

Radioisotope Production and Radiation Technology

Objective

To contribute to improved health care, better industrial performance as well as effective quality control processes and a cleaner environment, by supporting technology to strengthen national capabilities in Member States for producing radioisotope products and applying/adapting radiation technologies for socioeconomic benefit.

Radioisotopes and Radiopharmaceuticals in Medicine

Globally, the number of medical procedures involving the use of radioisotopes is growing, with an increasing emphasis on radionuclide therapy using radiopharmaceuticals labelled with particle emitting radioisotopes for the treatment of cancer. A new CRP initiated in 2007 on the development of therapeutic radiopharmaceuticals based on lutetium-177 for radionuclide therapy has helped accelerate the production of this radioisotope in Member States. This CRP is intended to complement another new CRP in the human health area on the clinical evaluation of a lutetium-177 radiopharmaceutical called ¹⁷⁷Lu-EDTMP (a phosphonate complex of lutetium) for bone pain palliation in metastatic prostate cancer. The goal of these two CRPs is to help develop products up to the clinical use stage.

A CRP on the development of technologies for generator produced therapeutic radionuclides was completed, resulting in the development of two generator systems for yttrium-90 used for the treatment of cancer and other diseases and a new technique for quality control testing. The electrochemical generator system developed will facilitate the wider availability of yttrium-90, while the ultra-sensitive new method of assaying the radionuclidic purity of yttrium-90 will help improve the safety of its use for therapy.

Radioguided sentinel lymph node (SLN) biopsy is a widely used procedure for the management of early breast cancer and melanoma to assess the risk for metastasis. A new CRP designed to complement a CRP in the human health area has as its focus

the development of a specific radiopharmaceutical for SLN detection (SLND). The SLN biopsy is used to guide surgical management in breast cancer patients, while in the early stages of melanoma SLND can improve staging of the disease and dictate patient management.

The regular production of fluorine-18 (the most used PET tracer) in an operating accelerator in South Africa and preparation of fluorine-18-fluorodeoxyglucose (FDG) for clinical use in cancer patients were the main achievements of a technical cooperation project completed in 2007. The project's main feature was the investment by South Africa in the equipment and facilities, while the Agency facilitated the transfer of know-how and training.

Radiation Processing Technology

Radiation processing is an important technique in the sterilization of medical products and the decontamination of spices and medicinal herbs, while its use in processing natural and synthetic polymeric materials is growing. Radiation induced grafting is a powerful technique for the preparation of novel materials based on easily available and low cost synthetic and natural polymers. There is growing interest in developing materials as special adsorbents and membranes for use in environmental and industrial applications. A new CRP initiated in 2007 seeks to use gamma rays, electron beams and heavy ions for the grafting of various monomers onto natural and synthetic polymers in order to develop novel adsorbents and membranes. These adsorbents can be used for the efficient removal of heavy metal ions from contaminated water and wastewater and for the collection and recovery of significant metal ions from sea water.

Enhancing the utility of natural polymers is an area of growing interest in Member States. In recognition of the potential benefits that radiation technology can offer for the processing of natural polymers into such products as hydrogel wound dressings, adsorbents of toxins, non-bedsores mats, and antibiotic, antioxidant and plant growth promoters, the Agency initiated a new CRP focused

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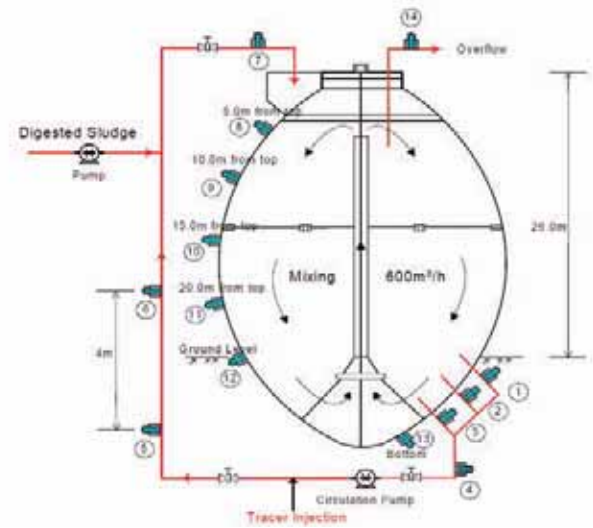


FIG. 1. Investigation of sludge digesters in a wastewater treatment plant in the Republic of Korea using scandium-46 as a tracer.

on the development of radiation processed products of natural polymers for application in agriculture, health care, industry and the environment. The main objective is to facilitate the wide use of radiation processed natural polymers and to bring together radiation technology specialists and end users.

Industrial Applications of Radioisotopes and Radiation Technology

Short lived radiotracers are used by industry to diagnose complex problems and obtain reliable and quick results. Radionuclide generators can help in overcoming the difficulties faced by users in obtaining such radiotracers. A new CRP seeks to investigate the potential of radionuclide generators for industrial radiotracer applications. The results of the CRP are expected to improve the availability of industrial radiotracers and radiotracer services, especially in developing Member States that do not possess radioisotope production facilities.

Through a regional technical cooperation project, the Agency is assisting Member States in Africa to maximize the commercial application of radiotracer and sealed source technologies for solving specific technology problems in priority industrial sectors such as the petroleum and petrochemical industries, and in mineral ore mining and processing. The application of these technolo-

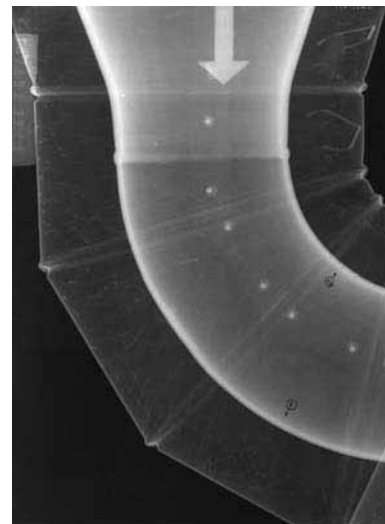


FIG. 2. Gamma radiography of a pipe without removing the insulation reveals internal flaws that are not reliably identifiable by non-nuclear methods.

gies increases productivity and safety and reduces environmental impacts. Other related technologies are also being promoted for specific applications, such as nucleonic gauges for calibration and repair purposes and in training courses for personnel. In 2007, Agency assistance focused on human capacity building in key radioisotope technologies, and on the conversion of conventional training material into information and communications technology based training/learning material.

Wastewater treatment plants (WWTPs) are the final barrier against possible contamination of

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downstream surface waters such as rivers, lakes and the sea. Therefore, it is very important to maintain effective operating conditions of the plants to eliminate or reduce the risk of environmental pollution. Radiotracer techniques can be used to study the plants with the aim of improving their design features and optimizing performance. With the assistance of the Agency, the Korea Atomic Energy Research Institute developed a technology which was certified by the Ministry of the Environment for the in-service measurement of the effective volume of anaerobic digesters in WWTPs using scandium-46 as a radiotracer (Fig. 1). Through the injection of the isotope into the digester, the size and location of immobile layers can be found

without disturbing the plant's operation. Through this technique, the operational efficiency of sewage facilities can be enhanced, additional environmental pollution prevented and operating costs reduced.

Digital industrial radiography (DIR) has considerable advantages over the film based techniques currently used in most Member States (Fig. 2). The industrial requirements of increased accuracy and ease of analysis and interpretation of data are more readily available from DIR, and hence a new CRP was initiated in this area in 2007. The objective is to design, develop, test and validate simple and low cost digital radiography techniques, in particular by optimizing the X ray detector and detector-source configuration.