Environmental radioactivity during 50 years

Nielsen, Sven Poul

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Environmental radioactivity during 50 years

Sven P. Nielsen
Investigations of man-made radioactivity in the Danish environment from 1957
Atmospheric nuclear weapons tests

Global pollution from atmospheric nuclear weapons tests: fission products, activation products, fissile material and tritium
Radioecological sensitivity

• Studies covering
  – Air, water, soil
  – Grain, bread
  – Grass
  – Vegetables and fruit
  – Sea plants
  – Milk, meat, fish
  – Total diet
  – Human body, bone

• Radioecological sensitivity is the time integral of quantities of the sample type from a quantity of the radionuclide deposited

• Example for Cs-137 in Danish cow’s milk
  – 2.0 Bq/L d per Bq/m$^2$
Strontium-90 and caesium-137

- Fission products of particular importance due to long half lives and significant uptake in food chains
Aerosols

- Monitoring of radioactivity in air is based on aerosol collectors located in Haderslev, Allinge and Risø.
- Air is sampled at flow rates of 500-2000 m$^3$/h through organic filters retaining particles.
- Filters are changed weekly and analysed for short-lived radionuclides first and later for longer lived radionuclides, particularly $^7$Be, $^{210}$Pb, $^{90}$Sr, $^{137}$Cs.
Radioactivity in Air at Risø

Atmospheric nuclear weapons tests 1945-1980

Chernobyl, 1986

Fukushima, 2011

CONCENTRATION (µBq/m³)

YEAR


Sr-90

Cs-137
Precipitation

Precipitation is collected at Risø and 10 other locations in Denmark and analysed for content of Sr-90 and Cs-137.
Milk, potatoes, vegetables and total diet
Cereals: rye, oats, wheat, barley

Graphs showing the concentration of strontium-90 in rye and rye bread over time. The text explains that strontium-90 in rye was collected from 1959-2008, while in rye bread, it was collected from 1962-1990.

Map of Denmark highlighting various locations where grain samples were collected, including State experimental farms. The map includes markers for locations such as Tystrup, Ledreborg, and Sønderup.
Stream, lake and ground water
Sea water and plants

Casium-137 in seaweed (Fucus vesiculosus and Fucus serratus) from February 1983 to June 2009 collected at Klint, Zeeland (55°38'N, 11°35'E).

DTU Nutech, Technical University of Denmark
Caesium-137 in fish/cod

![Graph showing concentration of caesium-137 in fish from various regions over time. The x-axis represents years from 1960 to 2010, and the y-axis represents concentration in Bq/kg fresh weight. The graph includes data from different regions: Færøerne, Grønland, Nordsøen, Kattegat, and Østersøen.](image-url)
Humans

- Employees at Risø monitored for radiocaesium and tritium
- Human bone samples received from hospitals (with difficulty)
External exposure rates in 4 locations in Denmark, as measured with a Na(Tl) detector.
Radioactive contamination in Denmark

- Poster in building 204 shows concentrations of strontium-90 and caesium-137 in air, precipitation, milk and grass at Risø and in Denmark since the 1950’s
- Including input from the Fukushima accident in Japan in 2011
Why monitor environmental radioactivity?

- EURATOM Treaty: Health and safety matters - Obligation of EC Member States to monitor levels of radioactivity in air, soil and water and to ensure compliance with basic standards
- Helsinki Convention: Contracting Parties undertake to prevent and eliminate pollution of the marine environment of the Baltic Sea Area caused by harmful substances from all sources
- Study man-made and naturally occurring radionuclides in the environment to document baseline levels and increase knowledge on behaviour and processes
- Expertise available for emergency purposes in case of accidents/incidents involving release of radioactivity to environment
- Improve radiological assessment models in decision support systems used by authorities in case of accidents
- Useful platform for research and development of existing and new analytical methods and application of these in other areas