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**FINAL REPORT
HALF-PLANT ZETA POTENTIAL TEST**

R. G. Geier

and

G. W. Wells

December 4, 1967

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FINAL REPORT
HALF-PLANT ZETA POTENTIAL TEST

I. INTRODUCTION

With the exception of N Reactor, the production reactors operated by Douglas United Nuclear, Inc., use treated Columbia River water as the coolant on a once-through basis. Thus, radionuclides formed largely by the neutron activation of river salts are discharged to the river. One method of reducing the quantity of radionuclides in the effluent is to increase the efficiency of parent isotope removal during the coolant treatment process.

Prior to 1961 the water treatment process had been improved to the point that reactor quality coolant could be produced using an average alum flocculant feed rate of 6 ppm. Laboratory experiments carried out in 1959 and 1960 demonstrated that a markedly increased removal of parent isotopes resulted when alum feed rates in the neighborhood of 20 ppm were used. This was confirmed by two half-plant tests of short duration.⁽¹⁾ In July, 1961, all water treatment plants began to feed alum at a somewhat arbitrarily selected rate of 18 ppm. The practice did reduce the amount of radionuclides in the effluent. However, it was recognized that an alum feed rate of 18 ppm is not necessarily optimum throughout the year. During certain periods it may be well in excess of requirements and overfeeding could be as detrimental to efficient parent isotope removal as underfeeding. Thus, a continuing effort has been underway to find a method for controlling alum feed rate to an optimum value.

Flocculant feed rate control based on producing a constant value of the electrokinetic charge (zeta potential) of the floc has been practiced at some water treatment plants. Although the hypothesis has not had universal acceptance in the water treatment field, laboratory and field data^(2,3,4) accumulated at Hanford indicated that further evaluation of the approach was warranted. In order to determine the effects of coagulant control based on zeta potential a half-reactor test was initiated at C Reactor on September 1, 1966.⁽⁵⁾

The data obtained during the first seven months of the test have been summarized previously.⁽⁶⁾ The test was terminated August 31, 1967, and it is the purpose of this report to present the results of the test.

II. SUMMARY

The half-plant test comparing an alum feed rate of 18 ppm to an alum feed rate adjusted to produce a zero zeta potential was terminated after one year. The average concentrations of phosphorus-32 and arsenic-76 in the test side effluent were nearly identical to those in the control side effluent. Thus, it can be concluded that no improved parent isotope removal resulted. However, it was also shown that there were no detrimental effects from the variable feed rate.

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Since the variable feed averaged 15 ppm for the year, the use of zeta potential for water plant control was initiated at B and C Reactors on September 1, 1967 and at the K Reactors on November 6, 1967. It is estimated that an annual savings of \$20,000 will result.

III. DISCUSSION

A. General

In nature nearly all colloids are electronegative. Such a condition results from an electropositive particle being surrounded by a layer of negative ions which have been drawn to the colloid by electrostatic attraction. Some of the oppositely charged ions (counterions) are so strongly attracted that they will adhere to the surface of the colloid as a firmly attached layer, known as the Stern layer. The Stern layer partially neutralizes the charge of the colloid so that the remaining counterions can be further away even though still held in the immediate vicinity of the colloid. They form the so-called diffuse layer. The zeta potential is the electrokinetic charge at the boundary separating the Stern layer from the diffuse layer. The influence of the colloid toward ions and other colloids is governed by the magnitude of the zeta potential, and the stability of a colloidal suspension is derived from the mutual repulsion of like charges.

The application of zeta potential in water treatment is based upon the hypothesis that improved agglomeration and flocculation will occur when repulsive forces between similarly charged colloids are eliminated by regulating the coagulant feed rate to a value that will result in essentially zero zeta potential. The improved flocculation would be expected to result in an increased removal of the isotopes which are activated to become effluent radionuclides.

B. Operating Conditions

1. Alum Feed and Zeta Potential

On September 1, 1966, the alum feed rate on the far (south) side of the reactor was reduced to a rate which would produce a floc zeta potential of zero based on readings taken every four hours. The alum feed rate on the near (north) side was maintained at 18 ppm. These conditions were maintained until December 1, 1966. At that time the alum feed rate on the far side was increased to 18 ppm, and the near side feed rate was reduced to the value required to produce a floc zeta potential of zero. In other words the test side of the reactor was changed from the far side to the near side. The latter

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conditions were maintained through August, 1967. The daily average alum feed rates to both sides of the reactor, the floc zeta potentials, and the raw water zeta potential for the first seven months of the test were presented in Reference 6. The data for the last five months of the test are given in Tables I through V. The data are summarized to monthly averages in Table VI.

