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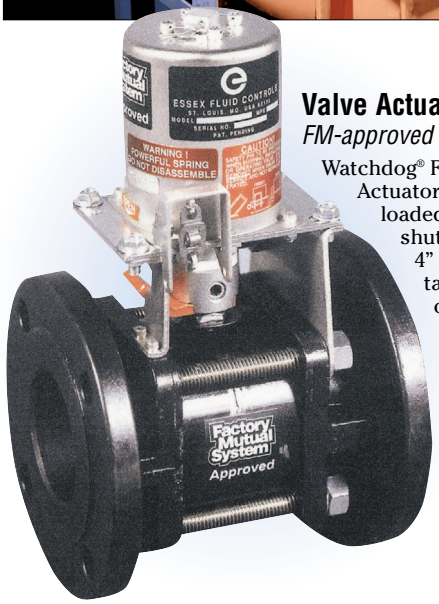
CHEMICAL EQUIPMENT®

AUGUST 2004

PRODUCTS, SYSTEMS & SERVICES FOR THE GLOBAL CHEMICAL PROCESSING INDUSTRY



Valve Actuator

FM-approved

Watchdog® Fusible link Shutoff Valve Actuator is a self-contained, spring loaded device that automatically shuts off or opens 1/4" through 4" fire safe ball valves to contain spreading of flammable or toxic material in dangerous situations. Available with heat activated Thermal Links or ETL Link elements, actuators can also be manually operated as standard fire safe valves. **Essex Fluid Controls**

Use InfoLINK 4H1101 or Call 800-287-0093

Case Scale

for in-motion weighing

AC4000 Case Scale's design insures reliability and maintenance-free operation. Weightable is virtually damage proof, with overload protection up to 1000 pounds. Controlled by AC4000 electronics, scale is capable of weighing up to 140 packages per minute, depending on package length. Case scale has four 250-lb. steel load cells in the conveyor section that eliminates any off-center loading errors. **Thermo Electron Corp.**

Use InfoLINK 4H1102 or Call 800-287-0093

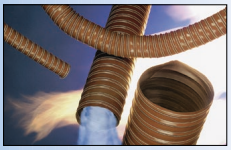
Filter Cloth Materials

lower operating costs

PEEK™ replacement screens excel in high temperature and aggressive chemical environments. They are designed to provide improved performance and lower operating costs for screeners, filters, dryers and other equipment. Material offers excellent chemical resistance in environments up to 500°F. Pore sizes down to 12 microns are available. **Sefar America Inc.**

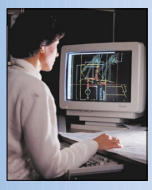
Use InfoLINK 4H1103 or Call 800-287-0093

THERMAL PROCESSING & HEAT TRANSFER ISSUE



FEATURE ARTICLE

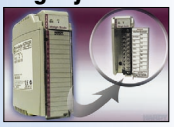
Care And Feeding Of Brazed Aluminum Heat Exchangers



Brazed aluminum plate-fin heat exchangers are highly efficient heat transfer devices that represent a quantum leap in technology and design. See page 20 for further details.

LATEST INNOVATIONS

Scales & Weighing Systems



Hardy Instruments' CompactLogix® Weigh Scale Module is a single channel PLC-style module optimized for use with Allen-Bradley MicroLogix™ 1500 and CompactLogix™ controllers. Further information on this and other weighing equipment is on page 10.

Slurry & Metering Pumps

GLV Series valveless metering pump from Neptune Chemical Pump is designed to eliminate gas locking during sodium hypochlorite injection. Pump is designed specifically for 12-15% sodium hypochlorite or other chemicals with severe off gassing problems. More details are available in the Slurry & Metering Pumps Spotlight on Page 14.

The Care And Feeding Of Brazed Aluminum Heat Exchangers

by Dan Markussen, Principal Sales Engineer and Account Manager for Chart Industries' Heat Exchanger Group

Brazed aluminum plate-fin heat exchangers are highly efficient heat transfer devices that represent a quantum leap in technology and design. Produced in a vacuum furnace that joins the fins and parting sheet at a specific temperature, they are used for a wide range of cryogenic and non-cryogenic applications, including industrial gas production, natural gas processing, refinery and petrochemical processing, and hydrogen and helium liquefaction.

Brazed aluminum plate-fin heat exchangers offer the benefits of compact design (typically 20% the size of comparable performance carbon or stainless steel shell and tube exchangers), close temperature approaches, flow options and a unique ability to exchange heat with multiple streams.

Brazed aluminum plate-fin heat exchangers offer the benefits of compact design (typically 20% the size of comparable performance carbon or stainless steel shell and tube exchangers), close temperature approaches, flow options and a unique ability to exchange heat with multiple streams. Collectively, these help to lower installation and operating costs and minimize engineering, insulation, support systems, testing, documentation, transportation, and site arrangements.

