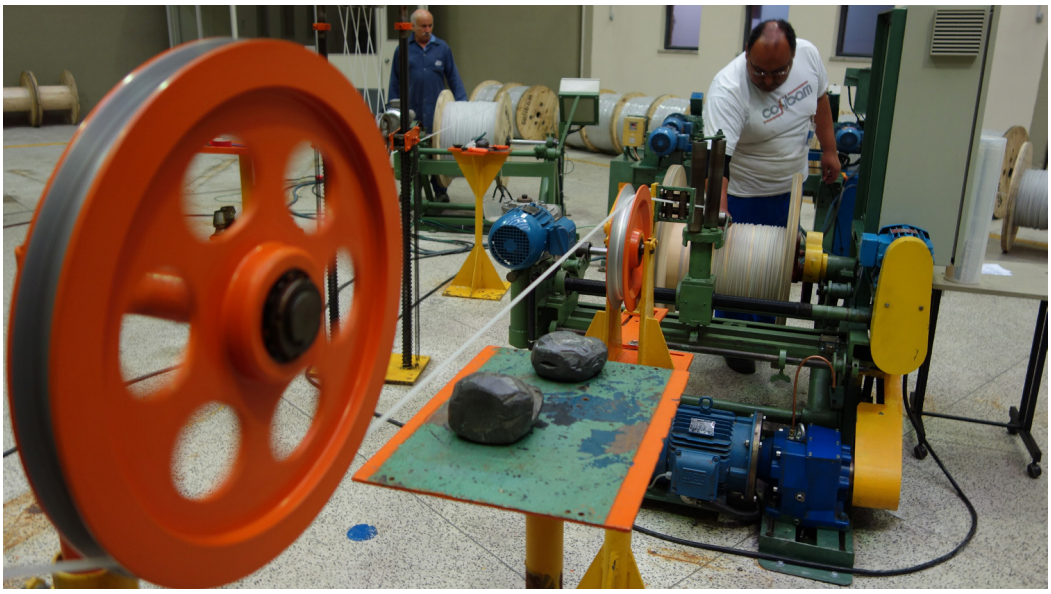
A look at radiation science and technology

By Nicole Jawerth



Wires and cables can be made stronger and more resistant to harsh chemicals and extreme temperatures, such as fire, with the help of radiation technology.
(Photo: L. Potterton/IAEA)

"Radiation technologies can help to alleviate emerging environmental challenges, and help us ensure a sustainable future, particularly in low and middle income countries. As these tools continue to develop and evolve, there will be new possibilities for how we can use them."

— João Osso, Head, Radioisotope Products and Radiation Technology Section, IAEA

Smartphones, car tyres and bandages: these are just a few of the everyday products that are made safer, more reliable, or more effective with radiation technology. Beyond these products, this technology is also a tool for safety checks, cleaning up water and air pollutants, and even improving food production and preservation, among others. Through advances in research and innovation in radiation science, this technology's global impact on daily life and sustainable development continues to grow.

"Look at farmers in India, who have arms full of vegetables because of fertilizers made from irradiated sewage sludge. Or admire thousands of beautiful art pieces and cultural relics in Brazil that have been saved from insects and mould thanks to radiation," said João Osso, Head of the IAEA's Radioisotope Products and Radiation Technology Section. "The potential benefits of radiation are vast."

Scientists have been studying radiation (see The Science box) and its chemical effects for decades. These studies have resulted in a range of tools and methods that take advantage of these effects and apply them in a variety of areas, from agriculture and industry to environmental protection to safety and security. Compared to many conventional methods, techniques involving radiation are often quicker, more cost-effective and environmentally friendly.

Non-destructive testing (NDT), for example, is a quality control method used in industry to detect leaks, cracks and other structural inconsistences in products, building structures and machines. It works by passing radiation, like X-rays, through the material so that it can be detected using specialized devices. These devices produce images of what is happening inside the material. Read more about this on pages 6 and 12.

Radiotracers are another family of tools often used to improve the productivity of sectors such as the mineral processing and metals extraction industry. Specialists inject key radioisotopes into a fluid or a mixture containing a substance, where these atoms latch on to the molecules of the substance. Using special scanning machines, specialists can track the radioisotopes to take measurements and understand different characteristics of the substance and how it moves inside a system. Read more about this on page 14.

New materials for a more sustainable future

Radiation science research has also led to new ways of restructuring and linking molecules to create new materials, many of which are more sustainable, effective and eco-friendly. These new materials are made from irradiated organic compounds and polymers, such as proteins from milk,

Radiation technology can be used to inspect the internal components of a process or piece of equipment without interrupting production.
(Photo: A. Rachad/CNESTEN)

leftover materials from plants, or cellulose from natural sources such as trees and crustacean shells. In some cases, these compounds are combined with fibres from other natural sources, such as wood, to improve durability. This has resulted in, among other things, new building materials, improved gels for healing wounds and eco-friendly food packaging material. Read more about this on pages 10 and 18.

Using the same radiation tools, but at different energy levels, scientists can modify how cells and molecules behave so as to treat unwanted contaminants or infestations. At certain dose levels, the radiation can change key components inside the cells to inhibit their reproduction or break down molecules to make them easier to treat. Read more about this on pages 8 and 16.

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THE SCIENCE

What is radiation?

Radiation is a form of energy, like heat and light from the sun. There are two types of radiation: ionizing radiation and non-ionizing radiation. Ionizing radiation is usually what people mean when they talk about radiation.

Ionizing radiation comes from atoms that are unstable and are in the transformation process towards becoming stable — this process is called radioactivity. It can also come from the acceleration of particles by an electromagnetic field. There are several types of ionizing radiation: alpha particles, beta particles and gamma rays, as well as accelerated particles and waves called electrons, protons and X-rays. There are also sub-atomic particles like neutrons or charged ions that serve as a source for radiation applications.

Scientists can use ionizing radiation, combined with special tools, to determine different characteristics of substances or, when used at a high enough dose, to modify the substances. For example, a special camera is used to detect radiation as it passes through an object, which results in an image outlining what is happening inside of the object.