It will be noted that the 12-month average alum feed was 18.0 ppm on the control side. This produced a zeta potential near zero in September, 1966. The zeta potential increased in the positive direction until January and February 1967 when it reached +4 mv. At that point it began to decrease toward zero and reach -2 mv during May and June after which it increased to near zero again.

The control of the test side alum feed rate to produce a zero zeta potential was excellent with a preponderance of the daily values being zero. The 12-month average alum feed rate was 15.1 ppm. The alum feed rate decreased from 16 ppm in September 1966 to 11 ppm in December 1966 and January 1967. It then increased to 22 ppm in June 1967 and then decreased to 17 ppm in August 1967.

2. pH and Sodium Dichromate

A sodium dichromate feed rate of 1 ppm and a coolant pH of 6.6 were maintained on both sides of the reactor throughout the test. All of the acid required on each side of the water plant for pH adjustment was added through the bauxite conversion box.

C. Effluent Radioactivity Results

The concentrations of arsenic-76, neptunium-239, phosphorus-32 and chromium-51 in the reactor effluent are determined every weekday during reactor operation. Normally, the results for each reactor are obtained on a composite of samples from both effluent risers. However, during the course of the test individual results were obtained from each riser at C Reactor for P-32 and As-76. (7,8,9) The monthly average concentrations are shown in Table VII. The 12-month average values for the P-32 and As-76 in the reactor effluent were as follows:

<u>Phosphorus-32</u>		<u>Arsenic-76</u>	
pCi/ml		pCi/ml	
<u>Test</u>	<u>Control</u>	<u>Test</u>	<u>Control</u>
13.6	13.6	115	105

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It is quite apparent that there is no difference in the concentrations between the test side and control side. In as much as nothing unanticipated happened during the last five months the conclusions reached in the interim report are still considered valid. These were:

1. The control of alum feed rate by making periodic adjustments to maintain a zero zeta potential did not result in a reduction in the effluent radioactivity as compared to a fixed 18 ppm feed rate.
2. On the other hand, the use of zeta potential control did not result in an increase in effluent radioactivity.

D. Conversion to Zeta Potential Control

In as much as the test showed no deleterious effects on effluent radioactivity, the use of zeta potential for water plant control was instituted at both B and C Reactor plants on September 1, 1967 as indicated in Reference 10. The use of zeta potential for water plant control was begun at the K Reactor plants on November 6, 1967. It is estimated that an annual savings of \$20,000 will result.

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REFERENCES

1. HWSA-2192, "The Effectiveness of High Coagulant Feed in Reducing Hanford Reactor Effluent Radioisotope Concentrations," W. B. Silker, July 14, 1961. (Unc.)
2. HW-72926, "Optimum Alum Feed Rates at 100-K Reactors," W. B. Silker, March 7, 1962. (Unc.)
3. RL-REA-922, "Preliminary Investigation of Water Coagulation Characteristics as Affects Reactor Effluent Radionuclides," J. W. Frymier, April 5, 1965. (Secret)
4. Personal Communication, W. B. Silker
5. DUN-1041, "Production Test PTA-027 - Half-Plant Zeta Potential Control of Coagulant Dosage - 183-C," R. G. Geier and G. W. Wells, May 9, 1966. (Unc.)
6. DUN-2410, "Interim Report - Half-Plant Zeta Potential Test," R. G. Geier and G. W. Wells, April 28, 1967.
7. DUN-2457, "Reactor Effluent Water Analytical Data - 1964, 1965, 1966," F. E. Owen, June 6, 1967.
8. DUN-2456, "Reactor Effluent Water Analytical Data - January, February, Marcy 1967," F. E. Owen, May 8, 1967.
9. DUN-2456 Sup 1, "Reactor Effluent Water Analytical Data, April, May June 1967," F. E. Owen, July 31, 1967.
10. Letter, OC Schroeder to W Devine, Jr., "The use of Zeta Potential for Water Plant Control," May 11, 1967.

