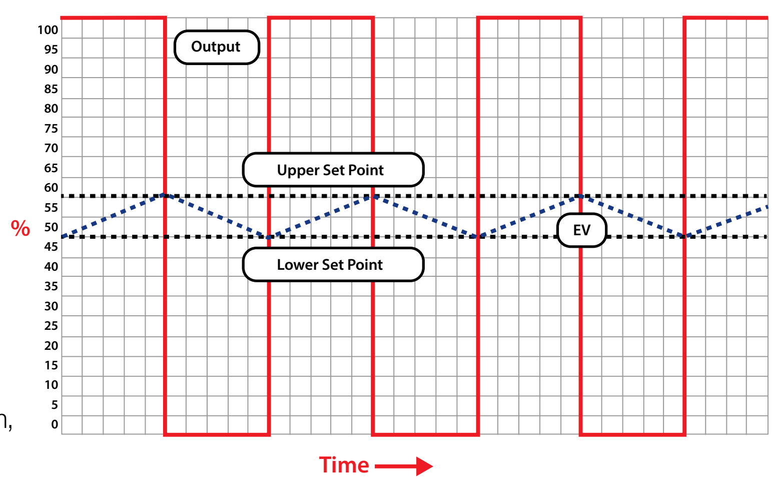
FIGURE 1



On/Off control is another type of heater control method. Basically, the system just turns on or off based on a temperature setpoint. When the temp is below the setpoint, the system is on, and when the setpoint is reached, the system turns off. This can be achieved by sending a signal to a contactor or relay, or an SSR. Figure 2 below shows a typical system response for on/off control. As you can see from the image, the system is defined by upper and lower setpoint. This is due to the system being unable to control to one specific setpoint.

So lastly, what are contactors and solid-state devices? Both contactors and solid-state devices are essentially just big, enclosed switches, but they way they operate as a switch is what makes them essential to controlling electric heaters. Contactors are great for coupling and decoupling large loads. They use a magnetic coil to close the switch. Solid state devices are designed to open and close very rapidly. These devices are typically controlled by pulse width modulation, or a 4-20ma analog signal.

FIGURE 2



Now that we understand a little better the terminology, and the devices in question, we can better explain why using PID control is the ideal method for controlling your heater. By using PID control, you have the ability to pick a desired temperature setpoint, and just press start and allow the controller to do its thing. If one were to use on/off control, then there would be an under and overshoot of the desired setpoint, and a lot of tweaking of values. Now that we understand a little better the terminology, and the devices in question, we can better explain why using PID control is the ideal method for controlling your heater.

Continued on next page

Engineering Talk

Why You Should Use PID Continued

By using PID control, you have the ability to pick a desired temperature setpoint, and just press start and allow the controller to do its thing. If one were to use on/off control, then there would be an under and overshoot of the desired setpoint, and a lot of tweaking of values. PID control is also much more reactive to process changes. If the flow rate through the heater changes, then PID control is able to sense the change, and adjust the output to the heater to ensure the desired setpoint is maintained at all times. PID control also greatly increases the lifespan of the heater by minimizing the temperature the heater runs at, based on the setpoint.

PID control also has other built-in features. Custom program setpoints, depending on specifics with the customer process, built in process timers, and data logging capabilities. PID controllers also have built in alarms and relays, that can be adjusted to customer specifics. PID controllers can also be configured for Hi-limit control as a secondary safety mechanism for processes, to ensure the process does not go over a hi-limit, or also as a failsafe to ensure the heater does not have an internal failure do to over-temperature. PID controllers can also be controlled and monitored remotely. This is accomplished via 4-20ma remote setpoint, rs485/422/232 serial communication, or via Ethernet communication, via Modbus TCP/RTU or Ethernet IP protocol. With PID controllers you can also change all of the PID values individually, to optimize your process, or you can use the autotune feature to let the controller figure out the optimal values based on the heater inlet conditions. You can also purchase PI or PD controllers. These with typically perform better than on/off control but do lack when compared to full PID control.

