The Presence of Radionuclides in Sewage Sludge and Their Effect on Human Health

Questions & Answers

What prompted the Department of Health to study radioactivity in sewage sludge?

In 1991, the department sampled two treatment plants in the Seattle area and found small amounts of radioactive material which were from natural sources, fallout, and medical uses. In 1992, the Nuclear Regulatory Commission (NRC) published a national report identifying radioactive material in several treatment plants. In 1994, NRC and the Environmental Protection Agency sent a joint letter to state agencies suggesting the possibility that radioactive material might concentrate in sewage systems. In the light of this letter and the earlier concerns, the Department of Health began this study.

Given what we know about radioactivity in sludge in Washington communities, how close are we, in the worst case, to having levels that pose a significant threat to human health?

We are far from posing a risk to human health. Under realistic scenarios, there is no increased risk to the most impacted individual person, let alone to the general public. Even if the concentrations were greatly increased, the potential threat is minute. The generally accepted regulatory dose allowed to members of the public is 15 to 100 mrem per year above background levels, which vary from 200 to 700 mrem per year. The highest realistic dose calculated in this study, using the most likely plan for the most radioactive sludge, was 0.4 mrem per year.

What are isotopes?

Isotopes are different atomic forms of a particular element. All have the same number of protons in the nucleus, but each isotope will have a different number of neutrons. For example, hydrogen (H) has three isotopes: H-1 (1 proton, 0 neutrons), H-2 (1 proton, 1 neutron), and H-3 (1 proton, 2 neutrons). An isotope can be stable (such as H-1 and H-2) or radioactive (such as H-3, also called tritium). A radioactive isotope is sometimes referred to as a radioisotope.

What is a radionuclide?

Radionuclide refers to the nucleus of a radioactive atom. For the purpose of this report, radionuclide and radioisotope can be considered synonymous.

What are the most common ways that radioactive materials get into sewer systems?

There are four sources for radioactive material in the sewer system: natural, fallout, medical, and industrial. There are three pathways for that material to enter the sewer system: carried by water (natural, fallout), in human excrement (natural, fallout, medical), and through direct disposal by licensed users (medical, industrial).

The following are examples of how radioactive material might enter the sewer system from different sources:

- Radioactive iodine and technetium are used in a number of medical procedures. Much of the material is injected into patients, who eventually excrete it.

- A number of companies are licensed to use or posses radioactive material for industrial or research purposes. The radioactive material they dispose of through sewers is required to be soluble, but it is possible that some becomes trapped in the sludge.

- Both natural radioactive material and fallout can enter the sewer system through rain water runoff, potable water, or excrement.

Are there any current laws or regulations that place limits on how much radioactivity can enter a sewage system?

The state Department of Health has regulations (based on federal regulations) controlling the amounts and concentrations of radioactive material that licensed users may dispose of through the sewer. Medical isotopes excreted by patients are purposely not regulated because it would mean keeping all patients receiving diagnostic tests in the hospital for many days, so their excretions could be monitored, and because medical radionuclides have very short half-lives and decay before they can have any effect on the general public.

What are the ways in which radionuclides in sludge might pose a health threat to human beings?

At the concentrations found and the uses evaluated in this study, there is no health threat from radionuclides in sludge. To determine this we evaluated two scenarios.

We evaluated using the sludge on wheat fields as fertilizer The potential exposure pathways were the farmer's direct exposure to gamma radiation from working in the field, inhalation of dust containing radioactive material, growing half of his food on the land, and drinking water from a well on the property.

We also evaluated using the sludge as covers in a landfill which is then made into a park. In this case the pathways for highest potential exposure were direct exposure to the park attendant, inhalation of dust, and soil ingestion.

What is the best way of measuring a potential health threat from radiation?

The risks from exposure to very low levels of radiation (such as from the radioactive material in sewage sludge) are very low and difficult to quantify. At present, the method used is to sample and analyze the media in question, develop realistic scenarios, and evaluate the media in that scenario using an accepted computer program, such as RESRAD. The resulting dose can then be compared against standards from the nuclear industry, and against background exposure.

Do we need more information about the presence of radionuclides in sludge?

From a strictly technical point of view, more information is desirable, but not critical. More information would provide greater certainty that the facilities sampled were representative of all such facilities in the state, and would relieve possible public concern about sludge from their particular plant. It would also be possible to evaluate other exposure scenarios, though it is unlikely that there are any realistic scenarios more likely to produce harmful doses than the ones already evaluated in this report.

How difficult is it to obtain such information?

It is not difficult to obtain more information. It would require sampling more facilities and analyzing the results. Funding would present the greatest difficulty.

Are any other agencies collecting this kind of data?

The U.S. Nuclear Regulatory Commission and the U.S. Environmental Protection Agency are planning a joint study in the near future. They will survey up to 900 facilities across the country and then select around 300 to sample. It will be useful to see how this study compares with ours.

If there were a significant threat to human health posed by radionuclides in sludge, what would be the possible ways of protecting people from such a threat?

The simplest way of protecting people would be to dispose of the sludge in places where people will not come in contact with it. We evaluated two such methods: use of sludge as cover in landfills and putting it on non-public forests to promote tree growth. Sludge could also be used to fertilize non-food vegetation such as plantings on freeway right of ways. This would provide a benefit while decreasing the exposure to humans.

What are the costs of reducing the amount of radioactive material disposed in sewers?

In the case of medical radioisotopes, reduction would be very costly. The number of facilities offering nuclear medicine procedures would probably decrease, as smaller clinics would choose to stop rather than accept the added difficulty and expense. Current outpatient procedures would require days or weeks of hospital stay.

Reducing the amount disposed by licensees, which includes research facilities and universities, would increase disposal cost significantly. It is likely that some lines of research would stop due to the increased expense.

There is no practical regulatory way to reduce the contributions from fallout or natural sources.

What would be the benefits of reducing the amount of radioactive material disposed through sewers?

There would be no benefits. The risks associated with current disposal practices are so low that decreasing the amount of radioactive material in the sludge would not decrease risks in a meaningful way. Instead of benefits such a change would have high costs, both monetarily and in inconvenience to business and the sewage treatment facilities.