RETURN CONDENSATE MONITORING

BACKGROUND

All water used to generate steam contains impurities. After removing as many of these impurities as possible through reverse osmosis, ion exchange, or other processes, there are still some impurities even if only in minute quantities.

As water is heated, the cleaner part of the water turns to steam leaving slightly less pure water in the boiler. As the steam passes through its processes, some of the steam is lost before it returns to the boiler. This lost water must be replaced with new makeup water. In time, the solids content of the boiler water increases to a point where the carryover of the dissolved solids into steam reach unacceptable levels.

In less critical applications, the build-up of dissolved solids can be controlled by boiler blowdown. In more critical applications, this can be monitored through the use of return condensate monitoring systems and the Model CH16D or Model CH16RB Larson-Lane condensate monitors. When the steam is used to operate a turbine, the requirements of the steam purity are usually very high, and the measurement of the steam itself may be used in addition to return condensate measurements.

PROCESS

If the steam is simply condensed and measured with a standard conductivity meter, there will be several problems. In all high purity water boilers, the ultra pure water, after it is purified as much as possible, has chemicals added to prolong boiler life. These chemicals increase the conductivity of the water and mask the conductivity of the dissolved solids.

Another problem is that the steam is at high temperatures and pressures. If the temperature and pressure decrease, it is possible that some of the solids dissolved in the steam will come out of suspension and may be deposited on the walls of the piping, rather than remaining in the condensed water where it may be measured.

To make accurate measurements of steam under these extreme conditions, we use the Model SC19 Larson-Lane Steam analyzer as is called out in ASTM D2186. To use this system, a steam sampling nozzle should be used on the steam line following ASTM procedures. This line should be connected directly to the pressure-reducing device on the input to the SC19 with as short a line as possible. If this line is more than a few feet long, steam tracing or other methods may be needed to ensure that the steam has not degraded prior to entering the system.

After the steam has passed through the pressure reducing device, it goes through a heating coil and enters the condensing chamber (1) where the cooling coils cause it to condense in the bottom of the chamber. This sample is held at temperatures near boiling, and gases are vented (2). See Figure 1.

The sample then passes through the first conductivity cell (3) for an optional specific conductivity measurement. Next, the sample enters the ion exchange chamber (4) where it passes through a cation resin. This cation resin converts solutions, which may be either basic, to water or certain salts, to acids, passing acids through unchanged (*see the CH16D application note for additional details on this). Thus, conductivity of the “bad stuff,” such as an acid, would be unchanged, while that of dissolved salts would increase 3 to 6 times. The conductivity of the “good stuff,” such as water treatment chemicals, will generally go to near zero. This way, the cation conductivity coming out of the resin column is caused by the undesirable materials in the water. After passing through the resin column, the water is reheated to just under its boiling point in the reboil chamber (5) where gases such as CO_2 and other volatiles are driven off through the vent (6).

The condensed sample is then measured by the second conductivity cell (7). This measurement is often made as a raw (non-temperature compensated) reading; however, in recent years it is becoming more popular to temperature compensate the system using a cation temperature compensator.

Using a system like this, one can expect to obtain a sensitivity of approximately 50 ppb dissolved solids. If greater sensitivity is needed, the SC19C would be used.

The SC19C system adds a second cooling chamber (8) [Figure 2] before the ion exchange chamber (4). Thus, the temperature of the system may be held constant with changing loads or cooling water temperature by the temperature controller (9). The rest of the system would be the same as in the SC19A. This second temperature controlled system, which is pneumatically operated, allows the SC19C to have a sensitivity of approximately 10 ppb dissolved solids.

INSTRUMENTATION

For this system to work, the customer must have a live steam sample and tap his steam line in such a way that the inlet to the SC19A or SC19C pressure-reducing devices is the same as in the steam line. Either system will require approximately 50 lb/hr (25 KG/hr) of steam and approximately 350 lb/hr (160 KG/hr) of cooling water below 32°C (90°F). The SC19C also requires 15-20 psi (104-138 kPa), of air for the temperature controller.

A Model 404 sensor and Model 1055 analyzer would be used for the measurement of the conductivity at the second cell outlet, as long as the conductivity is under 10 µS/cm. This system will either measure and control raw (non-temperature compensated) or cation temperature compensated conductivities. In some cases the customer may also want to measure the water at the first conductivity cell position. In this case the Model 404 Sensor and Model 1055 analyzer would also be used, if the reading is expected to be under 10 µS/cm. If it is consistently over 10 µS/cm, the Model 1055 analyzer may be used instead.

*See Application Notes ADS 4900-80 & ADS 4900-81 for related articles.

