



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



Coastal environment protection: Combatting pollution from municipal and industrial wastewaters

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.

In the specific field of wastewaters treatment optimization and outfalls studies, the main technology involved is radiotracers.

With the advent of industrial growth, water as a resource is becoming a limiting commodity. This is due largely to the uneven distribution of available sources of usable water, and the deterioration in quality of potential water sources due to the discharge of wastewater on land and into existing water bodies. These problems can be tackled simultaneously by:

- Improving the main water harvesting methodologies so that precipitation is distributed more evenly for water usage,
- Treating the used water in such a way that it does not significantly affect the water quality of the sources currently available.
- Studying and optimizing the design of wastewater outfalls to protect the environment from remaining pollutants

These methods together can be considered important for water management. Wastewater management essentially addresses the second and third parts of the strategy i.e. how effectively and efficiently one can treat the wastewater, so that it can be discharged without affecting the environment or can be recycled and reused.

Sewage treatment is a multi-stage process. The purpose of wastewater treatment is to remove pollutants that can harm the aquatic environment if they are discharged into it. It includes physical, chemical and biological processes to reduce or remove organic matter, solids, nutrients, disease-causing organisms and other pollutants from wastewater.

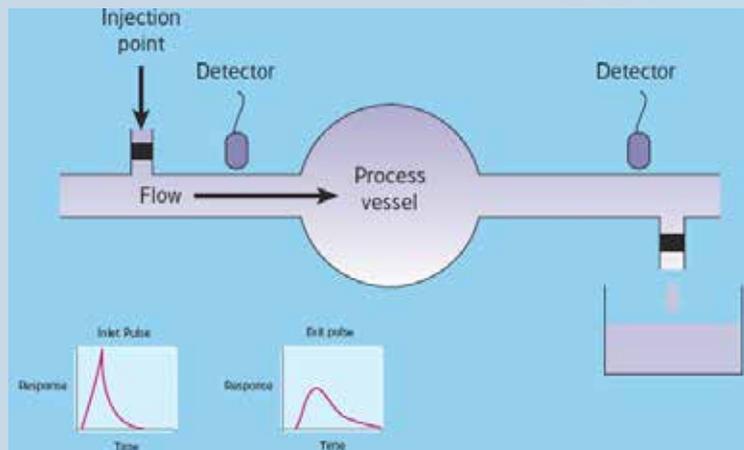
View of a typical
Wastewater Treatment
Plant (WWTP)



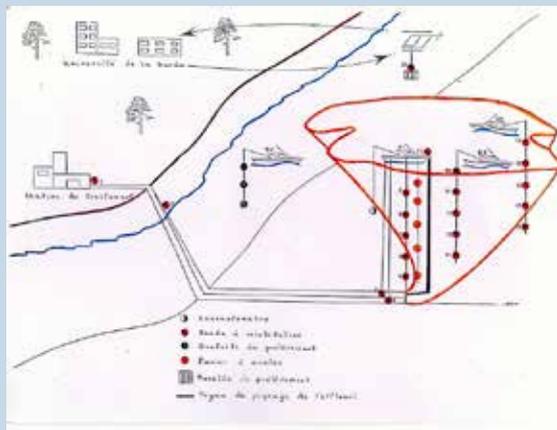
Assessing wastewater treatment

Operation of a wastewater treatment plant or lagoon can be deceptively complex. Given the unsatisfactory state of current theoretical approaches, there is a need to be able to assess performance practically. Tracer techniques are highly useful tools to investigate the efficiency of purification in wastewater treatment installations aiding both their design and performance optimization. There are many kinds of tracers. The radioactive tracers are the most sensitive and are largely used for online diagnosis of various operations in WWTP. The success of radiotracer applications rests upon: (1) the extremely high detection sensitivity of radiotracers, which facilitates their use in large scale WWTP, treating millions of liters of wastewater, (2) the strong resistance against severe process conditions; (3) the on-line investigation mode without sampling; and (4) the simultaneous tests for solid and liquid phases completed by the multi-tracer tests.

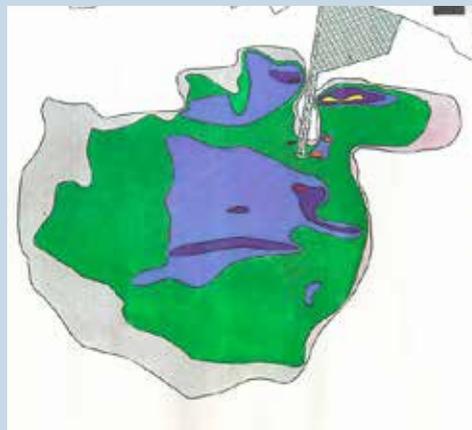
The tracing principle consists of a common impulse-response method: injection of a tracer at the inlet of a system and recording the concentration-time curve $C(t)$, at the outlet. In the simplest way, a sharp pulse of tracer is injected upstream of the vessel and a detector located at the inlet marks time-zero. A second detector located at the outlet records the passage of the tracer from the vessel. The response of this detector is the residence time distribution (RTD). This methodology is applicable in any type of system, with any type of tracer and any type of detection system, even manual sampling.



Principle of tracer residence time distribution (RTD)



Dynamics of the effluent in the water column



Map of the deposit of sludge particles on the sea bed

Assessing wastewater sea outfalls

Even after treatment, wastewater still contains pollutants. The behaviour and dynamics of pollutants is important for environment protection and can be assessed with radiotracers in a safe and efficient manner. Tracers can also be used as indicators to help in taking samples at the right place knowing the history (dilution) of the pollutant at this time and place, and thus perform relevant lab analysis. Finally, the data obtained allow the validation and/or calibration of CFD models developed to predict the behaviour of pollutants in the long run.

