IAEA Technical Cooperation Programme

Supporting industrial applications of e-beam and gamma irradiation in the Philippines

The challenge

Like many countries, the Philippines face challenges in food and water safety, and in assuring the quality of locally-produced goods.

Despite efforts to improve sanitation in food production and sales, disease-causing bacteria such as Staphylococcus and Salmonella have been found in Filipino food, and diarrheal diseases have been a significant cause of morbidity in the Philippines for many years. However, Gamma irradiation and electron beam (e-beam) irradiation can improve microbiological safety and the shelf-life of food products.

Irradiation can also be used to control pests, disinfect and clean waste water, and produce industrial goods such as wires and cables in a cost-effective and timely manner. The Philippines therefore decided to increase national capacity to apply radiation processing in industry.

The project

In 2009, the IAEA initiated the first of three consecutive national technical cooperation projects in the Philippines, with the aim of establishing both a semi-automated gamma irradiation facility and an electron beam facility at the Philippine Nuclear Research Institute (PNRI), that could be used for research and development and for industrial services.

The PNRI Electron Beam Irradiation Facility (irradiation cell). (photo: PNRI)

Initially, the IAEA assisted in the procurement of equipment and the provision of expert advice for the commissioning of the semi-automated gamma irradiation facility. Local staff were trained through fellowships in the operation and maintenance of the facility, and also received training on dosimetry. Facility managers made scientific visits to existing fully automated gamma irradiation facilities to learn from their experience, with the intention of subsequently upgrading the semi-automated gamma irradiation facility to full automation.

The IAEA also provided assistance for the establishment of the electron beam irradiation facility, supplying equipment as well as expert advice for the design, safe operation and quality management of the new facility. PNRI staff received training through courses, fellowships and scientific visits that focused on radiation-induced polymerization and cross linking, nanotechnology and food irradiation, as well as on operation, maintenance and dosimetry.

The impact

As a result of the three technical cooperation projects, the Philippine's national capacity in radiation technology has been strengthened, and safe irradiation services for radiation-induced polymerization and crosslinking have been established and enlarged.

The upgrade of the gamma irradiation facility has improved its performance, resulting in a higher throughput and allowing PNRI to provide more services to clients from commercial, industrial, academic and research sectors. The facility currently serves about 75 clients (52 from industry and 23 from academic and research institutes), irradiating spices, dehydrated vegetables, herbal

17-43111

PROJECT INFORMATION

Project No: Three national projects

Duration: 2009–2017

Budget: €1 051 676

Regional Agreement: RCA

Contributing to:

Partnerships and counterparts

Philippine Nuclear Research Institute. The E-Beam and Gamma Irradiation Facility received funding from the IAEA and the Government of the Philippines (including the Department of Science and Technology), and from China, the United States of America and Japan through the Peaceful Uses Initiative.

Facts and figures

Thirteen scientific visits and 17 fellowships were delivered through the three technical cooperation projects. The new research facilities have increased the competitiveness of industry in the Philippines, and are contributing to economic growth and socioeconomic development in the country. For example, radiation processing has been used to create several new locally-produced high technology products, such as plant growth promoters prepared from radiation processed natural polymers such as carrageenan, an extract of seaweed, which increase rice production while protecting plants from infestation.

The science

A product or material can be irradiated to preserve, modify or improve its characteristics. The principal industrial applications of radiation are currently sterilization of health care products (including pharmaceuticals), irradiation of food and agricultural products (disinfestation, shelf life extension, sprout inhibition, pest control and sterilization), and materials modification (polymerization, polymer crosslinking and gemstone colourization). Gamma ray irradiators and e-beam accelerators are very efficient radiation sources for medical and industrial applications.

Most food and agricultural products treated by irradiation are processed in gamma radiation facilities that use cobalt-60 as the source of ionizing radiation. Gamma irradiation is a simple, robust and well-established technology.

Electron beam and X-ray machines employ electricity to generate ionizing radiation. By manipulating electric and magnetic fields, free electrons in a vacuum can be made to form a fine, uninterrupted beam of kinetic energy. These ‘e-beams’ can be precisely controlled to deliver an equally precise dose of heat or energy to solid-state matter, whether it is human tissue or a steel cable. E-beam processing creates useful changes effectively and efficiently in material properties and enhances the quality of locally-produced high technology products.

products, cosmetic raw materials and accessories, and medical devices for microbial decontamination and sterilization. It is also used by academics and researchers for research and development studies. The semi-automated facility is being upgraded to a fully-automated facility, which will increase its throughput, enhance safety and reduce human intervention while products are being irradiated.

The new e-beam facility was inaugurated in 2014. It is the first facility in the country intended for full-scale pioneering research and development of high-value products from natural and synthetic polymers. The state-of-the art facility serves as a site for industrial research on the technical and economic feasibility of products treated or produced using e-beam irradiation. In addition, the facility serves as a centre of training on all aspects of e-beam technology, including radiation processing, quality assurance, radiation safety and dosimetry, and the operation and maintenance of an e-beam facility. The facility will help entrepreneurs to establish cost-effective technologies for the production of advanced materials, thereby reinforcing the competitiveness of the Philippines in this growing market.

Using e-beam irradiation, the Philippines will be able to improve the microbiological safety and shelf-life of food products such as frozen meat. It will also be able to produce plant growth promoters at a much faster rate than in the gamma facility. E-beam treatment of waste water will be used to eliminate pathogens effectively and completely, remove residuals from textile plants, clean refinery vessels, and decompose halo-carbons and volatile organic compounds. Additionally, e-beam technology will be used to produce wires and cables, which is faster and less expensive than the process of ‘chemical crosslinking’.