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C.W. Botsford
Pile Engineering, Group Head
Pile Technology Division

This document contains
2 Pages
January 9, 1951

RE: CALCULATION OF ACTIVITY INDUCED IN DIATOMACEOUS EARTH

Your interest in purging the 105 process tubes without the usual shutdown was expressed to the Analytical Research Group on December 27, 1950. Such a purge requires the passage of 100 ppm of diatomaceous earth in the process water through the active zone for a period of one hour. The possibility of inducing an excessive amount of activity by the irradiation of this foreign material might preclude a purge during full scale operation. The calculations shown in Table I were made according to our verbal agreement to determine the amount of induced activity. The method of calculation and the data are based on the article by Sonfite and Leavitt, Nucleonics, May 1950.

Three hours after the irradiated material leaves the back face the residual activity (essentially Si 31 and Mn 56) will be 400 microcuries per pound of diatomaceous earth. At 100 ppm that amount corresponds to 0.088 microcuries per liter of effluent water. Such activity would be in addition to the present pile effluent water activity of approximately 1.3 microcuries per liter after three hours. Because the effluent activity would be increased only seven percent, purging of the 105 process tubes without shutdown would not be hazardous from a radiation standpoint.

Assumptions made in calculating the values of Table I are:

1. Average flux = 10^{13} neutrons/cm²/sec.
2. Irradiation time = 2 seconds (conservatively long)

Holdup of material in the tubes should be no more of a problem than during a standard purge. Such material would normally be irradiated after startup anyway. Impurities in the diatomaceous earth and their concentrations are taken from a spectrographic analysis made by the Analytical Section on December 27, 1950.

It would be desirable that experimentation be inaugurated to determine the optimum time of purge and the optimum concentration of purging material. Both of these quantities as now specified may be higher than necessary.

RECEIVED

MASTER

Milton Lewis
Milton Lewis

ML:mbs

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Analytical Section
Technical Services Division

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TABLE I

CALCULATED ACTIVITY INDUCED IN DIATOMACEOUS EARTH
(Two second irradiation at 10^{13} neutrons/cm²/sec.)

Constituent Element	Concentration Percent	Decompositions/Minute/Microgram of Element		Decompositions/Minute/Gram of Diatomaceous Earth	
		At Zero Time	After Three Hours	After Three Hours	After Three Hours
Al	2.3 m.	1.0	3.9	10 ⁻²⁴	10 ⁻²⁰
Ca	long	0.5	1.4 x 10 ⁻²	1.4 x 10 ⁻²	
	2.5 h.		0.43	0.19	
	30 m.		5.12	0.08	1420
Cr	26.5 d.	2 x 10 ⁻³	3.1	3.1	53.2
	1.3 h.		0.28	0.06	4330
Cu	12.8 h.	10 ⁻³	510	433	
Fe	long	0.5	10 ⁻²	10 ⁻²	60
	46 d.		2.2 x 10 ⁻³	2.2 x 10 ⁻³	7550
K	12.4 h.	0.05	18	15.1	0.2
Mg	10.2 m.	0.05	112	4 x 10 ⁻⁴	5.05 x 10 ⁵
Mn	2.6 h.	0.01	11,200	5,050	8.3 x 10 ⁴
Na	14.8 h.	0.05	204	178	
Ni	long	5 x 10 ⁻³	4.9 x 10 ⁻⁴	4.9 x 10 ⁻⁴	
	2.5 h.		20.4	8.9	445
P	14.3 d.	5 x 10 ⁻³	2.7	2.7	135
Si	2.8 h.	46	5.9	2.8	1.29 x 10 ⁶
V	37 m.	5 x 10 ⁻³	1.96 x 10 ⁴	750	3.75 x 10 ⁴
Total:					1.94 x 10 ⁶
					or 0.88 microcuries/gram
					or 400 microcuries/pound

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