Heater Pass Flow Control

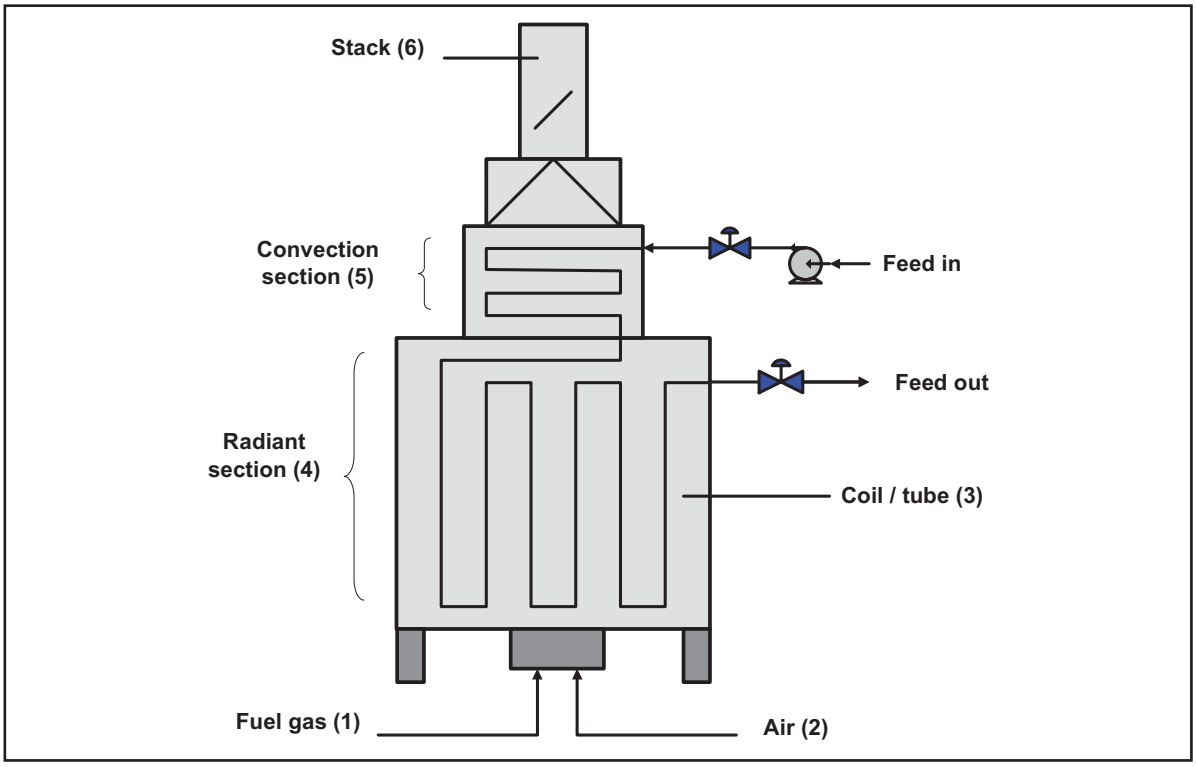

Figure 1: Industrial Heater

Typical Heater Design

A furnace or direct-fired heater is equipment used to provide heat for a process or can serve as reactor that provides heats of reaction. Furnace designs vary as to its function, heating duty, type of fuel and method of introducing combustion air. However, all furnaces have some common features.

Fuel flows into the burner (1) and is burnt with air (2) provided from an air blower. There can be more than one burner in a particular furnace that can be arranged in cells that heat a particular set of tubes. Burners can also be floor mounted, wall mounted or roof mounted depending on design. The flames heat up the tubes (3), which in turn heat the fluid inside in the first part of the furnace known as the radiant section (4). In the chamber where combustion takes place, known as the firebox, the heat is transferred mainly by radiation to tubes around the fire in the chamber. The heating fluid passes through the tubes and is thus heated to the desired temperature. The gases from the combustion are known as flue gas. After the flue gas leaves the firebox, most furnace designs include a convection section (5) where more heat is recovered before venting to the atmosphere through the flue gas stack (6).