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TABLE I
C Reactor
Zeta Potential Test
Daily Average Operating Conditions

Date	Raw Water	Test Side*		Control Side	
	Zeta Potential, mv	Alum, ppm	Zeta Potential, mv	Alum, ppm	Zeta Potential, mv
4-1-67	-12	13.4	0	18.3	+5
2	-16	13.8	0	18.2	+5
3	-14	13.6	0	17.9	+4
4	-14	13.8	0	18.0	+5
5	-12	13.7	0	18.2	+5
6	-13	14.7	0	18.0	+5
7	-13	15.0	0	18.0	+4
8	-12	15.0	0	18.0	+3
9	-14	14.7	0	18.0	+4
10	-15	14.8	+2	18.1	0
11	-15	14.8	+1	18.2	0
12	-13	14.9	0	18.0	0
13	-14	14.9	0	18.0	-1
14	-12	14.8	+1	18.0	+1
15	-15	15.0	0	18.0	0
16	-12	14.9	0	18.1	0
17	-13	14.9	0	18.1	0
18	-13	14.9	+1	18.0	+1
19	-13	14.7	0	18.0	0
20	-12	14.8	0	18.1	0
21	-13	14.8	0	18.1	0
22	-11	14.2	0	18.1	0
24	-9	14.2	0	17.9	0
27	-12	13.9	0	17.9	0
28	-13	15.3	0	17.6	0
29	-10	15.4	0	18.0	0
30	-14	15.8	0	18.3	0
Avg.	-13	14.6		18.0	+1

* Near or North Side

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TABLE II
C Reactor
Zeta Potential Test
Daily Average Operating Conditions

Date	Raw Water	Test Side		Control Side	
	Zeta Potential, mv	Alum, ppm	Zeta Potential, mv	Alum, ppm	Zeta Potential, mv
5-1-67	-13	15.5	0	17.9	0
2	-14	15.8	0	18.5	0
3	-12	16.5	0	18.3	0
4	-13	17.6	0	17.8	0
5	-13	17.6	0	18.5	0
6	-13	18.0	0	18.0	0
7	-14	18.0	0	18.0	0
8	---	18.9	-1	17.7	-2
9	-14	19.5	0	17.9	0
10	-18	19.7	0	17.9	-1
11	-18	20.1	0	18.0	0
12	-18	19.9	0	18.0	0
13	-15	19.6	0	17.8	0
14	-15	19.9	0	17.9	0
15	-15	20.0	0	17.9	0
16	-14	20.0	0	17.9	-3
17	-15	19.9	0	17.9	-2
18	-14	19.9	0	17.8	-2
19	-16	19.9	0	17.6	-4
20	-14	19.9	0	17.9	-4
21	-14	19.3	0	17.6	-4
22	-13	19.9	0	17.6	-2
23	-14	19.8	0	17.5	-4
24	-14	19.9	0	17.7	-4
25	-14	19.9	0	17.8	-1
26	-13	20.3	0	17.5	-5
27	-16	21.8	0	17.3	0
28	-14	22.1	0	17.6	-5
29	-14	22.2	0	17.6	-4
30	-14	22.0	0	17.5	-5
31	---	22.7	0	17.9	-4
Average	-14	19.6		17.8	-2

* Near or north side

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TABLE III
C Reactor
Zeta Potential Test
Daily Average Operating Conditions

Date	Raw Water	Test Side*		Control Side	
	Zeta Potential, mv	Alum, ppm	Zeta Potential, mv	Alum, ppm	Zeta Potential, mv
6-1-67		22.0	0	18.0	-4
2				17.2	-5
4	-14	21.7	0	17.4	-4
5	-15	21.4	0	17.5	-3
6	-13	23.4	0	17.7	-4
7		23.3	0	17.6	-4
8	-14	23.5	0	17.7	-4
9	-14	23.0	0	17.7	-3
10	-14	23.5	0	18.0	-4
12	-14	23.5	+3	18.0	0
13	-14	22.7	+3	17.8	-1
14		21.7	+1	17.8	-1
15	-14	20.9	0	17.9	0
16		19.7	+1	17.8	-1
17	-16	19.8	0	17.9	0
18		19.5	0	17.8	0
19		19.9	0	17.9	0
20		20.0	0	17.9	0
21		20.2	0	18.2	-1
22		20.8	0	17.8	-1
23		21.1	0	17.9	0
24		21.9	0	17.9	0
Average	-14	21.6		17.8	-2

* Near or North Side

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TABLE IVC ReactorZeta Potential TestDaily Average Operating Conditions

