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. Heat exchangers 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.

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 corrosions 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 excellent 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 contaminates (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.

Figure 1. Process Flow Diagram

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 thru 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 an 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 FLEXA Contacting Conductivity Analyzer
- 4-wire SC450G Contacting Conductivity Analyzer
- 4-wire DC402G Dual Channel Contacting Conductivity Analyzer

**Sensor Selection:**

**Option #1:**

SC42-SP34 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.)

**Note:** For additional information on this application contact the local Yokogawa Process Liquid Analyzer Department.