Refineries throughout the world use direct-fired heaters to bring feedstock to suitable processing temperatures. **For crude and vacuum heaters** the desired temperature is typically between 280ºC and 380ºC and for **thermal crackers, cokers, catalytic crackers, reformers** up to 450 – 520 °C. The heater is effectively a direct-fired furnace, containing a series of tubes called passes. The feedstock is pumped through these tubes, with the process temperature being governed by the length of time the feedstock takes to pass through the heater. Typically, there are between four to eight passes per heater, with each one having its own individual flow control valve.

2721/01/01 EN • 8/2011

Heater Pass Challenges

Heater pass control valves have traditionally been globe valve designs, which may cause some problems in performance and reliability. Refineries are now finding it advantageous to replace their conventional globe valves in this application with rotary control valves for several reasons:

Health, Safety, Environment – For any refinery HSE-issues are important aspect since plants are working around the clock under severe temperature and pressure conditions. Heater pass control valve leaking poses both an environmental and safety issue due to risk of fire and oil spills, as the sticky residue accumulates on the valve bonnet and refinery ground.

Throughput efficiency – Maximizing process unit throughput and thus production is an interest of any refinery. Minimizing process variability reduces production losses, upsets and fuel consumption. At the same time it is also important to maximize process unit flexibility in changes related to feedstock, downstream units or process revamp. Sticking and leaking in heater pass valve reduces the accuracy of throughput control and adversely affects not only the heating of the media, but also the downstream processes.

Minimize maintenance costs. Poorly performing valves in the direct heater system must be maintained because they will have a direct impact on the efficiency of the process. The cost of unscheduled maintenance will be quite high, with a typical service costing about 70% of the cost of a new valve. Add this to the cost of removing the valve from the line and disruption of the process and the total cost will be much higher. Maintenance could be required for conventional globe valves from every 6 months to even 2-3 months. All maintenance operations require frequent visits from operators to the plant.

Metso Automation Rotary Advantages

Metso Automation's Solution. Neles metal seated rotary control valves together with Neles ND9000 smart valve controllers and Neles FieldCare valve condition monitoring can answer all these challenges with wide margins of assurance.

Avoid HSE-risks related to leakage. Metso Automation rotary gland systems are inherently more reliable and will not suffer the leakage problems typically associated with conventional globe designs. This is due a rotary stem does not tend to move process media into gland packing similarly as a rising stem. For further protection from leaking, users can choose our qualified self-adjusting emission gland systems, which eliminate gland leaks and maintenance.

Reduce maintenance costs. Simple rotary designs offer non-clogging flowports and rugged hard-faced trims. Costly service work involving the removal of the valve from the line and replacement parts is eliminated. Same face-to-face dimensions as globe valves, upgrading linear valve technology to rotary designs eliminates the need for changes to pipework configurations. Major refineries in Europe and Latin America have tested these concepts by installing rotary heater pass valves to replace conventional globe valves that had begun leaking after several months. The rotary valves have been in service for several years without requiring maintenance and show no sign of leakage. This obviously also reduced the visits of operators to the plant.

Eliminate throughput bottlenecks. Throughput losses due to sticking and poor control performance will be avoided with high perfromance rotary valves. Flow through the heater pass may be changed as the need arises. With maximum rangeability of 150:1 of rotary valves a superior control today and extra built-in capacity for the future will be provided. This avoids costly refurbishing that is required when the heater pass valve is the process bottleneck. For even higher levels of performance and to reduce process variability, these valves may be equipped with Metso Automation's advanced ND9000 digital valve controller. This smart device ensures higher positioning accuracy and faster response.

Avoid unscheduled shutdowns. Trend data collected by the Neles ND9000 valve controller and analyzed by FieldCare configuration and condition monitoring software based on open FDT/DTM makes it possible to predict and respond to maintenance requirements and avoid unscheduled downtime.

Figure 2: Eccentric rotary plug valve, Neles Finetrol™, provide reliable, long-lasting performance for heater pass control.

Figure 3: Rotary stem vs. rising stem. Rising stem (on the right) tends to draw process media and dirt into the gland area.

