



Nuclear Waste Management

Ankita Ojha
Assistant Professor
Department of Chemistry
Maharaja College, Arrah

Nuclear Waste: An Introduction

- Type of hazardous waste that contains radioactive materials.**
- The radioactive wastes are by-products of nuclear technology.**
- After use in nuclear reactors the nuclear fuels attain a form of nuclear waste which it looks exactly like the fuel that was loaded into the reactor from outside — typically assemblies of metal rods enclosing fuel pellets. But in actual they are used nuclear fuels with not the same content.**

Sources of radioactive nuclear wastes

**Nuclear
Medicine**

**Nuclear
Research**

**Nuclear
Power**

**Nuclear
weapons**

**Coal and
rare earth
mining**

Properties of Radioactive Wastes:

- the type of radionuclides contained and the radiation emitted (alpha, beta, gamma), the activity (number of atomic nuclei which spontaneously disintegrate per unit time - expressed in becquerels);
- the radioactive half-life (the time it takes for a radioactive sample to lose half of its activity).

According to the French Environmental Code (Art. L 542.1-1), final radioactive waste is defined as the radioactive waste for which no further treatment is possible under existing technological and economic conditions. Treatment methods particularly entails extracting any part of the waste that can be recycled or reducing any pollutants or hazardous substances it contains.

In modern nuclear plants over 96% of spent fuel is recycled back into uranium-based and MOX fuel (Mixed Oxide Fuel; consists of more than one oxide of fissile material)

Classification of radioactive wastes

- **Nuclear wastes are classified according to their activity level and radioactive half-life of radionuclides they contains.**
- **The activity level determines the degree of protection to be provided.**
- **Such wastes are therefore divided into categories as very low-level, low-level, intermediate-level and high-level waste. Radioactive wastes are said to be “short-lived” if it only contains radionuclides with a half-life of less than 31 years.**
- **They are said to be “long-lived” if it contains a significant quantity of radionuclides with a half-life of over 31 years.**

- **Very Short-lived Waste (VSLW):** Such wastes generate from medical applications of radioactivity (such as radio-diagnostics and radiation therapy) and mostly contain radioactive elements with a half-life of less than 100 days.
- **Very Low-level Waste (VLLW):** These wastes come from the nuclear industry, in particular from facility decommissioning operations. They consists of very slightly contaminated dismantled equipment parts and rubbles.
- **Low- And Intermediate-level Short-lived Waste (LILW-SL):** These wastes come from the nuclear industry and some of the research laboratories.

- **Low-level Long-lived Waste (LLW-LL):** It constitutes major part of nuclear wastes and consists either of waste contaminated by radium (known as radium-bearing waste), resulting mainly from naturally radioactive raw materials used in industry, retrieval of radium-bearing objects and the cleanup of polluted sites, or graphite waste.
- **Intermediate-level Long-lived Waste (ILW-LL):** The most of ILW-LL is formed as a result of spent fuel reprocessing (spent fuel claddings, reprocessing sludge, etc.) and nuclear facility maintenance work.
- **High-level And Long-lived Waste (HLW-LL):** They are the by-products of spent fuel reprocessing that cannot be recycled.



**Management Techniques for
radioactive waste disposals**

- There are multiple pathways for the disposal of nuclear wastes:
 1. **Sorting:** The process in which wastes are separated according to their different properties. In case of radio-nuclear wastes, sorting is done on the basis of their half life. The waste is separated, incinerated, compacted or molten down to reduce the volume of the wastes.
 2. **Treatment and conditioning:** Various types of waste undergo different types of treatment such as incineration, calcination, melting, compacting, cementation, vitrification, etc.). They are further sealed into a container. The result of this is a radioactive waste package.
 3. **Storage and disposal:** These facilities are designed to accommodate waste packages for a limited period of time. Disposal is the final stage of the waste management process and implies that the packages have reached their final destination or, at least, that there is no intention of retrieving them. However, proper steps must be taken to ensure that they are not reintroduced into the environment.