International Research Journal of Research in Environmental Science and Toxicology Vol. 12(6) pp. 1-2, December, 2023
Available online https://www.interesjournals.org/research-environmental-science-toxicology/archive.html

Perspective

Nuclear Physics and Radioisotope Technology Applications in Environmental Sustainability

Johan Neyts*

Department of Environmental Science, Artevelde University of Applied Sciences, Hoogpoort, Belgium

*Corresponding Author's E-mail: johan.nts@kuleuven.be

Received: 27-September-2023, Manuscript No. JREST-23-118579; **Editor assigned:** 01-October- 2023, PreQC No. JREST-23-118579(PQ); **Reviewed:** 14-October- 2023, QC No. JREST-23-118579; **Revised:** 01-December-2023, Manuscript No. JREST-23-118579 (R); **Published:** 28-December-2023, DOI: 10.14303/2315-5698.2023.61

INTRODUCTION

Stable isotopes can be used to establish the source's history, rainfall conditions, mixing/interaction features of associated water bodies, pollution processes and evaporation processes, whereas radioisotopes can be used to determine the age of water.

Industrial Applications of Nuclear Technology (IAEA):

Nuclear techniques are used to identify and evaluate the qualities of various materials, to measure pollution levels, to sterilize and disinfect components, to monitor and optimize industrial processes and to change chemical, physical and biological properties in order to create novel materials.

The systematic collection and analysis of particular environmental media, such as air, milk and water, to detect the quantity of radioactivity present is known as environmental radiation monitoring. To provide a safe environment, radioactive levels are compared to safety regulations.

DESCRIPTION

Radiation is now employed to assist humanity in medical, academia and industry, as well as to generate power. Radiation is also useful in agriculture, archaeology (carbon dating), space research, law enforcement, geology (including mining) and many other fields. Radioactive elements released into the environment can contaminate the air, water, surfaces, soil, plants, buildings, people and animals.

Uses of radioactivity

- Medical procedures including diagnosis and treatment of cancer.
- Sterilizing food (irradiating food).
- Sterilizing medical equipment.
- Determining the age of ancient artefacts.
- Checking the thickness of materials.
- Smoke detectors (alarms).

Radioactivity is also used to detect oil leaks in pipelines and to safeguard the environment from oil contamination. By introducing clever nucleonic gauges technology, nuclear science and radioisotopes led to the advancement of measurement devices that can work in a very complex environment. This technology has aided in the development of a new generation of measuring devices capable of determining various static or continuous measurement parameters such as levels, flow, weight and density of any materials stored in closed tanks or flow lines, as well as distinguishing separations between different products.

It can also be used in production lines to test liquid levels in opaque containers, check quality and exclude nonconforming products. Nuclear science and radioisotope technology have contributed to the detection of faults in the manufacturing industry through the use of non-disruptive nuclear imaging techniques that traditional approaches were unable to deliver. Nuclear non-destructive techniques aid in detecting the presence of cracks in industrial structures as well as the extent of welding quality, inspecting the bodies of aircraft, ships and bridges and finding deposits in pipes or alloys.

Nuclear energy has helped to environmental sustainability by reducing greenhouse gas emissions. Nuclear technology has enabled the production of electricity for domestic and industrial uses with zero greenhouse gas emissions, as well as the conversion of surplus energy into stored hydrogen energy that can be used as hydrogen fuel for transportation,in addition to its ability to desalinate seawater and meet the increasing demand for water and power due to population growth.

Ionized radiation is used in cross-linking polymerization to change the properties of materials such as food packaging polymer foams, electrical wire and cable, radial tyres, carbon fiber composites, Nano and micro composite sensors, medically oriented applications and many other plastic products. Radiation cross-linking polymerization gives these products the necessary strength, flexibility, stiffness and heat and weather resistance. To summarize, the applications of nuclear technology and radioisotopes in industry are so diverse and important that they are credited for our safety at home and at work through smoke detection devices.

Nuclear power is a zero emission source of clean energy. Fission, the process of splitting uranium atoms to produce energy, is used to generate power. The heat produced by fission is utilized to generate steam, which turns a turbine to generate power without emitting the toxic pollutants that fossil fuels do.

Radioisotopes in water resources and the environment

- Environmental tracers and isotope hydrology techniques aid in the characterization of ground and surface water resources.
- The usage of nuclear technologies has aided in the management of water resources in numerous countries throughout the world.

Radioactive tracers

Radioactive tracers (or radiotracers) are chemical compounds that include one or more radioisotope atoms. Radiotracers are one of several environmental tracers that can be used, but they are important in detecting and analyzing pollutants because even very small amounts of a given radioisotope can be easily detected and the decay of short-lived isotopes means that no residues remain in the environment. To estimate the amount of vulnerability, hydrologists utilize radiotracers to determine the passage and rate of contaminants travelling through groundwater.

Water resources

Groundwater is the world's largest supply of freshwater, accounting for 30% of the total. Isotope hydrology takes advantage of natural variations in the composition of water resources. Each source of water has a unique isotopic 'fingerprint' or makeup. The isotopes in a source can be natural or man-made, stable or unstable. Stable isotopes can be used to establish the source's history, rainfall conditions, mixing/interaction features of associated water bodies, pollution processes and evaporation processes, whereas radioisotopes can be used to determine the age of water. The findings enable planning and long-term management of these water resources. They can provide information about leakages through dams and irrigation channels, the dynamics of lakes and reservoirs, flow rates, river discharges and sedimentation rates for surface waters. Neutron probes can monitor soil moisture very precisely, allowing for better management of salinity-affected land, particularly in terms of irrigation.

CONCLUSION

Nuclear research and radioisotope technologies are critical in promoting long-term development. It has numerous applications in various industries. The oil and gas industry, for example, uses a variety of technologies, such as neutron activation analysis, to investigate petroleum and minerals, revealing the presence of oil and gas reservoirs, the type of mineral components and the percentage of their presence in the earth. Furthermore, nuclear science and radioisotope technology play an important role in reservoir knowledge and, as a result, enhancing oil and gas production rates through better recovery operations.