Cooling Water Control

BACKGROUND

The chemical process industry, petroleum refining, utilities, and many other industries, use large quantities of water for cooling.

There is an increased emphasis being placed upon the re-use of cooling water by means of cooling towers. 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. The problems encountered in cooling systems are not usually with the equipment, but with the water. As the water evaporates, the dissolved solids concentrate. These impurities in water cause scale and corrosion in the heat exchange equipment.

PROCESS

There are many variations in cooling towers and heat exchange design. A common feature is the control of the water quality with the use of continuous pH and conductivity measurement while maintaining a given set of conditions. This is done to further minimize corrosion and protect the equipment. Continuous recirculation of the cooling water causes the concentration of the impurities to increase. The relative concentration of the impurities in the water is measured by a contacting conductivity sensor, such as a Model 400 sensor. A conductivity controller initiates the opening of a blowdown valve when the conductivity becomes too high. This causes a demand for make-up water, which is less concentrated in impurities, and thus lowers the conductivity.

Most of the impurities in cooling water are alkaline, which is indicated. The alkaline impurities, especially calcium carbonate, are less soluble at high pH values. Therefore, a small quantity of sulfuric acid is added to the circulating water to lower the pH value and thus prevent the formation of solids (scale). The ideal pH sensor for this application is the general purpose Model 3900. The Langelier Index is a factor obtained from calcium hardness, alkalinity, pH, conductivity, and temperature, and indicates scaling potential.

For cooling water containing a high level of suspended solids, a toroidal conductivity sensor such as the Model 228 and a fouling-resistant pH sensor such as Model 396P are recommended.

Corrosion and scaling are further minimized by the addition of chemical scale and corrosion inhibitors. Inhibitors are fed based upon one of three methods: on acid demand, on opening the blow down valve, and on operating the make-up water valve. Inhibitors are fed on acid demand when the acid pump runs and/or when the inhibitor pump runs. On opening the blow down valve, the inhibitor pump adds the inhibitor to another part of the system and precisely balances the loss of inhibitor by blowdown.

The warm water and air also produce an ideal environment for biological growth. To control algae and slime growth, biocides (i.e., chlorine or bromine) are added on a time basis, such as a given quantity once per day, twice per week, once per week, or by one of the above methods. Chlorine levels can be monitored using the chlorine sensor Model 499ACL.

Dispersants are added to prevent coagulation or flocculation of suspended solids (dust, living microorganisms, dead cells, etc.). Dispersants are added in the same manner as inhibitors.

Ozone treatment is a powerful alternative to chemical treatment and will reduce operating costs significantly while increasing safety. Unlike most chemicals, ozone has a half-life of only 20 minutes and will not be found in blow down water. The dissolved ozone sensor Model 499AOZ is intended for continuous measurement of dissolved ozone between 0 and 10 ppm. Use of ozone treatment has seen a growing interest for cooling tower control and is a cost-effective solution for many applications.

INSTRUMENTATION

Model 1056 Analyzer

- Multi-Parameter Instrument – single or dual input. Any combination of pH/ORP/ISE, Resistivity/Conductivity, Chlorine, Oxygen, Ozone, Turbidity, Flow.
- Large Display – easy-to-read process measurements.
- Seven Languages: English, French, German, Italian, Spanish, Portuguese, and Chinese.
- HART and PROFIBUS DP Digital Communications.

Model 400 Conductivity Sensor

- Fast and easy start up with predetermined factory cal constant (not for 1055)
- Rugged titanium electrodes
- Versatile mounting configurations for screw-in, retractable, or flow-through

Model 3900 General Purpose pH/ORP Sensor

- Extended sensor life provided by double junction reference.
- Maximum chemical resistance provided by rugged polyphenylene sulfide body, completely sealed to eliminate sensor leakage
- Optimum versatility with various mounting options.

