**Introduction**

Steam is used throughout the world as a means of producing energy. Steam is converted back to water in condensers and further cooling in *Heat Exchangers*. Heat exchangers are widely used in space heating, refrigeration, air conditioning, power plants, chemical plants, petrochemical plants, petroleum refineries, and natural gas processing. Heat exchangers are devices that provide the flow of thermal energy between two or more fluids at different temperatures and they are used in a wide variety of applications. These include power production; process, chemical and food industries; electronics; environmental engineering; waste heat recovery; manufacturing industry; and air-conditioning, refrigeration, and space applications.

A heat exchanger may be classified according to the following main criteria: Recuperators/regenerators; transfer processes: direct contact and indirect contact; geometry of construction: tubes, plates, and extended surfaces; heat transfer mechanisms: single-phase and two-phase; flow arrangements: parallel-, counter-, and crossflows. One common example of a heat exchanger is the radiator in a car, in which a hot engine cooling fluid, like *antifreeze*, transfers heat to air flowing through the radiator.

Since steam is used to produce energy, corrosion of the heat exchanger is a constant maintenance problem. The use of corrosion-resistant metals and improved methods of water treatment have minimized the effect of corrosion on the steam side of the heat exchanger. But corrosion on the process side remains a serious problem.

**Exchanger Leakage**

Corrosion on the process side causes the heat exchanger tubing to mechanically fail, allowing the process fluid to leak into the condensate return line. This can cause serious damage to the boiler. Therefore, it is necessary to monitor the condensate downstream of the heat exchanger and to dump the condensate as soon as it shows signs of contamination.

An accurate indication of contamination can be obtained by measuring the conductivity of the condensate, because pure condensate has a very low conductivity value, 1 to 10 µS, while contaminants (typically salts, acids or alkalis) that are introduced when leakage occurs have a significantly higher conductivity values. Because of the sizeable differences in values even the slightest leak will sharply increase the conductivity reading. Any marked increase in the conductivity of the condensate indicates that leakage is present, and the condensate should be sent to drain.

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**Figure 1. Process Flow Diagram**

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Industry: Refining, Food & Beverage, Power, Oil & Gas, Pulp & Paper, Chemical Products: Contacting Conductivity Process Liquid Analyzer
For best results in leak detection, you need to measure a couple of things: sample conductivity range, contaminant conductivity, and how fast the sample conductivity can change relative to the time through the leak source. As shown in the simplified diagram below, the conductivity instrument can be utilized to directly control the dumping of contaminated condensate. A single point conductivity analyzer (SC450G) can be located downstream of the heat exchanger, and utilize a high alarm relay to trigger the value. Another option is to use a dual input conductivity analyzer (DC402G) with one sensor upstream of the heat exchanger and one downstream. The built-in deviation calculation of the analyzer can be used to alarm, or activate a valve when the downstream conductivity deviates significantly from the upstream conductivity. This method compensates for a variance in the condensate conductivity.

Summary
Measurement and control of heat exchanger leakage can help prevent costly maintenance, repair, and downtime. The simple, essentially maintenance-free measurement of condensate conductivity will give the operator necessary information (or provide automatic control) to prevent severe damage to the boiler should a breakthrough of the heat exchanger occur.

Product Recommendations
Conductivity Measurement System:

Process Liquid Analyzer:
• 2-wire FLXA202 Contacting Conductivity Analyzer
• 4-wire FLXA402 Contacting Conductivity Analyzer

Sensor Selection:
Analog and Digital SMART sensors are available. Analog options allow users to interface with a system that has been used historically. SENCOM™ technology, which allows sensors to transmit and receive data when connected to a transmitter/analyzer or a PC. The SMART digital sensors maintain specific measurement and calibration data on an integrated chip along that is an integral part of the sensor providing easy plug and play solutions. The data management software optimizes the performance of sensors for enhanced reliability and process safety.

Option #1:
SC42-S*34 Large-Bore Conductivity Sensor (fittings available for Flow-Thru, Insertion, or Immersion installations)

Option #2:
SC4A Conductivity Sensor (fittings available for Insertion, Sanitary, or Retractable installations.)

Digital SMART Option:
The re-useable smart adapter, SA11, offers full measuring parameter functionality of analog sensors equipped with a Variopin connector and Yokogawa ID chip. The SA11 automatically recognizes the installed sensor and prepares the right configuration.

Note: For additional information on this application contact the local Yokogawa Process Liquid Analyzer Department | www.yokogawa.com