

industry: energy and environmental technologies

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subject:

The benefits of using a cascade control system with long lag-time processes



summary:



Materials with poor thermal characteristics used in process can lead to scalding of the material or damage to electric heating elements if not controlled correctly. Often a single control loop is not satisfactory and will lead to these results.

A better solution is to use a cascade system. This paper discusses cascade theory and how to implement with EZ-ZONE[®] product.

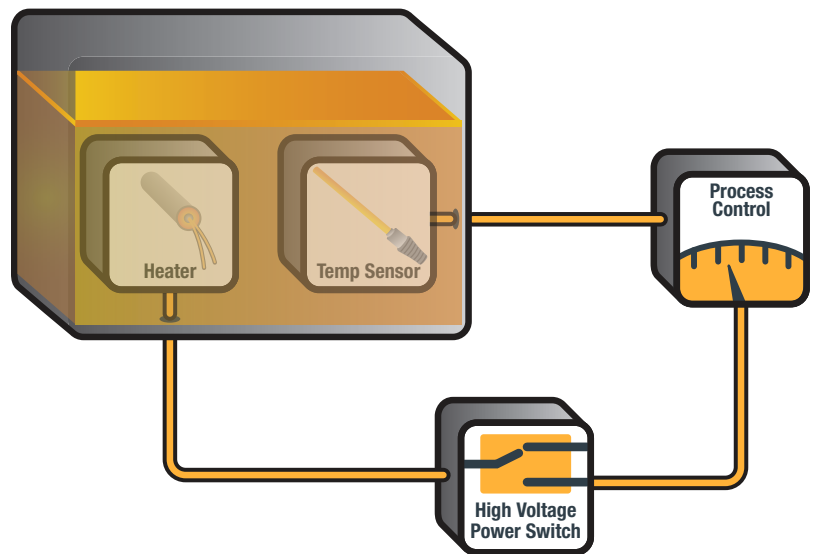


introduction:

Often times in energy process applications, the product or medium being heated is not a good conductor of thermal energy. Take for example, number 6 fuel oil. This material is very viscous and does not transfer heat well, however, it requires pre-heating before it can be used in a secondary process. This requires an electric heater with a lower power density (watts per square inch (WSI)) than other applications.

If a single loop of control is used (figure 1), the fuel oil directly surrounding the heater element can become burned or scald to the elements. This will lead to less thermal transfer from the elements and further scalding. Given time, the heater will burn itself out.

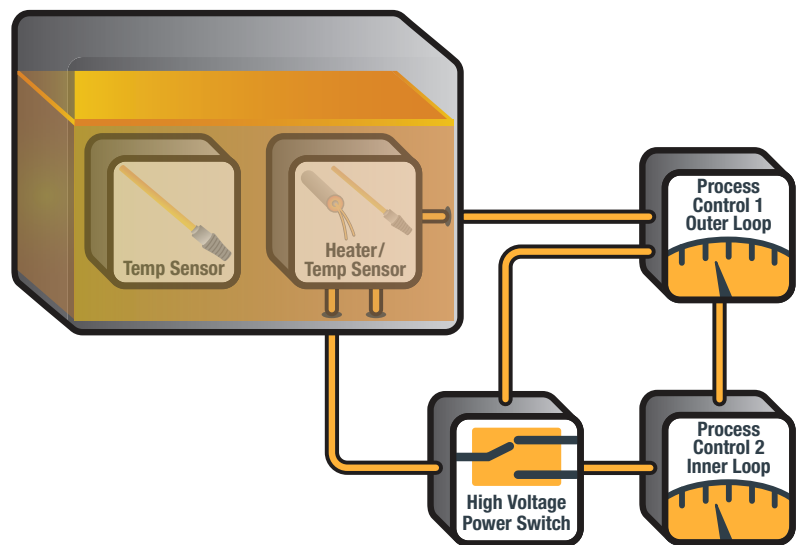
Figure 1:
Single loop of
control heating
number 6 fuel oil



a better way:

When a thermal system has a long lag time between heat applied and increased temperature, the best option is to use cascade control. This control strategy uses two control loops with the first, or outer loop, providing a 0-100% heat/cool request that is mapped on to a remote set point scale and fed into a second control loop, or inner loop. This provides an adjustable set point for the inner loop and is measured against a second measurement device to control the heat source with finer detail. (Figure 2). Refer back to the example of the fuel oil. An additional second temperature sensor and control loop allow for more stable control.

Figure 2:
Cascade control
for heating
number 6 fuel oil



takeaway:

Materials with poor thermal characteristics can have a long lag time between applying heat and the material exhibiting increased temperature. Cascade control will prevent scalding the material or damaging the heating elements by providing more precise temperature measurement and control.