Model 499AOZ Dissolved Ozone Sensor

- Rugged construction
- Automatic pressure equalization maintains correct membrane tension
- Quick cable to sensor disconnect — Variopol option

Model 499ACL Free Chlorine Sensor

- Measures free chlorine without sample pretreatment or reagent
- Automatic correction to 9.5 pH
- Easily replaceable membrane with no special tools required

For high solids or coating applications, use the following sensors:

Model 396P pH/ORP TUpH Sensor

- Polypropylene reference junction and helical pathway mean longer sensor life in process solutions containing heavy solids.

Model 228 Toroidal Conductivity Sensor

- Toroidal measurement principle greatly reduces sensor fouling problems.

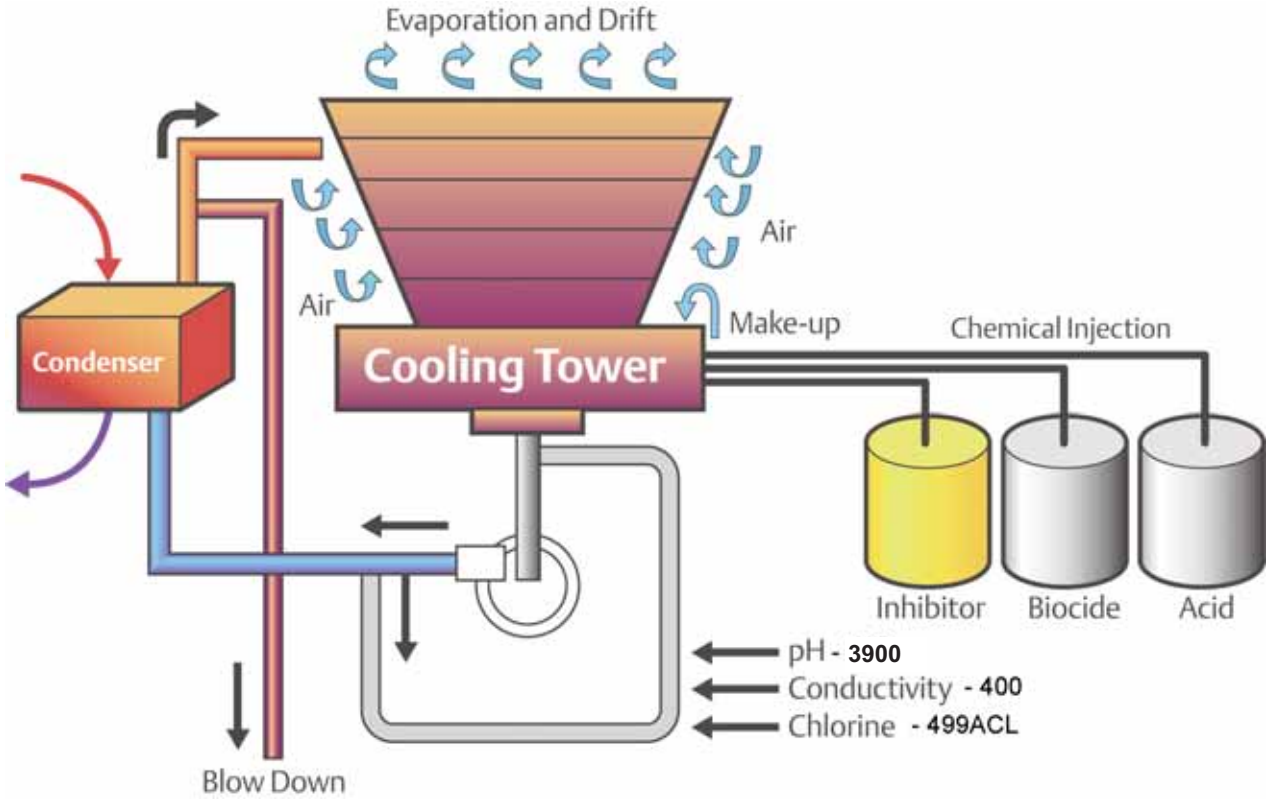

FIGURE 1. Typical Cooling Water System

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