It is important to point out that PID control cannot be used with just a contactor. The average PID controller has a refresh rate of more than once per second, and the contactor is not capable of turning on and off that quickly, and has a relatively low rated cycle count, when compared to a solid-state device. Due to this, the PID controller must be connected to a solid-state device, to enable the heater to fire on and off many times a second. Solid state devices though have a tendency to fail in the closed position, when they are overworked, or reach the end of their service life. Due to this, the proper way to setup a control system for an electric heater, is to run power through a contactor, with a safety circuit wired into the contactor coil, that typically contains a flow/pressure switch, and Hi-limit/overtemp relay. Then out of the contactor, is the solid-state device, with the PID controller sending it the signal to open or close. The benefit of designing the system this way, is you get all the benefits of PID control, while also having a safety circuit to protect against all type of potential system failures.

Does all of this sound very technical and complicated? At Farnam, we design and build in house, custom process air electric heaters, we also design and build heater control panels to UL508A standard. We design these panels around the customers heaters, as well as any other process i/o capabilities necessary to fully integrate into your system.

Works Cited:

https://www.ni.com/en/shop/labview/pid-theory-explained.html
https://control.com/textbook/closed-loop-control/onoff-control/

Feature Video

Replacing a SureHeat Serp VI Element

In this month's feature video, National Sales Manager, AJ Nidek provides an overview on replacing a Serp VI element.

TUTCO SureHeat's Serpentine Triple Pass heaters are modular, field-replaceable air heaters commonly used in OEM applications. The Serp II and Serp VI models, which can reach temperatures up to 1500ºF (815ºC), consist of a versatile Serpentine coil that fits into a stainless steel "triple-pass" exchange housing and makes electrical connections through fittings pressed into the base. The housing uses the incoming air to cool the outer shell before passing through the heater element.

In this video, learn how easy it is to replace the heating element in the Serp VI Heater. Available with a Type K thermocouple for control, the Serp VI components can be purchased individually, making them an ideal solution for many OEM applications.

WATCH THE VIDEO

Getting Hot Fast Part 1 – TUTCO HT Mica Band Heaters

In the world of industrial heating solutions, the TUTCO HT Mica Band Heater combines versatility, durability, and customizability Designed to meet the demands of a wide range of applications, this heater is ideal even for those applications that require "thinking outside the box."

The HT Mica Band Heater, built with internal high-temperature phlogopite mica insulation, a full stainless steel sheath, and robust termination connections, it stands as one of the most durable mica heaters available today. The heater's thin sheath design allows it to fit into tight spaces, ensuring quick heat-up times. With the largest size availability of any heater in our offering, it's easy to see why this product used across a variety of industries.

Customizability is one of the features that truly sets apart the HT Mica Band Heater. Whether you're working in plastics, polymers, food service, packaging, rubber processing, or even scientific equipment, this heater can be tailored to meet your specific needs. It can handle temperatures up to 900°F (482°C), making it ideal for demanding environments. Industries such as chemical processing, hydrogen processing, and various types of process reactors have all found the HT Mica Band Heater to be an indispensable tool. With inside diameters ranging from 3/4" to 60" and widths from 3/4" to 18", this heater offers a wide array of options. You can choose watt densities up to 45W/IN² and voltages up to 480 volts (AC or DC). It also come with various termination options, including stainless steel screw terminals or leads with no protection, fiberglass sleeving, stainless steel braid, or stainless steel armor.

Additionally, you can add ground studs or wires as needed. The heater's versatility extends to its clamping mechanisms, with options for weld-on strap ends, loose strap clamping, spring clamping, or Belleville washer assemblies. For those with specialized requirements, options like dual voltage, 3-phase voltage, terminal boxes, metric sizes, and custom configurations such as holes and cut-outs are all available.

The HT Mica Band Heater's ability to adapt to different applications makes it a go-to solution for engineers and designers needing consistent performance, reliability, and a rapid response time. It can also be UL and/or CSA listed.

If your application requires versatile and powerful heater that gets hot faster, TUTCO HT Mica Band Heaters are the perfect solution.

MORE THINKING OUTSIDE THE BOX

SPECIFICATIONS

Operating Temp Capability: 900° F

Holes: Yes

Cutouts: Yes

Expedited Shipping may be available – consult factory

Durability: Good

APPLICATIONS

PLASTICS
Extruders & Extrusion Die Heaters
Plastic Injection Molding
Injection Molding Nozzle Heaters
Blown Film Processes
Blow Molding Machines

AGRICULTURE
Holding Tanks
Drum & Barrel Heating

FOOD SERVICE
Food Processing
Candy Extruders
Food Service Warming

PROCESS
Chemical Processing
Tin and Flux Melting
Scientific Testing Equipment
3D Printers
Medical Process Heater