



Nuclear  
Sciences and  
Applications

## Radiation Technologies: Contributing to a Cleaner Environment and Better Health Care



## Wastewater and biosolids treatment: Solution for environment protection

Radioisotopes and radiation technologies, including radiation processing, radiotracers and nucleonic measurement systems, underpin a variety of industrial and environmental applications and contribute to the development of countries worldwide by providing environmentally friendly solutions. The Radioisotope Production and Radiation Technology Programme of the IAEA assists and advises Member States in assessing their needs for capacity building, research, development and deployment of environmentally sustainable technologies for socio-economic benefits.

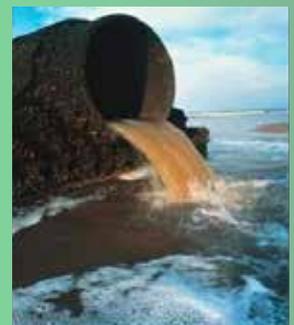
Radiation processing offers a unique additive free technology to treat wastewater from different origins and biosolids with high efficiency and reliability.

### The wastewater problem

Continued urbanization and industrialization of cities across the world, and accidental or intentional hazardous dumping of waste in water bodies are the leading factors contributing to contamination of ocean waters that is threatening the health and well-being of humans, plants and animals. Rapid developments in radiation technology have greatly increased our ability to effectively treat contaminants such as industrial wastewater and municipal wastewaters, which are the leading sources of pollution. Radiation techniques have been successfully deployed to demonstrate the effectiveness of the technologies.

### Radiation treatment of wastewater

The conventional processes used for wastewater treatment are not always capable of treating many of the chemicals present in wastewaters and treatment remains a challenge. The presence of emerging organic pollutants from industries and human activities, such as excreted drugs, pesticides and endocrine disruptors, may profoundly affect aquatic life, even at trace levels. Radiation-initiated degradation of organic pollutants helps to transform such pollutants into simpler substances that can be treated by conventional methods or to reduce them to levels below permissible concentrations.



Polluted Water



Electron beam  
treatment



Re-use of treated water

Radiation processing offers the following advantages:

- No addition of chemical compounds, no heating and ease of automation;
- In situ generation of reactive species for efficient decomposition of pollutants;
- Absence of hazardous by-products;
- Ease of integration with existing process systems;
- Economic advantages in comparison with conventional technologies.

The successful development of radiation processing technology with the support of the IAEA and the subsequent operation of an electron beam accelerator based process at an industrial complex in Daegu, Republic of Korea, to treat 10 000 m<sup>3</sup> of textile wastewater, combined with the existing biotreatment facility, has demonstrated the efficacy, reliability and cost effectiveness of the technology.

## Radiation hygienization of biosolids

Biosolid or 'municipal sludge', a by-product from wastewater treatment plants, is disposed of either in landfill or into the sea, resulting in pollution of water bodies including the oceans. Safe disposal of the vast quantities of municipal biosolids produced has, therefore, emerged as a new challenge for municipal authorities. Biosolid disposal in its present form, besides being difficult, leads to economic loss.

High energy ionizing radiation inactivates the pathogens present in biosolids with a very high degree of reliability, and in a clean and efficient manner, thus making treated biosolids useful as manure in agricultural fields to improve soil fertility and as a medium for growing bacteria useful for soil such as rhizobium that can be used to enhance crop yields.

The use of high energy radiation to hygienize sewage sludge has been demonstrated at Geiselbullach (near Munich, Germany), in Albuquerque, New Mexico (USA), in Boston, Massachusetts (USA) and in Takasaki (Japan). In India, at Vadodara, a full scale gamma radiation facility with a capacity of 500 kCi <sup>60</sup>Co has been integrated with the conventional sludge treatment process. The utilization of hygienized sludge as a soil amendment material to enhance agricultural productivity has also been demonstrated by converting low fertility lands into vineyards.

Advantages of the radiation hygienization process:

- Pollution free utilization of biosolids;
- Use as a bio-fertilizer to increase crop yield;
- Improved soil conditions, soil conservation;
- Reduced demand for water;
- Simple, highly effective and reproducible process;
- Ease of integration with conventional processes in the existing facility.



**Biosolid land use**



**Enhanced soil fertility**



**Higher production**