Impedance Pipe Heating – Spot light on Chocolate

The origins of chocolate, which is derived from the Theobroma cacao tree, stretch back at least 4000 years. The plant is believed to have originated in the Amazon or Orinoco basins in South America and was regarded by the Aztecs as being of divine origin.

Normally chocolate is held in storage between 110 and 120°F and will remain in a fluid state down to approximately 88°F. However, as the temperature of chocolate drops, the fluid viscosity increases rapidly. Too much heat causes damage (burning) and insufficient heat allows the material to become solid; therefore, consistency is vital for process heating.

Various types of pipe heating technologies are regularly employed in chocolate process pipe heating applications throughout the food industry. However, many pipe heating technologies are not up to the challenge. Too often the pipe heating technologies utilized do not provide the needed heating performance to successfully achieve the process requirements.

When pipe heating methods such as trace element pipe heating are applied to chocolate, hot spots, burned or damaged product are frequently experienced. Why? Trace element heating methods rely on heat being transferred from a hot trace element heating cable via conduction to the adjacent pipe. The heating cable is wrapped in intervals around the length of the pipe and subsequently covered with insulation. As the heating cable becomes hot the generated heat migrates from the hot cable into the adjacent pipe. This method of pipe heating results in non-uniform pipe temperatures across the length of the pipe. Due to the trace element cable being hotter than the process temperature, hot and cold spots are frequently experienced. These localized hot and cold spots along the length of the pipe can cause damage to the chocolate being processed. Burned, over-heated or cold altered product can quickly foul a piping system, causing process failure, reducing process output, increasing process downtime, maintenance and repair requirements. All result in increased costs, lost productivity and lower profitability.

The disadvantages of hot water tracing systems for chocolate 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, accurate temperature control along the length of the hot water heated pipe line can be a difficult as the hot water heating medium cools continuously as it flows along
the length of the pipeline. 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.

As an alternative, consider an electric impedance pipe heating (IPH) solution when dealing with chocolate products and processes. Impedance pipe heating systems have been utilized by the food industry for many years and have seen decades of reliable and successful service. An impedance pipe heating system provides even heating across the entire length of the piping overcoming the deficiencies and shortcomings of trace element pipe heating and double walled jacketed piping heating systems. An IPH system consequently eliminates the concerns of damaged product resulting from the hot or cold spots experienced with trace element and avoids the high cost associated with double walled jacketed piping heating solutions.

The simplicity of an impedance pipe heating system provides a reliable and cost-effective pipe heating solution. An impedance pipe heating system operates by applying a low voltage AC source to the piping being heated. Application of the low voltage source induces electric current flow through the wall of the pipe. The electrical resistance of the pipe opposes the flow of current and causes heat to be generated in the pipe. In other words, with an impedance pipe heating system the pipe becomes its own heating element. There is no heating cable or trace element installed under the pipe’s insulation making impedance pipe heating extremely reliable.

Utilizing the pipe as its own heating element has several benefits and advantages particularly when processing temperature sensitive products. Heat is generated evenly along the length and around the circumference of the pipe. This is due to the current flowing uniformly through the pipe’s cross sectional area. The result is that the product being processed is evenly and steadily heated with no hot or cold spots across the length of the piping. This is true no matter the length of pipe being heated. IPH also has the additional advantage of being able to heat the pipe consistently whether product is flowing or stagnant in the pipe. This characteristic many times eliminates the need and expense for circulated loops or recirculating lines. And with nothing installed under the pipe’s insulation an IPH system’s reliability is greatly enhanced over alternative pipe heating methods.

Ironically, temperature maintenance systems for chocolate-carrying process piping are often the least engineered and yet most important systems in a typical confectionery plant. Experience and existing systems typically govern the decision-making process, to problematic results.

Banner Day has vast experience heating chocolate with some of the world’s largest food companies. Contact us for your next chocolate heating application.