

Industry



Testing, Tracing and Measuring: How Radioisotopes Support Industrial Processes

SUMMARY

1. Radioisotopes are used in diverse areas of science and industry to improve productivity and to obtain specific information, by means of precise tracking and monitoring, that cannot be acquired any other way.
2. They usually come in the form of sealed radioactive sources and are used in various fields, such as industrial radiography, gauging applications and mineral analysis.
3. The IAEA supports its Member States in using radioisotope technology in industry.

INTRODUCTION

A radioisotope is the unstable form of an element that emits radiation, which is easily traceable, and are used in industry to test, trace and measure industrial processes and operations. Radioisotopes are used in many sectors of industry and for scientific research and development. This includes radioactive tracers, as nucleonic measurement systems for process monitoring, and as non-destructive testing for quality control of materials and structures as well as integrity testing.

The breadth of radioisotope applications in industry rests largely on two general attributes. Firstly, penetrating radiation capable of passing through considerable thicknesses of dense materials provides a means of determining the state of process materials within vessels. Secondly, it is possible to use this information in a quantitative manner as the basis of instrumentation for control and analysis.



A researcher at Myanmar's Department of Atomic Energy is testing equipment to be used for non-destructive testing at the country's oil refinery.

(Photo: M. Gaspar/IAEA)

Radioisotope instruments have three advantages:

- Measurements can be made without physical contact with the material or product being examined and with reduced inspection times;
- The isotope source requires very little maintenance;
- The cost-benefit ratio is tremendous — many instruments pay for themselves within a few months through increased cost-effectiveness and savings.



Technicians inspecting a PETRONAS pipe using NDT methods in order to test the quality of the pipeline.

(Photo: A. Nassir Ibrahim/Madani NDT Training Centre)

HOW DO RADIOISOTOPES SUPPORT INDUSTRY?

For any industry, a strong technological infrastructure is necessary for safe and efficient operations with access to the right tools and mechanisms for monitoring the quality, reliability and safety of equipment and the efficiency of industrial processes. Radiation-based techniques contribute to these tasks.

Industrial tracers

Radiotracers play a vital role in investigating and identifying technical issues in industrial operations. When small amounts of radioactive substances are added to materials used in various industrial processes, they help to assess problems in the mixing and flow rates of a wide range of materials, including liquids, powders and gases, and to locate leaks and investigate fluid flow. In the oil and gas industry, radiotracers are used to help define permeability and flow parameters within oilfields. They help identify engine wear and equipment corrosion.

An important characteristic of radiotracers is the ability to track processes from the outside without disrupting normal operations. For example, to find a

leak or blockage, the radioactive material is added at one end of a buried pipe. A radiation detector outside the pipe or above ground is used to track its progress through the pipe.

Radiotracer techniques also support process management and quality control in many industries, such as in the petrochemical, mineral and processing industries, which rely on them for performance analysis, identifying weak spots and reducing the time needed to track technical problems, energy consumption and pollution.

Non-destructive testing

Non-destructive testing methods include gamma and X-ray radiography and tomography, which are based on the differential absorption in different materials of radiation emitted by a radioactive source. Measurement of the rays that pass through the material without being absorbed allows its make-up and structure to be identified. These techniques are able to identify structural defects that cannot be discovered by traditional testing methods.

Non-destructive testing is a vital tool used worldwide in many industries to test the quality and integrity of



Gauges using radioisotopes and radiation are used for a number of industrial applications such as measuring water and sediment mixture density, level, thickness, and moisture, for component analysis in cement and coal industry as well in petrol, gas, paper, plastic, steel, and tobacco industry. It is mostly used for quality control of products on production lines. (Photo: P. Brisset/IAEA)

products such as pipes, boilers, pressure vessels, civil structures, aircraft equipment, railways and ships. Non-destructive testing using nuclear techniques involves the use of ionizing radiation to test the quality of materials and products. It plays a decisive role in the production and maintenance of materials and structures, without causing any damage to them or leaving any radioactive residue.

Non-destructive testing is also used to check the physical integrity of critical structures such as bridges, dams, schools and hospitals. The IAEA supports Member States upon request in using non-destructive testing for the inspection of civil structures for their quality assurance. These techniques are extremely useful for recovery following natural disasters. The IAEA assisted Nepal and Ecuador in recovery operations following earthquakes in these countries by urgently making available NDT equipment and techniques.

Measuring and checking: gauges

Gauges are instruments exploiting the interaction between ionizing radiation and matter. They are widely used in industry to measure various physical

parameters: for example, level measurements in liquids and solids, thickness of sheet material or density of products. Several hundred thousand such gauges are operating in industry across the world. They contain radioactive (usually gamma) sources.

The ability of radioisotopes to precisely measure thickness is extensively used in the production of sheet materials, including metal, textiles, paper, plastics and others. Density gauges are used as tools in the petroleum and mining industries to measure the density of mixtures. The aim is to control and improve product quality by optimizing processes and saving energy and materials.

There are a variety of nucleonic gauges that are used for measurement and analysis. They are also used in the coal industry. In paper manufacturing, beta gauges are used to monitor the thickness of paper.

Portable gauges have applications in agriculture, construction and civil engineering. For example, portable gauges may be used to determine the degree of soil compaction on agricultural land or the density of asphalt in paving mix for a road surface.



Radiotracers are used to monitor sediment transport in the sea.

(Photo: Bhabha Atomic Research Centre)

IAEA SUPPORT

The IAEA supports its Member States in applying radiation-based techniques. This includes advice on the use of radiotracers, sealed sources, nucleonic control systems and non-destructive testing techniques, and support for the development of human and institutional capacities.

The IAEA has supported establishing capacities in radiation techniques in over 50 laboratories in Member States.

Alongside technical publications and training courses, the IAEA assists developing countries by supporting the creation of expert groups and networks. In non-destructive testing, for example, nearly 90 developing countries are engaged through various regional and national projects. Core groups have been created that provide services to industry and conduct training and certification programmes.

The IAEA also promotes research and development through coordinated research projects related to these specific industrial nuclear-related techniques, and organizes meetings and capacity building activities at the IAEA laboratories and at collaborating centres.

Member States using nuclear techniques such as radioisotope technology, need to ensure that appropriate safety and security measures are in place, for which the IAEA provides support that include developing national safety and security infrastructures that are in line with the Agency's safety standards and security guidance.

AREAS WHERE MEMBER STATES MAY BENEFIT FROM IAEA ASSISTANCE

- Enhancing analytical capacities in radioisotope technology.
- Improving research and development for the application of radioisotope technology in industry.
- Collaborating with the IAEA in capacity building and training to use radioisotope technology to benefit industrial operations and processes.

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