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Radioisotopes Study and its Importance

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Atoms with unstable nuclei are constantly changing as a result of the imbalance of energy within the nucleus. When the nucleus loses a neutron, it gives off energy and is said to be radioactive. Radioactivity is the release of energy and matter that results from changes in the nucleus of an atom. As a radioisotope tries to stabilize, it may transform into a new element in a process called transmutation. Radioisotopes study is very critical yet challenging. Important characteristics of radioisotope for use as tracer are its half life, type, energy of radiation and availability. Short lived isotope element that lives for a few hours to a few days in half life is preferred as they have high specific activity within a limited span and the system becomes inactive very soon. When ever larger amounts of radioactivity element are needed for use, then it is preferred to have short lived isotopes rather than long lived. Moreover, it is ideal to have a gamma emitting isotope since gamma ray measurement is the simple and external monitoring is feasible.

The fundamental principle in radio-chemical investigations is that the physico-chemical properties of a radioisotope of an element are almost similar to those of the other stable/radioactive isotopes of the element. When radioisotope is present in a chemical combination identical to that of the bulk of the element in a chemical process, then any reaction that the element undergoes can be directly traced by monitoring the radioisotope. The radiochemical evaluation involves two major steps, firstly, the sampling of chemical species to be studied and secondly, the quantitative determination of the radiation emitted by the radioisotope in the sample. In radiotracer study, a short lived radioisotope in a suitable physico-chemical form is selected as reference that should be similar to that in the process material is used to trace the sample under study. The radioisotopes in suitable physical and chemical forms are introduced in systems under investigation. By monitoring, the radioactivity both continuously or after specific time duration, the sampling varying with the nature of study, the movement, adsorption, retention of the tracer and in turn, the bulk content under investigation, could be followed. The tracer concentration observed at various check points helps to draw information about the dynamic behaviour of the sample under investigation. The radioisotopes preferred for such studies are gamma emitters having half-life compatible with the duration of studies. The efficacy and the strength of radioactivity used vary depending on the nature of application. Utilization of radiotracers in chemical research covers the studies of reaction mechanism, kinetics, exchange processes and analytical applications such as radiometric titrations, solubility product estimation, isotope dilution analysis and autoradiography. Radioisotope tracers offer several advantages such as high detection sensitivity, capability of in-situ detection, limited memory effects and physico-chemical compatibility with the material under study. The radioisotopes have proved as a tool to study many problems in chemical, biological and medicinal fields. Radiotracers have helped in the identification of leaks in buried pipelines and dams. Process parameters such as mixing efficiency, residence time, flow rate, material inventory and silt movement in harbours are studied using radioisotopes. The efficiency of several devices in a wastewater treatment plant whether primary or secondary clarifiers or aeration tank is investigated by means of radiotracers. It is a valuable technique in pharmaceutical industries.

I hope the upcoming researchers and scientist could further explore the hidden mysteries in God creation and propose the better possibilities and applicability on elaborate field of isotope study, for the social and technological development.

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