**Recommended Chemical Cleaning Procedure**

**for OSU 17DA Carrier Chiller Condenser**

**Per: Kansas Water Technologies**

1. The chiller condenser will be filled with water with the air vent on inlet/outlet side of the condenser open to verify that the condenser is completely filled. Matt Driskel fabricated a “stand pipe” in the outlet portion of the end bell to assure the cleaning solution completely covers the tubes. Venting air from the top of the condenser and routing the outlet hoses above the top of the condenser will assure cleaning solution is to the top of the condenser.
2. The inlet and outlet valves will be shut and blinded. Matt Driskel fabricated inlet and outlet blinds and connections for the condenser. This eliminates all inlet and outlet piping and 660 gallons of volume and valves from the cleaning process.
3. The 1” hose from the recirculation pump discharge will be connected to a 1 ½” fitting at the inlet water line. A 1” hose will be connected to the 1 ½” fitting at the outlet water line. This hose will terminate at the recirculation tank. Two 1” hoses , one from each 30 GPM pneumatic diagraphm pump were connected to the inlet of chiller condenser. Recirculation of 60 GPM provided adequate flowrates through the condenser tubes (1.4 ft/minute)
4. Water will be recirculated for 15 minutes to verify there are no leaks in the recirculation system.
5. 85 pounds of Corrshield inhibitor will be added at the recirculation tank to the recirculating water. This inhibitor will be recirculated for 2 hours prior to adding sulfamic acid to the recirculating tank.
6. In order to enhance the effectiveness of sulfamic acid we will add a heating coil loop into the recirculation tank which will recirculate hot water from the plant’s hot water boiler closed loop. This will add heat to the recirculation loop. The solution will be heated to a maximum of 110-120 deg F. The heating of the solution will begin during the process described in No. 5 above. A 4000 BTU per hour heating coil was used to heat the cleaning solution with the plant’s hot water boiler loop. A larger heat exchanger or beginning the solution heating a few hours prior to adding acid is recommended.
7. A 10% solution of sulfamic acid will be prepared as per the specification in the RFQ. This will require the addition of 2835 (2500)pounds of sulfamic acid. The addition of the acid to the recirculation tank will require internal recirculation of recirculation tank followed by system recirculation over several cycles to add the full 10% acid to the system. This is because of the limited solubility of sulfamic acid in the recirculation tank.
8. Antifoam will be available as needed to control excess foaming of the recirculating cleaning solution. About 1 Gallon of antifoam was used in the process to control foam.
9. Percent acid tests of the recirculating cleaning solution will be run continuously during the addition of the acid.
10. Calcium hardness levels of the recirculating cleaning solution will be checked periodically during the cleaning procedure.
11. The recirculation of the cleaning solution will continue until the percent acid and calcium levels are stable for a minimum of 2 hours.
12. The final recirculation solution will be sampled and tested to determine the amount of caustic soda necessary to neutralize the cleaning solution to the pH levels specified in the attached Authorization by the City of Stillwater Environmental Programs Department to discharge neutralized wastes. Neutralization of the cleaning solution was difficult because of residual undissolved acid in the chemical mix tank. Neutralizing the mix tank of all residuals before neutralizing the system cleaning solutions will speed the neutralization process.
13. The recirculating cleaning solution will be batch treated in 250 gallon batches and discharged to the sanitary sewer as per the above mentioned authorization. Approximately eight 300 gallon batches were pH adjusted with caustic soda and as needed sulfamic acid to achieve pH 6-9 in the solution before discharging to the sanitary drain at the front of the chiller.
14. After the chiller is drained the blinds will be removed and the chiller will be flushed with fresh makeup water. The pH will be checked and flushing continue until the recirculating water is within .2 pH units of the fresh makeup water. The chiller was flushed with fire water. The chiller was flushed a minimum of three times to remove residual acids and or caustic solutions.

Notes: Attached are the following. These items were attached the original quotation.

1. An MSDS for sulfamic acid
2. An MSDS for the Corrshield Inhibitor
3. An MSDS for caustic soda
4. A product fact sheet for the Corrshield inhibitor
5. Calculation of total water volume in condenser and chemical requirements
6. A log sheet of chemicals added, temperature, percent acid and calcium levels will be provided.
7. A process diagram for the cleaning process is attached.
8. Authorization by the City of Stillwater Environmental Programs Department to discharge neutralized wastes at the plant.

Prepared by: Eric Fraser, Kansas Water Technologies, November 15, 2011 Revised January 10, 2012