Model 1055 Dual Input Analyzer

- Temperature correction for high purity water, cation conductivity, linear temperature coefficient.
- Two 4-20 mA outputs
- Three fully-programmable alarms.
- Choice of enclosures for pipe, surface, and panel mounting.
- NEMA 4X (IP65) enclosure.

Model 404 Flow-Through Contacting Conductivity Sensor

- Small hold-up volume to ensure fast response to changing conductivity.
- PVC construction capable up to 60ºC.
- Optional 316SST construction up to 100ºC.
- Housing protects sample from air contamination.

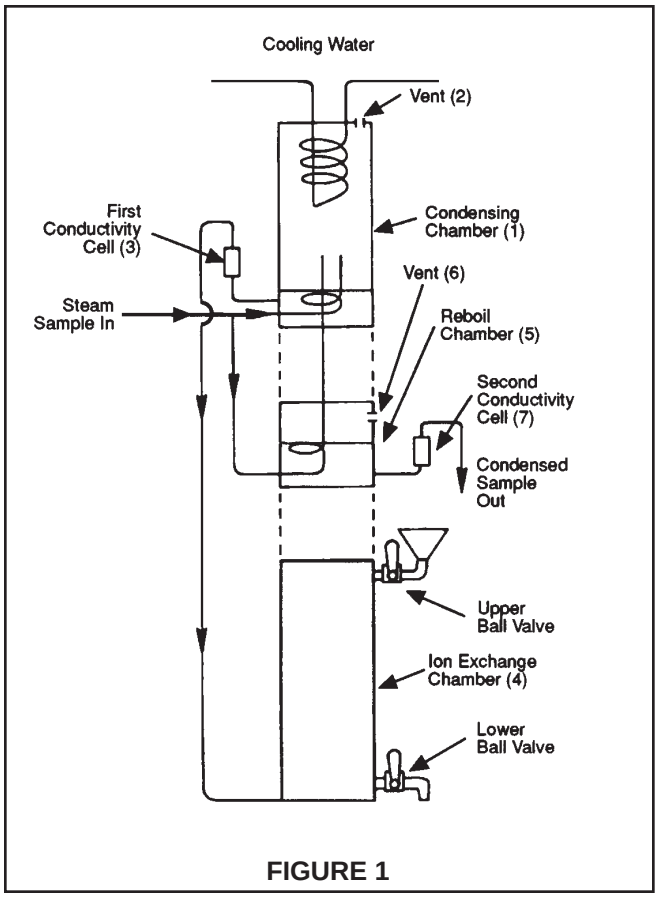

FIGURE 1

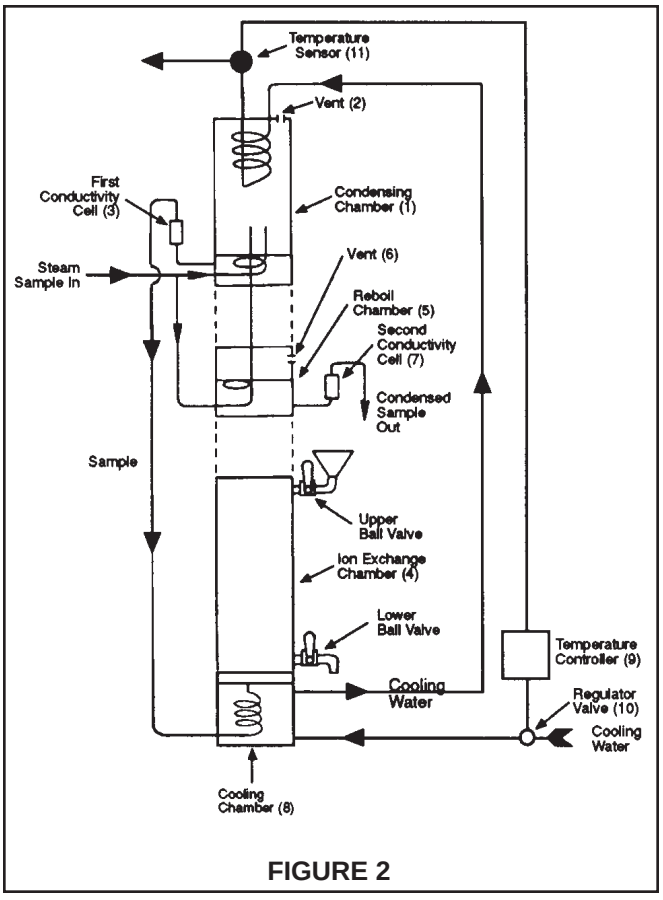

FIGURE 2

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