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EFFECT OF DETERGENTS ON ADSORPTION
OF RADIONUCLIDES BY SOIL

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EFFECT OF DETERGENTS ON ADSORPTION
OF RADIONUCLIDES BY SOIL

By

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K. C. Knoll

ABSTRACT

The uptake of ^{137}Cs and ^{85}Sr by soil from decontaminating solutions containing detergents was studied. Seven detergents were used in the study, each at two levels of concentration. In general, the adsorption of ^{137}Cs by soil was impaired in the presence of detergents. Adsorption of ^{85}Sr by soil from solutions containing detergents was equal to or better than the adsorption by soil in the absence of detergents. Any changes which occurred were more pronounced at higher concentrations.

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EFFECT OF DETERGENTS ON ADSORPTION OF RADIONUCLIDES BY SOIL

K. C. Knoll

INTRODUCTION

A previous report "Effect of Detergents upon Adsorption of Radioisotopes by Soils" (K. C. Knoll, August 1957, HW-52055) presented results which showed the effects of twelve different detergents, used as decontaminating agents, on the disposal of decontaminating solutions to the ground. Seven more detergents were studied for this report in which only their effect on the uptake of ^{137}Cs and ^{85}Sr by the soil was considered. Once again, no general conclusions can be drawn from the results; each detergent must be evaluated individually.

EXPERIMENTAL METHODS

The study was conducted by determining the distribution coefficients for ^{85}Sr and ^{137}Cs between soil and solutions containing two different concentrations of the detergents. The soil used was a composite of samples taken at 5 ft intervals between ground level and 180 ft in Well No. 11-16 and between 190 and 210 ft in Well No. 11-19. Both wells are near the Battelle-Northwest 300 Area. The soil was thoroughly mixed in a blender and then moistened to a 2 wt% water content. After equilibrating with the water overnight, one gram samples were weighed out to the thousandth of a gram. Two solutions containing, respectively, ^{137}Cs and ^{85}Sr were prepared without detergent additions. Four solutions were prepared for each detergent. Strontium-85 was added to two of the solutions that contained, respectively, 0.1 and 0.01 wt% of the detergent. Cesium-137 was added to the other two solutions containing, respectively, 0.1 and 0.01 wt% of the detergent. Samples of the prepared solutions were measured for radionuclide activity and for pH.

Fifty milliliters of each solution were shaken with a one gram sample of the soil for 16 hr. The soil was centrifuged and samples of the supernate were taken for gamma counting on a well-crystal scintillation counter. The difference in the activity of the solutions before and after contacting the soil was assumed to represent the amount adsorbed in the soil. The distribution coefficient (K_d) was then computed by the formula:

$$K_d = \frac{\text{activity present per gram of soil}}{\text{activity present per milliliter of solution}}$$

The K_d for the same soil was also measured for both ^{137}Cs and ^{85}Sr with no detergent present.

RESULTS

To measure the effect of a detergent on the uptake of the radionuclides, ^{137}Cs and ^{85}Sr , the ratio of the K_d for the prepared solutions containing no detergents to the K_d for those with detergents present was computed. Table 1 shows the detergents used and the pH of the solutions after contact with the soil. The K_d of these solutions is then compared with that of water with no detergents at its equilibrium pH with the soil.

From this table, the effect of the detergents on adsorption is apparent. Any ratio less than one indicates an adverse effect on the uptake of the radionuclide by the soil; those greater than one show an improvement due to the presence of the detergent. It is noticeable that any detergent studied lowers the uptake of ^{137}Cs if it is present in a 0.1 wt% solution. With the exception of two cases, the less concentrated detergent solution (0.01 wt%) also lowers ^{137}Cs uptake but to a lesser degree. The ^{85}Sr uptake is improved except in the presence of a 0.1 wt% solution of Turco 4518 where it is reduced. There is no general rule that can be drawn concerning results based on the type of detergent. It becomes a question of choosing the one least harmful to soil uptake in the application for which it is to be used.

TABLE 1. Comparative Distribution Coefficients of ^{137}Cs and ^{85}Sr
Between Detergent Solutions, Water, and Soil

Detergent	Conc. wt%	^{137}Cs			^{85}Sr		
		pH	K_d	$\frac{K_d \text{ Det}}{K_d \text{ H}_2\text{O}}$	pH	K_d	$\frac{K_d \text{ Det}}{K_d \text{ H}_2\text{O}}$
Oaklite LSD (Low Sudsing Detergent)	0.1	10.69	840	0.36	9.95	216	4.3
	0.01	9.42	1840	0.78	9.00	62	1.2
Ajax	0.1	8.51	1260	0.54	8.55	82	1.6
	0.01	8.18	1830	0.78	8.40	50	1.0
Tide	0.1	9.18	660	0.28	9.20	83	1.7
	0.01	8.12	2630	1.12	8.10	78	1.6
Pacific Chem Turco	0.1	10.46	870	0.37	10.60	172	3.4
	0.01	9.40	1540	0.66	9.50	74	1.5
Turco 4182	0.1	8.30	140	0.06	8.20	20	0.4
	0.01	8.07	330	0.14	7.90	64	1.3
Turco 4518	0.1	3.77	525	0.22	4.25	204	4.0
	0.01	8.08	1620	0.69	8.05	81	1.6
Spartan	0.1	7.98	1800	0.77	8.30	71	1.4
	0.01	8.06	2410	1.03	8.10	53	1.0
Control (Water)	—	8.28	2350	—	8.33	50	—

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