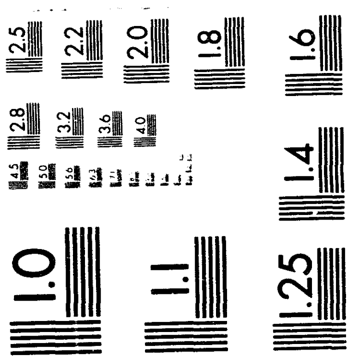
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HW-3-2710

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1 - C. N. Gross
2 - W. O. Simon - B. H. Mackey
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3 - N. H. Wahl, Wilmington
4 - F. H. Dineen - K. W. French
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June 25, 1945 COPY 1

THIS DOCUMENT CONSISTS OF 4 PAGES NO. 1 OF 10 COPIES, SERIES A

To: C. N. Gross, Superintendent
P Department

From: C. P. Kidder
100 Technical

UNIT PURGING

While the present method of purging a pile with 100 ppm. of turbidity for one hour, when the unit is down, is satisfactory to the extent that it is keeping film formation within limits that appears safe from a corrosion viewpoint, nevertheless certain modifications to increase the effectiveness of equipment and improve the technique of purging can be made to effect more complete film removal, less corrosion, and less downtime.

This memorandum presents these modifications, together with a brief review of the events and observations that led to the present purging procedure, which in turn serves as a background for a discussion of the reasons behind the proposal of changes in equip[illegible]

A Production Test [illegible] for review and approval. In[illegible] ment and purge procedure are [illegible]

(1) Install twin 50-me[illegible] headers to control [illegible] Department is plan[illegible]

(2) Install fine mesh [illegible] process water line[illegible] inch cross-header [illegible]

(3) Replace the presen[illegible] headers with 30-me[illegible] for F).

(4) Through the medium [illegible] frequency of low c[illegible] as a method to mai[illegible] Only minor modific[illegible] enable purging one [illegible] manner.

CLASSIFICATION CANCELLED
DATE 9-15-60
For The Atomic Energy Commission
H. F. Carroll
Chief, Declassification Branch

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HW-- 3 - 2710

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This memorandum presents these modifications, together with a brief review of the events and observations that led to the present purging procedure, which in turn serves as a background for a discussion of the reasons behind the proposal of changes in equipment and method.

A Production Test to prove the merit of the proposals is being prepared for review and approval. In the meantime the following modifications to equipment and purge procedure are enumerated for consideration.

(1) Install twin 50-mesh screens in Building 185 chemical pump suction headers to control suspended solids in the feed solutions (The Power Department is planning to install these).

(2) Install fine mesh screen in the perforated plate strainers in the process water lines in the valve pit to reduce the burden on the 4 inch cross-header screens. (A project has been approved to do this).

(3) Replace the present 50-mesh Dutch twill screens on the unit cross-headers with 30-mesh square weave screens. (This has been approved for F).

(4) Through the medium of a Production Test determine the efficacy and frequency of low concentration short duration purges while operating, as a method to maintain film accumulation and corrosion at a minimum. Only minor modifications to existing equipment would be required to enable purging one tube in each of the four orifice zones in this manner.

[redacted]

(5) After the above alterations have been completed, and assuming the proposed Production Test discloses no undue limitations from an operating or retention basin activity viewpoint give consideration to short frequent purges through one or more risers at a time while the unit is running. The exact duration and frequency of the purge as well as the turbidity concentration will be ascertained from the Production Test.

Discussion

Calculations based on corrosion data and theoretical considerations have indicated specific maximum amounts of film, for various temperatures and power levels, that may be prudently allowed to accumulate, from a corrosion viewpoint, in the respective orifice zones of the pile (Document 3-1844 and Supplement 3-2206). In order to prevent iron and aluminum film formation from exceeding the prudent maxima it has been necessary to purge each of the units with 50 to 100 ppm of diatomaceous earth for 30 to 60 minutes on an average of every 30 days. All purges to date have been made with the units down. Film removal in this fashion, though not complete, has been sufficiently thorough to enable the operation of the piles within probable safe pressure drop limits. However, the present purge procedure which calls for feeding 100 ppm of turbidity for one hour with the unit down presents several undesirable features that can be modified to provide a more efficient film removal technique, less corrosion for a given power level, less downtime, and probably less activity in the river. Before considering the shortcomings of the present purge procedure and potential corrective measures, consideration will be given to developments leading up to the selection of turbidity as a purging agent.

Experience at CMX indicated that under various conditions deposits of iron (hydrated ferric oxides), aluminum, tri-valent chromium, calcium carbonate, calcium oxalate and magnesium silicate would be precipitated from process water onto the aluminum tubes and slugs. It was found that these films either individually or in combination adversely effect heat transfer and cause higher metal surface temperatures which increase aluminum corrosion. In order to control film formation within tolerable limits several purge procedures were developed. Fifty to 100 ppm of oxalic acid at 3.5 - 4.0 pH (low pH reduces the amount of calcium oxalate precipitated) was found to be very effective in removing iron and aluminum films provided the temperature of the solution is above 50°C. Fifty to 100 ppm of turbidity such as diatomaceous earth, having a particle size of 5 to 40 microns, was found suitable at normal operating pH for removing iron, aluminum, and magnesium silicate films either at room or elevated temperatures provided 2 ppm of sodium dichromate is present to prevent abrasion of the aluminum. Neither of these purge procedures will remove a tri-valent chromium film and if this latter deposit is formed 50 to 200 ppm of hydrogen peroxide at 7.5 - 8.0 pH was found to be effective in oxidizing the tri-valent chromium to a soluble dichromate.

