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HW-12492

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S. E. Gylesen
BY *J. F. Lewis* DATE *8-13-90*

Wells
#2 - J. Greninger - 700
#3 - JW Connolly - WE Johnson
#4 - IF Measley
#5 - WK Woods
#6 - HW Ritchey
#7 - 300 File
#8 - Pink
#9 - Yellow

HW--12492

DE91 002678

Richland, December 1, 1948

Mr. H. T. Wells
Contact Engineer, Bldg. 105
P Division

TRANSMITTAL CONTROL NUMBER

HANFORD
51214

PROCESS WATER SPECIFICATIONS, GED-13

The following is submitted in compliance with your request of November 18, 1948:

1. Specifications for the chemical content of the effluent water.

Specifications covering all possible compositions of effluent water are not considered since the composition of the water which is available for cooling eliminate such possibilities as chemical contamination of the river.

From the standpoint of corrosion of both concrete and metals, the pH of the water should be maintained at approximately 7.5 and the total content of CaSO_4 , MgSO_4 , and Na_2SO_4 should be below 300 ppm. Lower values of pH might be permissible under conditions of very low mineral content. Dichromate and silicate are added at present to retard metal corrosion.

Maximum allowable radioactivity of effluent water is specified as 4.17 mcp per hour (contact immersion). Activity due to sulphur 35 is limited to a maximum of 0.02 microcuries per liter. No limiting concentration is specified for other elements, but appreciable radioactivity of any structural element of the body such as calcium and phosphorus is to be avoided.

2. Present analysis of effluent water.

Mineral content of the effluent water can be inferred from analyses of the influent. Some changes occur due to seasonal variations. A somewhat typical analysis, made in March, 1948, is as follows:

pH	7.45
Iron	0.02 ppm (all dissolved)
Silicate	7 (6.5 ppm added)
Dichromate	2 (added)
Sodium	4.5 (2.5 ppm added)

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December 1, 1948

Chlorine	0.15	
Chloride	1.3	
Calcium Carbonate	59	(by alkalinity titration)
Calcium	21	
Magnesium	4.9	
Sulfate	23	
Turbidity	11	

As well as inducing some radioactivity in the mineral constituents, passage through the pile causes chemical changes. The presence of 0.34 ppm of hydrogen peroxide in the effluent is the only such effect reported. The presence of decomposition products such as dissolved hydrogen is also probable.

3. Any corrosion effect resulting from the presence of radioactive salts in proposed recirculating system.

No acceleration of corrosion due to radioactivity has yet been observed. Normal service life for stainless steel, aluminum, zinc, and galvanized malleable iron is predicted from observations of their behaviors in effluent water at temperatures up to 90°C. From these data and the theories pertaining to corrosion mechanisms, it may be concluded that radioactivity of the effluent will have no effect, or perhaps have a slight beneficial effect on the corrosion resistance of all metals which are protected from corrosion by the formation of oxide films. Radiation does, however, cause embrittlement of organic materials such as plastics and rubbers, and renders glass opaque.

4. Effect of radioactive salts on effectiveness of zeolite.

So far as is known, no direct experience nor experimental evidence is available in regard to the effect of radiation on zeolite. Two possible mechanisms of influence might be presumed. One is a direct decomposition of molecular structure due to ionization by radiation. Calculations show that radiation absorption of 1 to 10×10^6 r could be expected to break 1% of the covalent chemical bonds, which in turn might be expected to produce detectable damage. Such damage would occur in a minimum of ten years if the zeolite were in contact with the most active effluent water immediately as it leaves the pile.

A second possible effect is more obscure, more difficult to evaluate, and far less probable. This involves a change in the electrical nature of the zeolite structure which might cause loss of base-exchange activity. It is doubtful if such a phenomenon could occur at the relatively low radiation levels encountered.

Dr. J. H. Wells

December 1, 1948

5. Radiation level to be expected in 100% recirculating cooling-water system not employing demineralization.

This question is treated in a letter from J. M. West to H. T. Wells now in preparation. Calculations presented in this letter place the total radiation level at approximately 10 mrop per hour (contact immersion) after 6 hours retention, of which approximately 90% is due to the sodium 24 isotope. It should be noted that demineralization with zeolite (replacement of calcium and magnesium with sodium) would cause a substantial increase in the activity of recirculated water.

LWR

File Technology Division

HW Ritchey/rs

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