Metso Automation's Solutions

Valves

Neles Finetrol™ rotary control valve for mild heater temperatures

- All actuator mounting directions can be used.
- Size range 1 – 10"
- Pressure class ANSI 150 - 600
- Temperature range -196°C…+425°C / -320 °F…+800 °F
- Fits different face-to-face needs, including globe valve face-to-face
- Fire tested and certified
- Stable, accurate and fast control
- Meets the latest emission standards
- Easy maintenance
- Fulfils NACE MR 103-2003 requirements
- Compact design
- Class IV tightness
- Patented Q-trim reduces noise and solves cavitation and vibration problems.
- Patented plug shape balances the flow forces and improves flow control accuracy.

Figure 4: Finetrol rotary control valve with QP-actuator and ND9000 valve controller.

T5 top entry rotary control valve for high heater temperatures

- All actuator mounting directions can be used.
- Size range 1 – 16"
- Pressure class ANSI 150 – 600
- Temperature range -200°C…+600°C / -328 °F…+1110 °F
- Fits different face-to-face needs, including globe valve face-to-face
- Fire tested and certified
- Stable, accurate and fast control
- Meets the latest emission standards
- Top entry design for easy maintenance
- Compact design
- Patented self-flushing Q-trim for fluids with particles or other impurities.
- Fulfils NACE MR 103-2003 requirements
- Class V tightness.
- Turn-down ratio up to 150:1.

Figure 5: Top entry rotary control valve with BJ actuator and ND9000 positioner

Actuators

QP – Quadra-PowrX for Finetrol

- Spring diaphragm actuator
- Long cycle-life
- Operating pressure up to 7 bar (100 psi)
- Adjustable travel stops
- Low friction bearings
- Easy & safe field operation
- Materials suitable for corrosive environment

BJ – Pneumatic Cylinder Actuator for Finetrol or T5 series

- Spring return for fail to close
- Long cycle life
- Operating pressure up to 8.5 bar (123 psi)
- Adjustable travel stops
- Wear resistant bearings
- Materials suitable for corrosive environment

Neles ND9000 – Intelligent Valve Controller

- On-line valve diagnostics
- Data can be saved to device memory
- Communication with HART, FOUNDATION Fieldbus, Profibus PA
- High speed of response
- Accurate measurements
- Linearisation of valve flow characteristics
- Excellent dynamic and static control performance
- Corrosion resistant finish
- Flame proof option available

Recommended Option

Neles FieldCare – Device and Asset Management Software

- Open solution based on FDT/DTM technology
- Accurate information during commissioning, operation and maintenance
- Multivendor device operation
- Service work history reports
- DTM catalogue management
- User management
- Documentation management

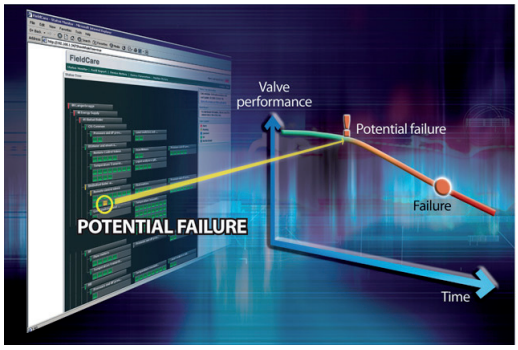

Figure 6: FieldCare Device and Asset Management

Metso Automation Inc.

Europe, Vanha Porvoontie 229, P.O. Box 304, FI-01301 VANTAA, Finland.
Tel. +358 20 483 150. Fax +358 20 483 151

North America, 44 Bowditch Drive, P.O. Box 8044, Shrewsbury, MA 01545, USA.
Tel. +1 508 852 0200. Fax +1 508 852 8172

South America, Av. Independência, 2500- Iporanga, 18087-101, Sorocaba-São Paulo
Brazil. Tel. +55 15 2102 9700. Fax +55 15 2102 9748/49

Asia Pacific, 20 Kallang Avenue, Lobby B, #06-00, PICO Creative Centre, Singapore 339411, Singapore.
Tel. +65 6511 1011. Fax +65 6250 0830

China, 19/F, the Exchange Beijing, No. 118, Jianguo Lu Yi, Chaoyang Dist, 100022 Beijing, China.
Tel. +86-10-6566-6600. Fax +86-10-6566-2575

Middle East, Roundabout 8, Unit AB-07, P.O. Box 17175, Jebel Ali Freezone, Dubai,
United Arab Emirates. Tel. +971 4 883 6974. Fax +971 4 883 6836

www.metso.com/valves