<u>Date</u>	<u>Raw Water Zeta Potential, mv</u>	<u>Test Side*</u>		<u>Control Side</u>	
		<u>Alum, ppm</u>	<u>Zeta Potential, mv</u>	<u>Alum, ppm</u>	<u>Zeta Potential, mv</u>
7-1-67		20.3	0	18.9	0
2		21.5	0	18.2	0
3		21.3	0	18.3	0
4		21.4	0	18.3	0
5		20.0	0	18.3	0
6	-15	18.5	0	18.2	0
7		18.5	0	18.5	0
8		18.5	0	18.3	0
9		18.4	0	18.2	0
10	-13	18.5	0	18.5	0
11	-14	18.7	0	18.3	0
12	-15	18.7	0	18.3	0
13	-13	18.7	0	18.3	0
14	-14	18.6	0	18.3	0
16		19.6	0		
17	-13	19.0	0	18.4	0
18	-13	17.9	0	18.2	0
19	-12	18.0	0	18.1	0
20		18.1	0	18.0	0
21	-14	17.9	0	17.9	0
22	-16	18.1	0	17.9	0
23		18.2	0	18.0	0
24		18.2	0	18.0	0
25		18.3	0	18.0	0
26		17.8	-1	18.1	0
27	-14	17.6	0	18.0	0
28		17.9	0	18.0	0
29	-12	17.9	0	17.9	0
30	-12	17.9	0	18.0	0
31		18.1	0	18.2	0
Average	-14	18.7	0	18.2	0

* Near or North Side

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TABLE V
C Reactor
Zeta Potential Test
Daily Average Operating Conditions

Date	Raw Water Zeta Potential, mv	Alum, ppm	Test Side* Zeta Potential, mv	Alum, ppm	Control Side Zeta Potential, mv
8-1-67		18.1	0	17.9	0
2	-16	18.0	0	17.9	0
3		18.0	0	17.9	0
4	-14	18.1	0	17.9	0
5	-13	18.2	0	18.0	0
6	-14	18.1	0	18.1	0
7	-12	17.5	0	17.7	0
8	-11	16.2	0	16.3	0
9	-14	16.5	0	16.5	0
10	-12	16.3	-4	16.5	-2
11	-14	16.6	-2	16.7	0
12	-12	16.8	0	16.8	0
13	-12	16.3	0	16.3	0
14	-14	16.5	0	16.3	0
15		16.4	0	16.3	0
16	-12	16.5	0	16.1	0
17	-14	16.2	0	16.1	0
18		16.0	0	16.3	0
19		15.9	0	16.0	0
20		16.0	0	15.7	0
21		16.0	0	15.8	0
22		16.1	0	15.9	0
23		16.9	0	16.6	0
24	-16	17.9	0	18.0	0
25	-11	18.2	0	17.9	0
26		18.1	0	18.0	0
27		18.0	0	17.7	0
28	-11	18.3	0	17.9	0
29	-12	18.7	0	18.3	0
30		18.5	0	18.5	0
31		18.5	-1	18.3	0
Average	-13	17.2		17.1	

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TABLE VI

C REACTOR
ZETA POTENTIAL TEST
MONTHLY AVERAGE OPERATING CONDITIONS

	Raw Water	Control Side		Test Side	
	Zeta Potential, mv	Alum feed, ppm	Zeta Potential, mv	Alum feed, ppm	Zeta Potential, mv
Sept. 1966	-15.0	18.0	+0.3	15.9	+0.2
Oct. 1966	-15.1	17.8	+2.1	12.5	+0.3
Nov. 1966	-13.6	17.9	+1.9	12.2	+0.4
Dec. 1966	-12.5	18.1	+3.1	10.8	+0.1
Jan. 1967	-13.2	17.8	+4.2	11.1	0.0
Feb. 1967	-13.2	17.8	+4.0	13.0	+0.1
March 1967	-13.0	18.2	+3.5	14.2	0.0
April 1967	-13.0	18.0	+1.5	14.6	+0.2
May 1967	-14.5	17.8	+1.9	19.6	0.0
June 1967	-14.2	17.8	-2.0	21.6	+0.4
July 1967	-13.6	18.2	0.0	18.7	0.0
August 1967	-13.0	17.1	-0.1	17.2	-0.2

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TABLE VII
C REACTOR
ZETA POTENTIAL TEST
MONTHLY AVERAGE EFFLUENT RADIOACTIVITY DATA

	<u>Control Side</u>		<u>Test Side</u>	
	<u>P-32</u>	<u>As-76</u>	<u>P-32</u>	<u>As-76</u>
	<u>pCi/ml</u>		<u>pCi/ml</u>	
Sept. 1966	13.2	85	9.4	95
Oct. 1966	11.8	120	8.1	125
Nov. 1966	12.8	80	6.7	80
Dec. 1966	9.7	100	11.4	100
Jan. 1967	9.6	120	10.5	155
Feb. 1967	11.3	75	13.6	85
March 1967	9.7	110	14.1	130
April 1967	17.7	150	19.7	170
May 1967	21.9	125	24.4	135
June 1967	15.1	125	15.4	125
July 1967	13.6	80	13.8	80
August 1967	16.4	115	16.3	115

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