FACTSHEETS

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CENTER FOR HUMAN RADIOBIOLOGY

Fact Sheet on

^{226}Ra in Municipal Water Supplies

Naturally occurring ^{226}Ra occurs in practically all municipal water supplies. The concentration in water from surface sources, such as rivers, lakes and reservoirs, and from wells that penetrate unconsolidated formations is usually quite low, less than 0.2 pCi/l. The daily intake of ^{226}Ra from these sources is less than the 2 pCi/day normally obtained from food.

Many private and municipal water supplies are developed in consolidated formations, and the ^{226}Ra content of these waters is generally much higher than that of water from other sources.(1) Water samples have been obtained from about 850 municipalities in Illinois, Iowa, Missouri, and Wisconsin that were known in 1968 to obtain their water from consolidated formations. The ^{226}Ra content of water samples from 380 municipal supplies is greater than 1 pCi/l, and averages 6 pCi/l. The ^{228}Ra content of 138 of these samples has been determined and ranges from 0 to 33 pCi/l, and averages 4 pCi/l.

Long-term retention of ^{226}Ra from drinking water may be estimated by the empirical relationship(2) $B = 36 + 50\ C_w$, where B is the total body burden (pCi), C_w is the concentration in water (pCi/l) and 36 pCi is the contribution from intake of radium in food. Thus, for adults who drink water that contains 5 pCi/l, the ^{226}Ra body content is about 300 pCi, and the average skeletal dose rate from ^{226}Ra and retained daughter products is about 10 mrad/yr.

Under the Safe Water Act, the EPA proposes that the ^{226}Ra + ^{228}Ra content of municipal drinking water shall not exceed 5 pCi/l. Municipalities having water supplies which exceed a gross alpha level of 2 pCi/l shall be required to submit samples for analysis on a quarterly basis.

Findings: A plot of population vs. ^{226}Ra content of the water supply is given in Fig. 1 for all communities that have water with a ^{226}Ra content greater than 1 pCi/l. The total population in communities that have water in excess of 5 pCi/l is 690,000 and that in excess of 10 pCi/l is 73,000. If we assume that the ^{228}Ra content of water that contains 3 pCi ^{226}Ra/l is 2 pCi/l, then 1.4 million persons in the four-state area are affected by the proposed regulations under the Safe Water Act.

The radium content of water is reduced by all methods of water softening. The degree of reduction depends on the method and ranges from 5% to 98%. In Iowa, the ^{226}Ra concentration of softened water averaged 11% of that of the raw water. However, the concentration of radium in the finished water which enters the distribution system may be higher since most municipalities blend raw and softened water for cost reduction.

An epidemiologic investigation has been made of the human population exposed to elevated levels of ^{226}Ra in drinking water in 111 Illinois and Iowa communities.(3)

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The population-weighted mean ^{226}Ra concentration was 4.7 pCi/l. Based on a retrospective analysis of data from death certificates from the period 1950 to 1962, this population group exhibited an adjusted bone neoplasm mortality rate slightly higher than that in a control population. The difference while suggestive was not statistically significant. In addition, a comparison of the adjusted mortality rates for all causes of death in an exposed and in a control community of about 10,000 population revealed significant differences in the age groups 0 to 9 and 30 to 39, but not in other age groups. A further study was suggested.

Future Plans: The projects proposed below have been done before, but they were not necessarily complete or systematic.

1. Prepare for publication the ^{226}Ra results currently available. This information would be of value to agencies and communities affected by the radioactivity limits imposed by the Safe Water Act.

2. Determine the ^{224}Ra, ^{226}Ra, and ^{228}Ra content of drinking water from those communities likely to exceed the 5 pCi/l limit.

3. Possibly design and establish a health study which includes all causes of death. This information would be of value to the Radium Project and would provide new input for evaluation of the cost benefits associated with the limits proposed under the Safe Water Act.

References:

1. Lucas, H. F., Jr. and F. H. Ilcewicz. The natural radium-226 content of Illinois Water Supplies. J. Am. Water Works Assoc. 50, 1523—1532 (1958).

2. Lucas, H. F., Jr., R. B. Holtzman, and D. C. Dahlin. Radium-226, radium-228, lead-210, and fluorine in persons with osteogenic sarcoma. Science 144, 1573—1575 (1964).

3. Petersen, N. J., L. D. Samuels, H. F. Lucas, Jr., and S. P. Abrahams. An Epidemiologic approach to low-level radium-226 exposure. U. S. Dept. of Health, Education, and Welfare, Public Health Report 81, pp. 805—814 (1966).

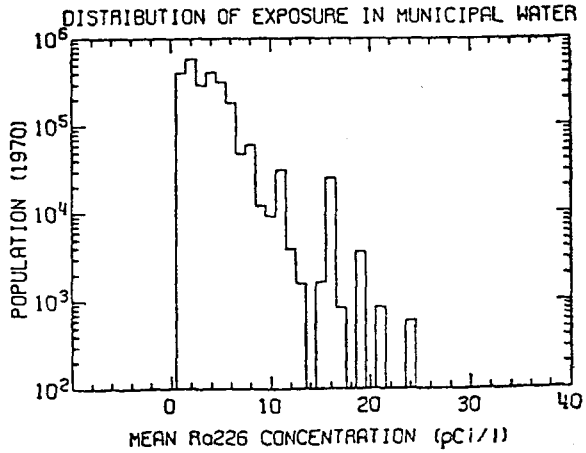

Figure 1