6/2009

CHEManager EUROPE

GIT VERLAG GmbH & Co. KG, Darmstadt, Germany www.gitverlag.com

THE NEWSPAPER
FOR THE CHEMICAL AND
LIFE SCIENCES MARKETS

Wrapped Up Warm

Solving Your Tube Heating Challenges

Temperature Control – Tube heaters are applied when liquid or gaseous media is delivered through tubes. These tube heaters have a critical impact on process results when used with thermal sensitive media or processes and contribute to the extension of maintenance cycles in the facility. Pump and Gas Line heaters, as introduced in this article, were developed especially for those kinds of applications.

Heating and tempering of media plays an important role in modern process engineering as many processes only proceed within a specific temperature range. Since raw material is generally delivered to the process chamber through tubing systems and reaction products are removed through tubing systems as well, it is necessary to hold delivery and exhaust lines at a certain temperature.

The smaller the temperature window is, in which the processes take place, the more important the right tempering of the tubing becomes. Precise temperature control along the tubing is essential for good process results in such cases. The following example emphasizes the importance of tube heating for thermally critical processes.

The pictures show exhaust lines of an aluminum etching tool as it is used in the Semiconductor fabrication. In figure 1 a tube with insufficient heating is shown, whereas figure 2 shows a fully heated tube. In this process, formation of aluminum chloride, which precipitates along the walls of the tubing, is critical. These precipitations lead to a successive reduction of the cross section of the tube and are sources for particles which negatively affect the results of the process which is run under clean room conditions. Moreover, these precipitations cause unscheduled maintenance cycles which generate significant cost due to equipment downtime. Use of conventional heated cable may not prevent precipitation because a full coverage of the tube and thus uniform tempering cannot be achieved.

Therefore, for this kind of applications a heating system was developed which ensures full coverage of the tubing and also uniform tempering. The heating elements are applicable at temperatures up to 200 °C and are available for different nominal voltages. Core of this so called Pump/Gas Line heating system is a heater jacket made from fibreglass enforced silicone material with backside insulation and snap fasteners or Velcro for easy assembly and disassembly. With this design time-consuming wrapping of heat trace around the tubing and subsequent insulation becomes redundant. Moreover, each heating jacket is equipped with plugs that ensure easy connection between the individual heating jackets and to the control unit. For temperature measurement,

Fig. 1: Illustrates the reduction in tube cross section due to aluminum chloride build up in an insufficiently heated tube.

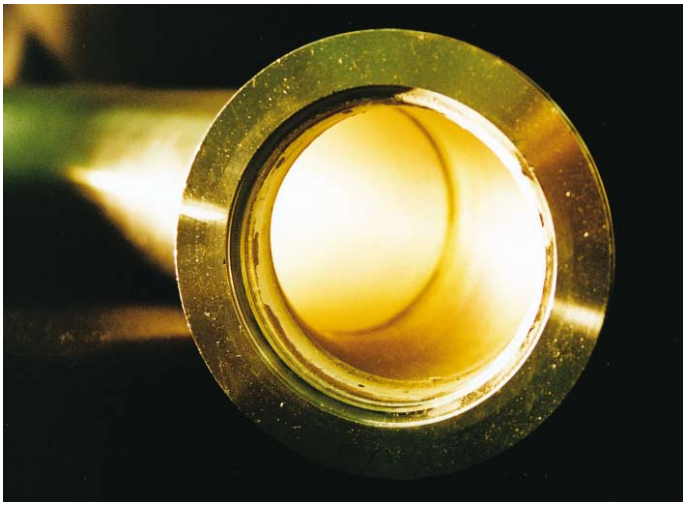

Fig. 2: Fully heated tube shows no build up of precipitate.

thermocouples or RTDs can be attached to the heating elements. The system is completed by a control unit, equipped with a PID temperature controller and semiconductor power switch. Optionally, the control units can be connected to a PC. This allows configuration and data logging with a Human-Machine Interface software package. Pump and Gas Line heaters are available in different diameters, lengths and geometries as a standard. Also elbows, flanges and T-sections can be covered and heated with standard jackets. By choosing suitable heater jackets, a full covered heating of the complete tubing will be achieved.

Minimizing Heat Losses

In most tubing systems, additional components like pumps, valves or other equipment are integrated which create particular challenges for uniform tempering. These components create the biggest heat losses, and their geometry is in most cases considerably unsymmetrical which makes efficient heating extremely difficult. Sufficient heating of these particular components however, is of great importance, because condensation and precipitation preferentially take place in these areas. This is due to the significantly different thermal properties of these components compared to common tube sections. In these cases simple wrapping with heat trace does not lead to the desired results, so that a specific adjustment of the heating element to the component becomes necessary. Such an adjustment is not only limited to the geometry of the heater jacket, but also must consider heat losses in these locations. This requires an adaption of power and power density of the heater jacket to the specific thermal conditions.

Especially at valves, much higher heat losses occur compared to common tube sections which make a higher power input per surface unit necessary. In some cases it is required to equip the heating jacket with an additional temperature sensor and to operate it in a separate control loop. This becomes particularly necessary when the thermal properties of the valve are significantly different than the rest of the tubing system.

It ensures desired temperatures and prevention of condensation even in tubing systems with sections of highly different thermal properties. Another feature of these heating systems is the accurate distribution of heating power. This can be achieved on one hand by adapting watt density to the specific requirement, and on the other hand by temperature control of the heaters. This, together with the insulation of the heating jacket, leads to energy savings because only the amount of actually required power is brought into the thermal system.

▶ Contact:
Matthias Müller
Watlow GmbH
Kronau, Germany
Tel.: 07253/9400-0
Fax: 07253/9400-901
info@watlow.de
www.watlow.com