



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



# Ballast water: How to avoid the resulting threat in the oceans

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 ballast water treatment, radiation processing technology using electron beam accelerators offers an innovative solution for controlling conventional and emerging water pollution challenges without added chemicals.

### Marine bio-invasions

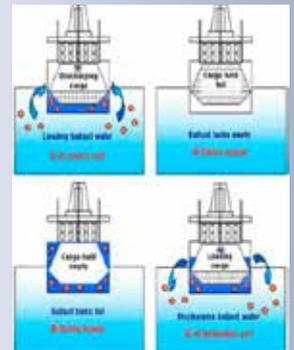
Ships use ballast water to provide stability and manoeuvrability during a voyage. Water is taken on at one port when cargo is unloaded and usually discharged at another port when the ship receives cargo. The presence of a multitude of aquatic species in ships' ballast water, including bacteria and other microbes, micro-algae and various life stages of aquatic plant and animal species, is a potential source for the introduction of non-native organisms — called bio-invasers, alien species, non-indigenous species or exotic species — into the port of discharge. The introduction and spread of alien invasive species is a serious problem that has ecological, economic, health and environmental impacts, including loss of native biological diversity.

### Controlling the threat of bio-invasion

Ballast water is one of the major pathways of biological invasion throughout the world. Removing organisms from ballast water is a promising way of preventing the introduction of bio-invasers. The International Convention for the Control and Management of Ships Ballast Water and Sediments was adopted by a Diplomatic Conference at the International Maritime Organization in 2004. The Convention sets a quality standard for discharged ballast water. According to the Convention, ships are to install and use an on-board ballast water management system by 2016.



A cargo ship pumps out ballast water



Marine bio-invasion

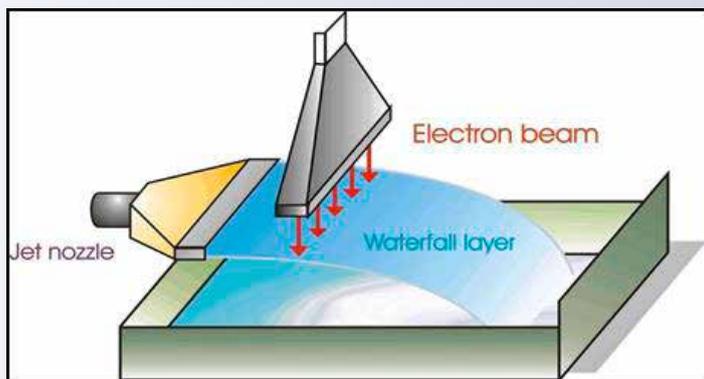


Electron beam treatment of water

The conventional treatment methods being propagated include mechanical treatment methods such as filtration and separation, physical methods such as heat or ultraviolet, and chemical methods such as chemical electrolysis and addition of biocides. These techniques have their own limitations such as secondary contamination and the low treatment efficiency for removal of contaminants.

## Ballast water treatment using electron beam technology

Radiation technology is a well proven and effective method used by the medical industry to sterilize medical products. This technology using electron beam radiation technology can remove various contaminants from the ballast water. The patented technology utilizes injecting high energy electron beams directly into ballast water to generate highly reactive species in the ballast water that rapidly damage and destroy the cells of harmful marine organisms, including viruses, bacteria and red algae within a short time, thus making it possible to remove various contaminants from the ballast water in a simpler manner. As the contaminants of the ballast water are removed by continuously irradiating with the electron beams, the treatment time for removing the contaminants from the ballast water can be reduced and the additional oxidative degradation of refractory organic matter can also be achieved, thus greatly increasing the efficiency of treatment of the ballast water.

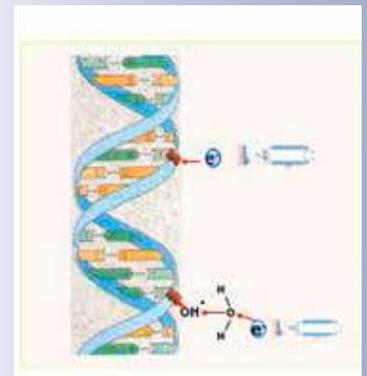


### Advantages of the technology:

- It is based on a simple, highly effective and well proven process used for sterilization of medical devices;
- The technology can be adapted to suit the varying levels of treatment required;
- It does not require any additional chemicals to be added;
- It is based on an ON/OFF system of treatment.



A ship releasing ballast water



Disinfection mechanism by electron beams