IMPEDANCE PIPE HEATING – HOT WATER TRACING COMPARISON

Traditionally, the decision on which type of pipe heating method used for a given application is made early in the project cycle, and with no cost or technical evaluation performed prior to that decision. In this article a review and comparison are made between two unique process pipe heating solutions, hot water jacketed tracing and electric impedance pipe heating.

Although there are several pipe heating technologies available, the decision to go with one over the other is typically dependent on what was done on the previous project, thereby bypassing the opportunity for proper technical performance and cost evaluations of available pipe heating solutions. The result too often is a new heated pipeline installation with an inadequate, unreliable or overly costly pipe heating solution. First, let’s consider hot water jacketed tracing.

Hot Water Tracing
Hot water tracing is a traditional pipe heating solution employed to heat process pipe lines. Hot water trace pipe heating systems are often applied to applications involving temperature sensitive products or ingredients that can be damaged or burned by local high temperature surfaces. Hot water for process pipe heating is typically produced from a heat exchanger utilizing either steam or electricity. Steam is a common plant utility and available heat source for process heating. While the availability of steam is convenient, most plants do not consider the significant cost of producing the steam used to heat the hot water utilized for pipe heating. Further, heating water for process pipe heating applications with electricity, whether it be to produce steam or generate hot water, can also be expensive. The electric boiler for such an application will be a significant electrical load on the plant, often several hundred amps of primary 480 VAC.

The typical hot water jacketed pipe heating application is temperature maintenance and utilizes either single- or double-walled pipe. Single-wall hot water pipe heating systems use a hot water tracer tube affixed onto the pipe being heated. The tracer tube carries heating hot water and is wrapped around the outer surface of the pipe it is intended to heat. Tracer tubes are often installed underneath the heated pipe’s insulation and protective jacketing. Double-wall (or jacketed) pipe systems are constructed as pipe within a pipe. Utilizing a jacketed piping system the typical configuration used for a pipe heating application consists of the following: The heated process fluid flows within the inner pipe and heating hot water flows between the outside surface of the inner pipe and the inside surface of the outer pipe.
Hot water flows directly through a tracer tube or the jacketed pipe passages. But, because hot water has a finite heat capacity and cools continuously as it flows, the pipe temperature varies across its heated length. Consequently, hot water tracing systems are challenged to maintain a narrow uniform temperature gradient along its entire length and have a practical temperature limit of 210°F (99°C) for safety reason.

Despite these limits, hot water tracing systems do afford some advantages. A hot water or steam source is present in many plants. The level of technology associated with hot water tracing systems are such that they do not require special skill service technician or maintenance personnel to maintain or service. And it is relatively easy to add equipment and piping to an existing system when process requirements demand and excess heating capacity is available.

The disadvantages of hot water tracing systems are several. First, flow issues can be a concern, as the overall system flow and pressure drop can be difficult to balance and manage making uniform heating a challenge. Further, as mentioned above accurate temperature control along the length of the hot water heated pipe line can be a challenge as the hot water heating medium cools continuously as it flows along the length of the pipe line. Finally, hot water tracing systems can require significant ancillary equipment such as boilers, pumps, holding tanks, heat exchangers, etc. that each consume utilities, space and require mechanical and electrical maintenance resources to sustain operating performance. Regular maintenance is required to maintain a leak-free hot water tracing system and avoid product contamination.

**Impedance Pipe Heating**

By comparison, electric impedance pipe heating systems are often viewed as elegant and a simpler pipe heating solution when measured against hot water tracing. The primary reason for this is that an impedance system utilizes the pipe itself as the heating element! This is accomplished by application of a low voltage source directly to the pipe. The resulting current flow through the wall of the pipe generates heat primarily due the pipe material's electrical resistance. Impedance pipe heating systems deliver even watt density heating and a uniform controlled temperature gradient across the entire length of the heated pipeline. Impedance pipe heating systems operate without hot or cold spots and deliver superior temperature control for those process applications where precise temperature control and tight tolerances are required. Finally, impedance pipe heating systems represent a significantly smaller electrical load compared to electric hot water boilers used for hot water tracing systems.

Impedance pipe heating systems are a cost-effective alternative to hot water tracing systems. A typical impedance pipe heating system consists of an isolation transformer, system secondary cables, RTD temperature sensor, a control panel and pipeline isolation hardware. Avoided are the high costs associated with expensive jacketed piping, hot water tracing tubes being installed onto the pipe and covered with insulation and expensive and maintenance intensive ancillary equipment associated with hot water tracing systems. Further, impedance pipe heating systems have a broader range of temperature applications compared to hot water tracing systems. Typical impedance pipe heating system applications range from simple freeze protection to 1400°F and greater. Finally, there is not potential for product contamination from an impedance pipe heating system as it generates heat directly in the wall of the pipe eliminating this risk.
Summary:
In this article a review and comparison were made between two unique process pipe heating solutions, hot water jacketed tracing and electric impedance pipe heating. The decision on which type of pipe heating method used for a given application is often made early in a project and often without thought beyond what was done on the last project. As described above, this is a missed opportunity to improve process performance and positively impact plant OEE, Overall Equipment Effectiveness, and maintenance resources. Attention must be given to the capital cost and technical performance prior to making a process pipe heating decision. Making an informed decision will result in a better performing and more cost effective process pipe heating solution.

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