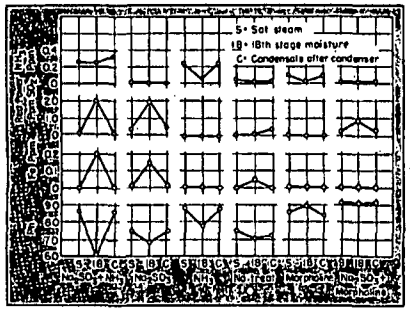
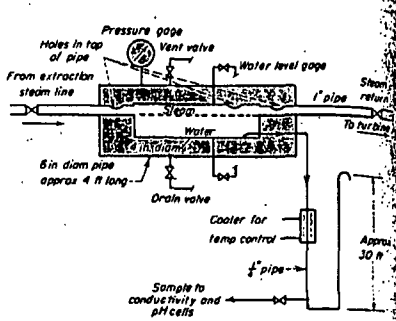
TECHNICAL BRIEFS

Latest engineering developments for busy power men

9 Digests for you on:
WATER TREATMENT
INSULATION
ELECTRICAL EQUIPMENT



1 Potential metal pickup in the preboiler cycle by various suspected materials was the basis for above test curves



2 Special apparatus for running metal pickup tests, left, required removing condensate from steam before it cooled

Water Treatment Gets Heavy Attention

Prevention of Metal Losses in the Wet Steam Areas of Steam Turbines. *By F L Archibald and John W Purssell Jr, Boston Edison Co; Frederick C Straub, University of Illinois.*

This paper deals with the potential metal pickup in the various portions of the preboiler cycle from the initial point of moisture condensation in the turbine, through the condensers, heaters, pumps and economizers. It shows the effect of the various materials such as sulfur dioxide, hydrogen sulfide, carbon dioxide, oxygen, ammonia and organic amines on the metal pickup in the cycle. Stress is laid on the temperature and vapor pressure relationship of these materials at the points of condensation in the turbine and condenser. This has resulted in the modification of the chemical treatment to prevent metal pickup in the cycle. Some early experience in Hydrozine is also presented.

Early in 1952 a program of investigation was started at Mystic Station to study the effect of the various chemicals used in the water treatment on the iron pickup in the areas of metal loss. In order to determine the composition of the moisture as it forms in the turbine it was necessary to remove the steam water mixture from the machine and separate the water from the steam for further testing. It is important that the condensate be removed from contact with the steam before cooling to insure duplication of conditions within the turbine. The moisture was starting to form in the region below the 18th stage which was about 15 psia under full load oo the turbine and down to 4 or 5 psia under low loads. The apparatus used for sampling is shown in Fig. 2, above. This allows for a continuous sample of the water separated from the steam to be cooled and then tested for specific conductance and pH before exposure to air. Samples could then be collected and analyzed for iron, ammonia and reducing power. The sampling equipment was constructed of 18-8 stainless steel in order to reduce iron contamination.

The results of the tests, Fig. 1, above, run with the regular water treatment in use, showed that when the pH of the steam leaving the boiler was around 9.0, the sample of water removed from the 18th stage of the turbine had a pH between 6 and 7 and the condensate at the condensate pumps had a pH around 9.0. The ammonia content was about the same at the three sampling points. Tests run to determine the reducing power of the steam showed almost a tenfold increase in the 18th stage sample with a marked increase in iron pickup. The reducing power was thought to he the result of liberation of sulfur dioxide from the sulfite in the boiler water, since it varied in proportion to the sulfite content of the boiler water. No hydrogen sulfide could be detected at any time.

These results indicated that the sulfur dioxide was concentrating in the liquid phase to form sulfurous acid. The ammonia was partially neutralizing the acid but was not present in sufficient amounts to increase the pH to the desired range. This decrease in pH in the liquid phase in contact with the metal in the turbine would tend to allow the iron to go into solution as the soluble ferrous hydroxide. When the temperature decreases and the liquid tends to be subcooled below its steam saturation temperature the ammonia dissolves in the liquid raising the pH. Thus at the condensate pump the pH approaches basic.

This increase in pH decreases the solubility of the ferrous hydroxide and causes the precipitation of the iron on the lower pressures blades and diaphragms and on the condenser tubes. Often it does not show as soluble iron in the condensate samples taken at the condensate pumps since it has already been precipitated out of solution.

Several of the chemicals being fed to the cycle were then varied in order to study their effect. Fig. 1 shows in graph form a summary of the results.

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