That said, the performance, safety and quality characteristics of heat exchangers can only be ensured through proper installation and care. Given the impact of heat exchangers on overall plant operational performance, a piecemeal strategy of installation and maintenance is simply not sufficient. Rather, the potential of brazed aluminum plate-fin heat exchangers can best be realized by strictly adhering to established standards and procedures, from the time of initial purchase and installation onward.

Purchasing Considerations:

Codes: The design, construction and testing of brazed aluminum plate-fin heat exchangers are governed by recognized international codes that apply to pressure vessels. Brazed aluminum plate-fin heat exchangers from Chart Industries are designed and manufactured in accordance with Section VIII, Division I of the ASME Pressure Vessel Code, carry the "U" stamp, and are registered with the National Board of Boiler and Pressure Vessel Inspectors. Associated piping is normally designed and manufactured in accordance with the ASME B31.3 Piping Code.

Considerations: Consideration should be given only to exchangers that meet one of the recognized international design codes, and adhere to strict quality control procedures, including:

- Hydrostatic and pneumatic proof testing
- Performance flow testing
- External and vacuum helium leak detection
- Dye penetrant and radiographic testing

Ideally, a total commitment to quality and reliability should be manifested through full accreditation to EN ISO9001.

Finally, customers and/or users of brazed aluminum exchangers should only consider suppliers that conform to the standards of ALPEMA (Brazed Aluminum Plate-Fin Heat Exchanger Manufacturers' Association). ALPEMA standards provide consistent quality and conformance guidelines for the design and manufacture of brazed aluminum exchangers. More information regarding ALPEMA may be obtained from www.alpema.org.

Installation Considerations

Initial Inspection: Upon arrival, a heat exchanger should be inspected for shipping damage and/or contamination. For units shipped unpressurized, check under the shipping covers for contami-

nation of the port openings. For units shipped pressurized (normally to 15 psig) with dry air or nitrogen, each stream should include a valve and coupling to which a pressure gauge can be mounted. A positive pressure should be indicated on the gauge when the valves are opened. If a stream does not indicate a positive pressure it should be repressurized with dry air or nitrogen to 15 psig. If, after repressurizing, the positive pressure is not maintained, the valve and couplings should be checked for leakage and replaced if they are determined to be the source of leakage. If the leakage continues, the manufacturer should be contacted for resolution.

Storage: Store heat exchangers in an indoor location away from any primary work. Exchangers that are shipped in protective crates or on wood or steel channel skids should be stored in the original shipping package. Exchangers should not be stacked unless the packaging has been designed specifically for stacking. For properly designed packaging, stacking should be limited to two high and to exchangers of the same size.

The storage area should provide level, uniform support with good drainage. It should be located in an area characterized by minimal temperature fluctuations and low vibration and be kept away from fluids that are corrosive to aluminum. Additionally, exchangers should be properly covered and sealed to prevent dirt, sand, water or other foreign materials from entering nozzles, ports or other openings.

Lifting and Handling:

Before moving an exchanger, confirm its weight, dimensions and lift connection locations. Select the appropriate hoisting machines, spreader bars, slings, shackles and other material handling tools to match the height and weight of the exchanger, as well as the angle and direction of the hoisting. A lifting diagram is often provided by the exchanger vendor that describes specific lifting instructions.

Pipe Loads:

Manufacturers provide the maximum allowable bending moment and the axial loads that can be safely applied at each nozzle location of the exchanger. Sufficient piping stress analysis should be conducted to assure applied loads are within manufacturers' specified limits.

Dryout:

Purge and dryout the exchanger prior to start up in order to remove moisture and heavy hydrocarbons that may freeze out at low operating temperatures. A thorough dryout must be performed at the commissioning and after subsequent shutdown where moisture may have reached the exchanger. A warm dry gas should be used to achieve adequate dryness. All dead legs in the piping should also be drained and purged.

Maintenance And Care Considerations

Thermal Stresses: While manufacturers of leading brazed aluminum plate-fin heat exchangers design their products for the specified pressure loads, potentially significant thermal stresses can arise from unsteady operating conditions such as large flow fluctuations, unstable flow in boiling channels, or inadequate plant control systems, as well as transient operating conditions that include start-up, shutdown, plant upsets, deriming, and cool-down/warm-up cycles. To reduce the possibility of damage or failure of the heat exchanger, consider the following guidelines:

- Regulate the pressure and external loads and limit temperature differences between adjacent streams at any point in the heat exchanger to those specified by the manufacturer
- When deriming, bring the exchanger back to operating conditions slowly to avoid excessive thermal stress. Follow a manufacturers' recommended practice when moving significantly out of the specified operating range of the equipment.
- Exercise care in applications where a liquid is totally vaporized within the exchanger. Boiling to total dryness can produce large temperature differences and induce flow instabilities
- Design and operate plant equip-

Heat exchangers from Chart Industries are designed and manufactured in accordance with Section VIII, Division I of the ASME Pressure Vessel Code, carry the "U" stamp, and are registered with the National Board of Boiler and Pressure Vessel Inspectors.

ment and piping connected to the exchanger to prevent flow excursion and instabilities

- Limit frequently repeated temperature fluctuations of any stream to + 1°C

Where any of the above conditions are a concern, a user should consult with the manufacturer to determine if the exchanger is within its acceptable operating range.

