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PURGING OF SURFACE CONDENSER TUBES
CA-719 - STUDY REPORT

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In our meetings of December 2, 1957, and December 5, 1957, a suggestion was adopted to install a funnel type discharge in each cell for the effluent cooling water from the condensers. The justification being that this would be less costly than the remote connection previously specified. This necessitated elimination of originally specified cross connections in the cold pipe gallery to permit reversing the flow through the surface condensers for cleaning purposes.

There has been much concern about fouling the inside and the outside of the condenser tubes. Since the above change effects the selection of a method for purging, it was suggested that the possible methods for purging the inside of the tubes be further investigated. The vapor side of the tubes will be taken care of to a limited extent by the provisions of adding a water spray at the vapor inlet on each condenser.

Our problem has been discussed with RW Reid, DL Moore, JP Cooke, WR Conley, Elliot Bailey, JF Hokenson and JA Ayers of the reactor areas as well as WA Haney and FE Adley. The conclusions are that:

1. Suspended solids in the cooling water will be a major factor in the film and scale buildup on the inside tube walls.
2. Our low velocities, 5 ft/sec or less, with the low pressures obtainable from the 201-A head tank for normal flow will contribute to the film and scale buildup and these velocities are inadequate for effective purging.
3. An acid purge might be effective, but would be injurious to the 304 surface condensers and the carbon steel effluent piping, as well as the corrugated effluent pipe to B swamp or Gable Mountain.
4. A sodium dichromate addition may give some protection from corrosion to the tube walls by plating out of the dichromate, but will give little benefit from film removal or reduction of scale buildup.
5. A diatomaceous earth purge would require considerable equipment to provide the velocities needed for effective purging. In addition, it has considerable risks in that, even though the number of parts per million of diatomaceous earth are small, it has a strong tendency to settle out and plug the lines. For these reasons, most supervisory personnel in reactor operation are reluctant to purge the reactor tubes any more than is absolutely essential.
6. The surface condensers maximum design operating pressure is lower than would be required for purge equipment to produce the tube velocities used in the reactor areas.

7. Approximately 4,000 gpm at 125 psi is the maximum which a surface condenser can handle on an individual purge. This could be obtained by a large tie-in line from the raw water header or by a large storage tank and pump situated near or at the surface condenser building.
8. Assuming the tie-in to the raw water header was not made, the purge equipment needed for item 7 for a five minute purge would be as follows:
 - One 4,000 gpm 125 psig discharge with a 375 HP motor, starting equipment and transformers.
 - One 25,000 to 30,000 gallon carbon steel storage tank.
 - One 10 gallon stainless steel mixing tank.
 - One agitator for the mixing tank.
 - One proportional pump with a 150 psig discharge and a 0.1 to 1.0 gpm capacity.
9. The equipment outlined in item 8 is costly and consequently it would not be appropriate to add this to the present project.
10. The 4,000 gpm from one condenser during a purge with a funnel type discharge from the condensers plus the normal discharge from the other condensers would present some problems with the discharge system.
11. Reactor area experience indicates that tube fouling might be a serious problem. However, experience with surface condensers in Purex and Redox does not indicate that the tube fouling would be a serious factor. It is therefore recommended that the inlet water lines to each surface condenser be provided with an 8" blanked stub and appropriate fittings to permit the addition of purge equipment at some future date. This purge equipment would permit operation at higher pressures than the normal cooling water supply system. It is further recommended that any additional project action on facilities for purging the inside of the surface condenser tubes be delayed until some operating experience has been obtained on the surface condensers.

Additional comments and information on purges in the 100 Areas, as well as the CA-719 surface condensers, are presented on the attached sheets.

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ATTACHMENT "A"PURGING CA-719 SURFACE CONDENSERS

Should diatomaceous earth be used as purge material on the surface condenser installation, it may be desirable to follow the purge with a sodium dichromate additive as an inhibitor to prevent corrosion on the tubes.

The sodium dichromate is toxic with small quantities being hazardous to fish life. However, in the surface condenser application, the purge material would be diluted with the main Purex cooling water stream before it reached the "B" swamp or the pond on the south side of Gable Mountain. The use of sodium dichromate has been discussed with WA Haney and FE Adley and there appears to be no problem.

The discharging of the diatomaceous earth purge material to ponds would tend to reduce the seepage rate to ground at the pond area. The action would not be too dissimilar to that of adding Bentonite to the water in surface ponds. If diatomaceous earth is used as a purge material for the condensers, larger tanks, mixers and pumps would be required, since raw water supply to the surface condenser building is not of adequate volume to give the needed tube velocities.

Tube cleaning - Water side of surface condensersMethods:

- A. Diatomaceous earth purge.
- B. Sodium dichromate - zinc sulphate.
- C. Agitation by injection of air (a possibility)

Passes and Tubes

6 passes of 94 and 96 tube units.

Tubes - 1" O.D. 12 gage BW tubes per pass .5452 sq. in. per tube.

Volume

5,709 gpm per condenser would be required to give 35 ft/sec tube velocity.

800 gpm per condenser for 7.13 ft/sec tube velocity is the maximum obtainable from 201 head tank.

4,000 gpm per condenser for 24.5 ft/sec tube velocity is the maximum possible at maximum design pressure.

ATTACHMENT "B"Reactor Area Purge DataType of Material - Quality

Johns Mansville "super cell"
Dicalite Division Great Lakes Carbon "Dicalite Special Speed"

Time of Purging - Reactor Tubes

30 minutes to one hour - for reactors.
3 to 5 minute test on 105 KE test section dropped inlet pressures
20 to 30 psi.

Water Velocity in the Tubes

35 feet per second range 30 to 40 ft/sec.
Header pressure 600 psi, tube 400 psi.

Mixing Time - Slurry

Depends upon capabilities of mixing equipment. Minimum time about one hour.

Slurry Mix - Proportions

Fifteen - 50 lb bags to 1,100 gallons of water. Mixes of 5% and higher
have a strong tendency to settle out. Range 0.1% to 5%.

Concentration in Tubes

25 parts per million.
1 part per million used on the 3 to 5 minute test at 105 KE. (This test
resulted in a 20 to 30 pound reduction in pressure drop on the tubes.)

Special Equipment

32 mesh screens are used ahead of the injection pumps in addition to
header and tube screens.

General

Suspended solids in raw water is a major factor in scale and film buildup
on the tubes.

Low pH of raw water increases tendency for film buildup.

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Purging is more effective when temperature of the reactor tube is high. There is considerable reluctance by supervision in reactor groups to use this purge in the reactors because of the tendency for the diatomaceous earth to settle out and cause plugging. The material is of such a nature as to be very difficult to unplug once it has settled out.

It is very important to keep the slurry moving and to have the diatomaceous earth well wetted before injection.

Data from RW Reid

DL Moore

JP Cooke

WR Conley

E Bailey

JF Hokenson

JA Ayers

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