Radiation technology helps China's industries make water cleaner

By Nicole Jawerth

"China is taking a multipronged approach to wastewater treatment, collaborating with a variety of private and public sector partners, including the IAEA, to develop expertise in radiation technology in combination with other methods."

— Kenneth Hsiao, President, Jiangsu Dasheng Electron Accelerator Device Co., Ltd., China

China is pursuing the use of radiation technology as part of its wastewater treatment methods to further efforts to manage industrial waste in an environmentally friendly way.

"Treating the water that comes from our industries is very important, so we have been doing this for a long time. Now we want to become better at making our water cleaner," said Jianlong Wang, Vice-President of the Institute of Nuclear and New Energy Technology (INET) at Tsinghua University in Beijing. "We are receiving a lot of support from the IAEA to use electron beam based technologies to help us get rid of various water pollutants that the other methods cannot do on their own."

Electron beam accelerators are machines that produce beams of electron radiation that can be used for cleaning wastewater, among other things (see box). Wastewater is water that has been adversely affected by its use in human activities, such as for industrial or agricultural purposes.

The electron beam scanning box is where wastewater can be irradiated by high energy electron beams.
(Photo: INET/Dasheng)

Industrial wastewater can contain a variety of chemicals, including pesticides, organic material, chemicals and dyes. These can be harmful and, in some cases, very toxic. Before releasing this water or reusing it, it must be treated to minimize the amount of these containments to prevent them from spreading to surface and groundwater resources.

For decades, China has been cleaning its wastewater using conventional treatment methods that involve physical processes and chemicals. To meet its tightening policies on energy saving and environmental conservation, China is now working to expand the use of radiation technology to remove harmful containments like, among others, cyanide, oils and greases, and dyes, from the leftover water, said Shijun He, Associate Professor at INET.

Conventional processes are difficult, inefficient and expensive to use alone, added Sunil Sabharwal, radiation processing specialist at the IAEA.

"Electron beam accelerators can be a very efficient and cost effective way to treat wastewater," said Sabharwal. Different types of contaminants need different treatment methods, and combining radiation technology with other methods can eliminate a spectrum of contaminants and more effectively break down organic matter, while leaving no secondary pollution and requiring very few or no additional chemicals, he explained.

Collaboration across sectors

"China is taking a multipronged approach to wastewater treatment, collaborating with a variety of private and public sector partners, including the IAEA, to develop expertise in radiation technology in combination with other methods," said Kenneth Hsiao, President of Jiangsu Dasheng Electron Accelerator Device Co., Ltd. in Jiangsu, China.

With the IAEA, China is focusing on ways to use electron beam irradiation to target specific types of pollutants and demonstrate the effectiveness of these radiation tools for adoption on a wider, larger scale in the future, explained Massoud Malek, an IAEA programme management officer working with China.

Water is ejected as it is treated to remove harmful contaminants and unwanted colours and odours.
(Photo: INET/Dasheng)

"The IAEA has been supporting China in developing electron beam irradiation to treat wastewater, remove certain contaminants, and help to ensure water resources stay clean and safe," said Malek.

From one country to another

Water is not bound by borders so international cooperation and effective national level treatment methods are essential, said Malek. "If contaminated wastewater reaches a surface or groundwater source, the contaminants can spread to other places through shared water resources and rain. So it is important that the water is made clean before it's released."

Studies like the IAEA projects in China can help further research and development of these technologies and show other countries how they can take up and use them. In this case they provide industries with appropriate means of cleaning up the results of their activities and further strengthen environmental protection efforts.

"So far there have been few projects like this, so China's project with the IAEA can be a source of expertise and knowledge for other countries and industries to adopt these tools for their own use," said Malek. "As more industries refine their wastewater treatment methods, the cleaner that water gets, helping us to protect the environment, people and our water resources worldwide."

THE SCIENCE

Treating wastewater using electron beam accelerators

The beams of high energy electrons produced by electron beam accelerators can be used to treat wastewater by minimizing harmful contaminants and removing unwanted colours and odours.

During the treatment process, the water is passed through a chamber that is exposed to ionizing radiation from the accelerator. This leads to chemical reactions in the contaminants, causing them to decompose into more manageable and easier to treat fragments. The water is then passed through biodegradation treatment that degrades these components further before the treated water is released or reused. This method does not make the water radioactive or leave any radiation behind.