Fouling & Plugging: Fouling and plugging in brazed aluminum exchangers is rare due to the fact that the processes in which the equipment is typically used are clean. However, before purchasing brazed aluminum plate-fin heat exchangers, fluid conditions must be examined for the presence of solids and foreign particles which could form deposits during operation - especially in low temperature regions.

Although fouling may not be caused by the process streams themselves, it is possible that fouling may arise from contaminants in the process fluids. A typical example is the use of seal oil with refrigerant streams, which could deposit as a solid film on the fin surfaces and reduce the thermal performance of the exchanger.

If the liquid/solid transformation of the fouling agent is reversible with temperature, changing the operating conditions of the heat exchanger and thus warming up the fouled zone may eliminate the deposits. In cases where this is not effective, solvent cleaning may be used. Brazed aluminum plate-fin heat exchangers can be modified or designed to incorporate solvent injection systems.

Plugging occurs when fin channels inside an exchanger are blocked by solid particles that entered the unit. Plugging can be detected by higher pressure drop in affected streams and diminished heat transfer performance. Typically, thermal performance is affected by the plugging medium being distributed to various passages and throughout the width of the exchanger. To prevent plugging, check the cleanliness of the connecting pipes to ensure that rust, debris and dust does not enter the exchanger. Filters on the feed streams should be installed upstream of the exchanger where there is a possibility of contaminating the process fluid. A recommended mesh size of 177 microns (80 Tyler) is capable of covering most applications.

Remedy for Fouling & Plugging: If the heat exchanger is fouled or plugged, several options exist for cleaning it. When the fouling is solid and coats the fins in the heat exchanger, the exchanger will typically need to be cleaned by chemical removal through a series of deriming, back flushing, and drying procedures.

Deriming and back flushing involves the use of heat and solvents to remove hydrates, heavy hydrocarbons, waxy materials, compressor oils or other soluble matter that freeze or collect in the heat exchanger.

When systems for injecting methanol during operation have not been provided, shut down and purge the heat exchanger and allow it to warm and defrost itself by natural heat leak or by an approved derime procedure. Typically, the combination of warming and back flushing a solvent such as trichloroethane, toluene, propylene, or methanol prove successful for this purpose. However, cleaning solvents should always be selected with regard to the suspected fouling agent. If the fouling agent is unknown, a sample should be chemically analyzed to determine its composition.

If a water based solvent is used to derime or back flush, or if water accidentally gets introduced into the heat exchanger, the exchanger must be completely dried before returning to service in order to prevent plugging or rupture caused by freezing. Use dry air, nitrogen or other dry gas.

If the heat exchanger is fouled or plugged by particulate matter, back puffing procedures are typically successful in cleaning the exchanger.

Since particulates normally cause blockages in the heat exchanger at the inlet ports and distributors, puffing in the reverse direction of normal operating flow is required to prevent pushing the particulates farther into the heat exchanger. The back puffing procedure involves attaching a rupture disk to the inlet nozzle or flange of the heat exchanger stream to be backpuffed and pressurizing the stream with a dry gas up to the manufacturer's approved pressure. However, extreme caution should be exercised as the rupture of the disk and the release of gas can result in a rapid discharge of gas and flying debris which could cause serious- and potentially fatal - personal injury. It is prudent to discuss the procedure and verify the recommended pressure with the heat exchanger manufacturer prior to attempting the procedure.

When back puffing, the plugged stream is slowly filled with dry air or nitrogen until the rupture disk bursts. If the intended rupture pressure is reached and the rupture disk has not burst, the stream should be depressurized and a new rupture disk installed.

The sudden release of gas out of the exchanger will help dislodge the particulate matter. This back puffing procedure should be repeated five to ten times, or until the amount of particulate removed becomes minimal and the discharge cloud is clear.

Process Environments Containing Mercury: Longtime fears about mercury's corrosive effects on aluminum have fueled some reluctance to embrace brazed aluminum technology. In reality, mercury will only react with certain alloys of aluminum and then only when liquid mercury is allowed to exist in contact with the heat exchanger and there is water present.

Mercury removal systems upstream of the exchanger are commonly installed so that brazed aluminum plate-fin heat exchangers may be used with streams containing mercury. Operators may also use special shutdown procedures to restrict moisture and maintain temperatures below 100° C. In addition to mercury removal systems, equipment from Chart Industries can be designed to be mercury tolerant. Chart's proprietary mercury-tolerant designs allow corrosive mercury to be present in the aluminum exchanger without causing the exchanger to fail.

Leaks: A leaking heat exchanger should be repaired as soon as possible. Prolonged operation may lead to further damage, especially when the cause is due to cyclical thermal or mechanical fatigue. Continued operation of an externally leaking exchanger installed in a perlite insulated cold box may lead to further damage and increased leakage from perlite erosion.

Chart Industries Energy & Chemicals Group

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