Liquid Analysis Measurements in Cooling Water Control

Process

Chemical plants, petroleum refineries, power plants, and many other industrial facilities use large quantities of water for process cooling. Often, these facilities utilize cooling towers to allow for the re-use of cooling water. The cooling effect is obtained by the evaporation of a small fraction of water and heat exchange with the air passing through the cooling tower. There are many variations in cooling towers and heat exchange design (Figure 1), but virtually all of them require several liquid analysis measurements to control the quality of the cooling water to protect the expensive equipment corrosion, scaling, and biofouling.

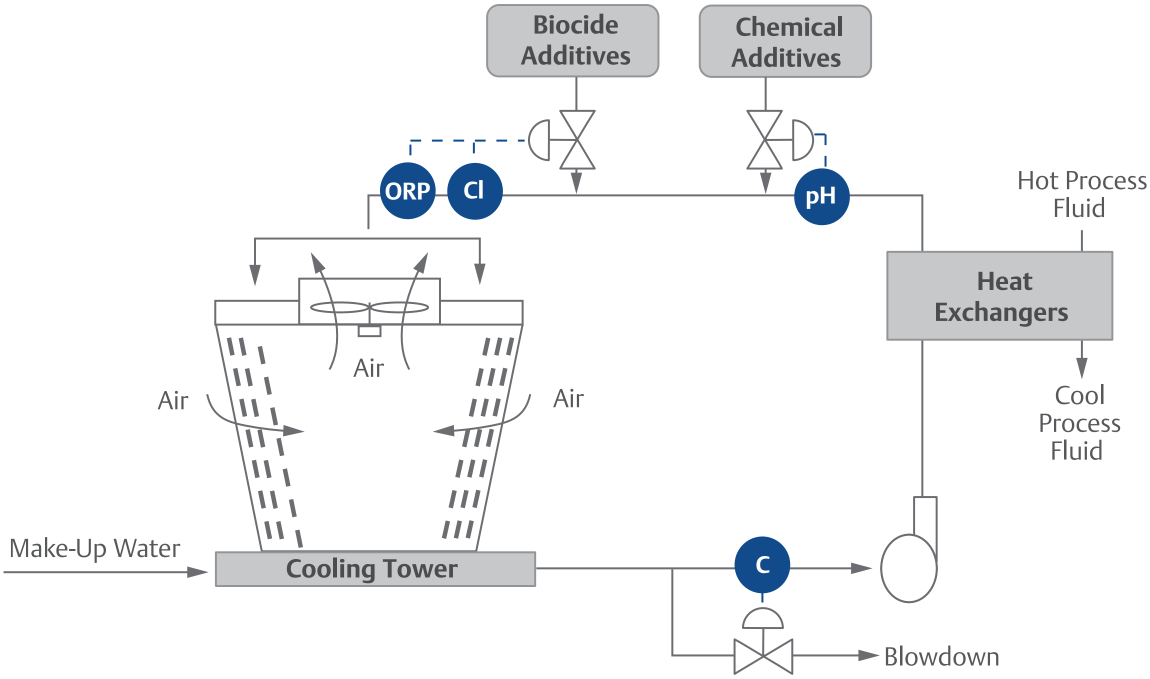
Conductivity Measurement

As cooling water is continually evaporated within the cooling tower, the low levels of dissolved solids present in the water become concentrated. Over time, these impurities cause scale and corrosion in the heat exchange equipment. The relative concentration of impurities in the water is measured by a contacting conductivity sensor. A controller initiates the opening of a blowdown valve when the conductivity becomes too high. This causes a demand for make-up water which has a lower concentration of impurities and thus lowers the conductivity of the overall system.

pH Measurement

Most of the impurities in cooling water are alkaline. The alkaline impurities, especially calcium carbonate, are less soluble at high pH values. Therefore, the pH of the cooling water is continually monitored, and a small quantity of sulfuric acid is added to the circulating water to lower the pH value to prevent the formation of solids (scale).

Figure 1 - Cooling Water System Control



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Chlorine, Ozone, and ORP Measurement

The warm water and air present in cooling water systems is an ideal environment for biological growth. The accumulation of algae and slime within the cooling water system coats heat exchange tubes and reduces process efficiency. These micro-organisms can also contribute to corrosion. To control algae and slime growth, biocides such as chlorine, bromine, or ozone are added at regular intervals, such as a given quantity once per day or once per week. When biocides are fed to the system the concentration of the biocide must be closely monitored and controlled.

The type of measurement system used to control the biocide feed depends on the type of biocide being used. Chlorine biocides should be monitored with either a free chlorine measurement system or a total chlorine measurement system, depending on the source and chemistry of the cooling water. If ozone is used as a biocide then the feed should be monitored using an ozone sensor. If a bromine biocide is used, then the appropriate monitoring system is an oxidation reduction potential (ORP) sensor.

The Emerson Solution

Emerson offers complete liquid analysis measurement solutions for cooling water control.

For monitoring conductivity the Rosemount™ 400 Contacting Conductivity Sensor is the right choice for most cooling water applications. For cooling water containing a high level of suspended solids the Rosemount 228 Toroidal Conductivity Sensor is recommended because its electrode-less design provides a reliable measurement even as the sensor becomes coated by solids from the process.

For monitoring pH the Rosemount 3900 General Purpose pH/ORP Sensor is the right choice for most cooling water applications. For cooling water containing a high level of suspended solids the Rosemount 396P pH/ORP Sensor is recommended because it features a larger area reference junction that provides superior resistance to the effects of coating.

ORP can be measured using either Rosemount 3900 or 396P ORP Sensor. Just as for pH, the preferred choice depends on the level of dissolved solids in the process water.

Free chlorine can be measured using the Rosemount FCL Free Chlorine Measuring System. This complete system does not require reagents and avoids the expense and inconvenience of sample conditioning.

Total chlorine can be measured using the Rosemount TCL Total Chlorine Analyzer. This system includes a sample conditioning and measurement system for continuous determination of total chlorine in water. The conditioning system continuously pumps buffered potassium iodide reagent into the sample. Free and combined chlorine (total chlorine) react with potassium iodide to form an equivalent amount of iodine. An amperometric sensor measures the concentration of iodine and sends its signal to the transmitter which displays the concentration of total chlorine.

Ozone can be measured using the Rosemount 499AOZ Dissolved Ozone Sensor. This sensor provides accurate continuous measurement of dissolved oxygen between 0 and 10 ppm.

All of these sensors are compatible with any Rosemount liquid analysis transmitter including the Rosemount 56 Dual Channel Transmitter which offers dual sensor inputs, a large full-color display, and built-in measurement and troubleshooting tips.

Rosemount 3900 General Purpose pH/ORP Sensor

Rosemount 400 Contacting Conductivity Sensor

Rosemount 499AOZ Dissolved Ozone Sensor

Rosemount FCL Free Chlorine Measuring System

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