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ABSTRACTS

Attached are six abstracts of our work for the IAEA program on "dissemination of information on Radioactive Waste Management".

1. Controlled Environmental Radioactivity Tests (CERT)
2. Relative Diffusion and Deposition of Uranine Dye and Molecular Iodine
3. Cloud Gamma Dose Study.
4. In-Place Observations of Tritiated Water Distribution in Unsaturated Soil.
5. Synthesis of some Alkaline Earth Zeolites.
6. Ion-Exchange Properties of Synthetic Zeolites.

If you need any further information please let us know.

Enclosures:
Abstracts - 6

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HEALTH SERVICES LABORATORY, U.S. AEC: AIR RESOURCES LABORATORY, ESSA, NATIONAL REACTOR TESTING STATION, IDAHO FALLS, IDAHO

Controlled Environmental Radioactivity Tests (CERT)

The objective of the program is to derive and test mathematical models which describe the behavior of radioactive materials in the milk-food chain. Since 1963, the behavior of molecular forms of radioiodine has been studied in three links of the food chain (air-vegetation, vegetation-milk, and milk-human thyroid). These studies have included laboratory experiments as well as field studies at the experimental dairy farm (EDF) at the National Reactor Testing Station (NRTS).

Principal results of the program to date have been:

1. Deposition velocity (v_d) is linearly related to grass density (D) up to at least 150 grams (oven dry weight)/m^2.

2. The ratio of deposition velocity to grass density is related to average wind speed as follows:

$$v_d/D(cm^3/gm\ sec) = 19.4\ \bar{u}\ (m/sec)$$

$$r = 0.74\ (\alpha = 0.01)$$

3. Chamberlain's resistance analogy model of transfer of airborne material to natural surfaces appears adequate for carbon plate deposition; however, neither Chamberlain's model nor Shepard's flux gradient model is adequate for grass deposition because they do not take into account the imperfect sink characteristics of grass for iodine nor do they account for the micro turbulence within the grass canopy.

4. The deposition velocity of methyl iodide is less than 0.05 per cent of that of molecular iodine (I_2).

5. Average uptake fractions for ingestion and inhalation of radioiodine were measured to be 0.19 (7 subjects) and 0.30 (3 subjects) respectively.

6. A four compartment model of bovine metabolism appears to match fairly well experimental data of iodine-131 in urine, milk, feces, blood and thyroid.

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An environmental chamber is being constructed to help study individual variables associated with the deposition process. Field tests are planned for the summer of 1968 to study the effect of feed matrix on the metabolism of iodine-131 in cattle. A test to measure the deposition velocity of $S^{35}O_2$ on alfalfa is also planned.

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Relative Diffusion and Deposition of Uranine Dye and Molecular Iodine

At the NRTS and elsewhere the downwind concentration of iodine-131 is predicted using predetermined diffusion estimates based on uranine dye measurements. The concentration so predicted is then reduced to account for up-wind depletion due to deposition. The two assumptions on which this procedure is based are 1) molecular iodine-131 diffuses in the atmosphere in the same manner as uranine dye having a mass median diameter of 1 micron. 2) Uranine dye can be considered non-depositing relative to iodine-131. These two assumptions are being checked experimentally.

A simultaneous 30 minute field release of uranine dye and molecular iodine was accomplished during a winter afternoon over snow covered desert terrain. From examination of air sampling data for 1 meter above the ground, the primary observations from this experiment were

1) Molecular iodine attached to uranine dye particles; near the plume center 80-90% of the iodine was attached; at the plume boundaries 20% or less of the iodine was attached.

2) The lateral plume spredding at 1 meter height was virtually identical for both tracers.

3) The vertical flux of molecular iodine within the first few hundred meters downwind was approximately 5 times greater than the uranine dye vertical flux. The vertical flux ratio follows a trend similar to a parabola along which the effect increases most rapidly within the first 200 meters downwind.

4) Iodine deposition measurements from 200 to 3200 meters downwind appeared in agreement with previous measurements.

Field tests are in progress to determine the reasons for the difference in vertical flux. Iodine deposition will be extensively measured within the first 200 meters to help resolve whether deposition, upward diffusion, or both produce this flux difference. The extent of these phenomena will be measured to 3200 meters downwind.

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Cloud Gamma Dose Study

The objective of the study is to measure the radiation dose near the ground which results from the passage of a cloud of gamma emitting radionuclides. The first test was carried out with 45 curies of Xe-133 released from a height of about 60 meters into an unstable atmosphere. The doses were too low for accurate measurement and therefore the test results were inconclusive. The next test will be in May, 1968 and will be a ground level release of Xe-133 into a stable atmosphere. Doses are measured with ionization chambers. Releases of radionuclides of varying energy from varying heights into atmospheres of varying stability are planned.

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In-Place Observations of Tritiated Water Distribution in Unsaturated Soil. Schmalz and Polzer, Health Services Laboratory, USAEC, Idaho.

Tritium concentration in soil water was determined to a depth of 410 cm under the desert conditions at the National Reactor Testing Station in Southeastern Idaho. A comparison of the data of tritium deposited over a 15 year period by a yearly mean rainfall of 12 cm per year indicates that 2 to 4 percent of the precipitation remains in the soil profile. Ninety six percent is in the surface 200 centimeters. The distribution is attributed to diffusion at an approximate rate of 0.56×10^{-5} cm^2/sec (44.4 cm^2/91 days) and a convective velocity of 4.5 cm/91 days.

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Synthesis of some Alkaline Earth Zeolites, Hawkins, D. B., Health Services Laboratory, USAEC, Idaho

Alkaline-earth varieties of the high-silica zeolites mordenite, clinoptilolite, ferrierite and yugawaralite were synthesized hydrothermally. A barium clinoptilolite-like phase was synthesized reproducibly apparently for the first time. The conditions favoring the formation of high-silica zeolites are: low alkalinity and the use of reactants which produce a high-silica activity. Seeding was important for the synthesis of clinoptilolite.

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Ion-Exchange Properties of Synthetic Zeolites, Hawkins, D. B., Health Services Laboratory, USAEC, Idaho

Studies of the calcium-strontium ion exchange properties of synthetic mordenite, clinoptilolite, ferrierite and yugawaralite show unequivocally that strontium selective zeolites can be prepared by synthesizing the zeolite in the presence of strontium. Synthetic strontium mordenite showed strontium-calcium separation factors ranging from 8.4 to 3.5 depending upon the alumina to silica ratio of the zeolite. Synthetic calcium mordenite showed separation factors of from 0.5 to 1.6. The ion-exchange behavior of synthetic strontium clinoptilolite was similar to that of strontium mordenite. Strontium ferrierite and strontium yugawaralite are not as strontium selective as clinoptilolite or mordenite and do not appear to warrant further study at present.

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