Calcium carbonate deposits were found to form at a pH of 9.0 or above. These can be removed readily by reducing the pH to 5.5 or less. Calcium oxalate deposits may occur if more than 5 ppm of oxalate ions are present at a pH above 4.0. Magnesium silicate may form at a pH of 9.0 or above and turbidity is the only known method for removing this type of film.

Shortly after start-up of 100-B when film formation had progressed to an objectionable amount, several unsuccessful attempts were made to purge the unit with 50 ppm of 3.5 - 4.0 pH oxalic acid at room temperature with the unit down.

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In order to establish whether the ineffectiveness of the oxalic acid purge was due to the presence of a tri-valent chromium film or because of too low a temperature Production Test 105-22-P was conducted. In this test three selected tubes in the B unit were purged individually with three different purge waters while the pile was down. One tube was treated with 50 ppm of turbidity (Super Cel) for 1 hour at normal flow rates, followed by 100 ppm of turbidity for a maximum of 1 hour. The second tube was treated with 50 ppm of 3.5 pH oxalic acid preheated to 50° C. for 1 hour at normal flow rates. The third tube was treated with 200 ppm of H_2O_2 for 1 hour followed by 50 ppm of 3.5 pH oxalic acid at 50° C. for 1 hour.

From the above tests it was concluded that 50 ppm of turbidity was about 80% effective in removing film and 100 ppm was more effective. The completeness of removal increased with turbidity concentration and purge duration. The hot oxalic purge removed the iron or aluminum film successfully, as judged from activity measurements of tube effluent water, but only slight improvement in pressure drop was obtained due to the deposition of a calcium oxalate film. It was established later on that sufficient time had elapsed after the introduction of the oxalic acid into the calcium bearing process water to allow calcium oxalate to form. This deposition of calcium oxalate can be avoided by removing the calcium from process water, by filtering out the calcium oxalate after formation, or by introducing the oxalic acid at the tube entrance so that there is insufficient time for precipitation to occur before the purge water passes through the tube. Any of these corrective steps would require major alterations to present equipment which is not warranted at the moment. As was expected, hydrogen peroxide did not remove any film, indicating that tri-valent chromium was not responsible for the pressure drop.

As a result of the favorable performance of 100 ppm. of turbidity at normal flow rates in the above tests, this method of purging has been used exclusively in all areas for recent purges. While it has permitted keeping film formation within reasonable bounds, several modifications to equipment and purge procedure should be made to increase operating efficiency, decrease slug corrosion, and reduce river activity.

1. The present 50-mesh Dutch twill cross-header screens are so fine that they frequently collect sufficient foreign material to interfere with complete passage of 100 ppm. of diatomaceous earth for one hour. This either results in decreased flow of water to certain tubes or necessitates a time consuming program of cleaning screens. It also reduces the completeness of the purge.

This condition may be materially improved by installing fine mesh screen in the perforated plate strainers now installed in process water lines in the valve pit. A pre-screen such as this, which can be removed for cleaning frequently while operating, will reduce foreign material accumulations on the cross-header screens. Further assurance against plugging may be attained by replacing the present 50-mesh Dutch twill cross-header screens with 30-mesh square weave screen, since the latter type of screen has been shown to be much less susceptible to blinding by diatomaceous earth.

2. Film removal is not complete particularly in the outer, low velocity zones after a 1 hour purge with 100 ppm. of Super Cel. Incomplete cleaning results

[redacted]

[redacted]

in a higher slug surface temperature with attendant higher corrosion than would be encountered if slugs were maintained in a relatively clean condition.

More thorough cleaning of the slugs may be accomplished either by a longer purge while the unit is down or by more frequent short purges while the pile is operating. The latter technique would keep film formation and corrosion low at present power levels with no loss of production time, or it would permit higher operating levels without increasing slug corrosion above current values. In either case the use of modified screens as reviewed under item 1 would be advisable.

3. The present practice of shutting down the pile before purging, even though a discharge takes place during the shutdown, results in $2\frac{1}{2}$ to 8 hours lost production time, depending upon the number of cross-header screens that have to be cleaned or replaced.

With improved valve pit and header screens it would be feasible to purge more frequently, for less than an hour, while the pile is operating. While it is not anticipated that screens would plug under these conditions, it is worth mentioning experience has shown that when screens do plug the reduction in flow is gradual, and by stopping the turbidity feed at the first indication of abnormal flow rates the screens would free themselves rapidly without a detrimental decrease in water to the unit.

4. In general, activity in the 107 retention basin increases as the amount of film in the unit increases. With other influences constant, it is believed that a lower retention basin activity would result from a unit in which a low level of film formation was maintained at all times.

C. P. Kidder
C. P. Kidder, 100 Technical

CPC:llj

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