RCA Innovation Supporting Regional Chemical, Petrochemical and Petroleum Industries

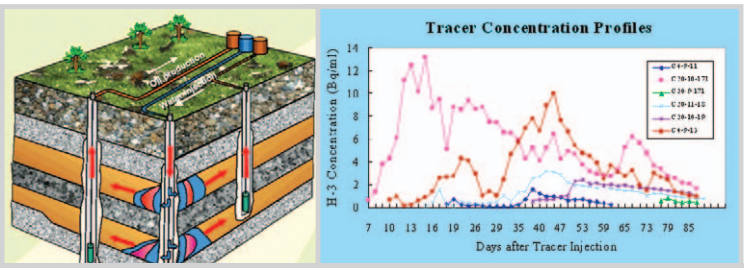
Major industries and particularly those involved in the operation of chemical, petrochemical and petroleum plants, have long recognised and used radiotracers and sealed source technologies as effective tools for online control and measurement as well as indispensible agents for troubleshooting when problems occur. The cost effectiveness and the suitability of nuclear technologies for exploitation in industry led to the establishment of "in house" teams to apply the technologies and at the same time this move to keep the skills "in house" also protected the industries' commercial advantages and operational secrets. A consequence of this restricted availability of the technology has been that often emerging industries in the RCA Member States have had limited or no access to many of these technologies and have not been able to benefit from the associated efficiencies and cost savings.

In response to this situation a series of RCA projects on radiotracers and sealed source technology have been implemented to transfer this knowledge and enhance the capabilities and capacities of RCA Member States to respond to the needs of regional industries. Member States have established local teams to acquire the knowledge and skills being transferred. These teams carry out the important task of interacting with local industries to inform them of the new range of techniques available to assist them in their operations and, where suitable, they carry out demonstrations or longer term studies. In addition, this contact with industry enables the teams to learn more about the needs and problems in this sector and hence they become better able to identify where nuclear techniques can assist.

Many teams have not been content just to receive the transferred technologies through the projects. They have carried out additional adaptation and development of the technologies to meet the special needs of particular industries in their country as well as providing services to relevant industries on a regular basis. The following two examples are in selected areas of significant importance to the chemical, petrochemical and petroleum industries and illustrate the achievements and skills of these local teams as they build on the knowledge transferred through the RCA projects.

Radiotracers for Interwell Studies in Oil Fields

The Fundamentals: the extraction of crude oil from underground sources is mostly a difficult and expensive undertaking. Crude oil is found in various rock strata and usually water and gas are also present. Natural underground pressure formed when this mixture expands, can force it to the surface in a process that is usually termed *natural production or primary production*. However this is not a very efficient process and only about 25% of the original oil in place will be extracted, with the remaining 75% being held in pores and fissures of the various strata.



Interwell tracer test in oil field and an example of a series of tracer response curve showing concentration profiles for a range of tracers

A further 50% of the original oil in place can be recovered through a process called *secondary recovery*, in which water is injected below ground though special wells (injection wells) to help flush out the remaining crude oil, which is extracted from a series of other wells (production wells) surrounding the injection well. The efficiency of the water flooding process is highly dependent on the nature of the rock strata, the characteristics of the fluid being extracted as well as the water injection strategy. Optimum recovery of the oil can be achieved if all these various factors are known and this is where the power of the tracer technology is revealed.

The underground flow behaviour of the fluids between the injection well and the production well(s) can be measured by adding a tracer to the injection water. Periodic sampling at the production well(s) and analysis for the tracer will provide what is termed a *tracer response curve*. Specialist analysis of this curve can then provide the important information about the character of reservoir and makes it possible to optimize the injection regime, improve the production strategy and thus maximize the overall recovery of the crude oil.

Member States' Innovations in Interwell Tracer Technology (IWTT): in China, the Project Team at the China Institute of Atomic Energy (CIAE) has been engaged in interwell tracer test in industry, has established an interwell radiotracer laboratory and promoted its application in China. The team has developed new tracers, tracer analysis techniques and computer modeling and simulation techniques. At present the Project Team conducts 400 well operations annually in the oilfields. In addition work has been carried out in other countries; for example contract work has been undertaken in Kazakhstan and proposals for reservoir tracer tests have passed technical evaluation in Oman and Libya.


Tracer injection in oil field by the Chinese team

In Vietnam, the Centre for Applications of Nuclear Technique in Industry (CANTI) have established an interwell radiotracer laboratory and have developed improved tracer methods for high temperature and fractured basement reservoir conditions. They have established their capability for the investigation of oil reservoirs in Vietnam oil fields and are now providing routine commercial service to most oil fields in Vietnam. The Vietnam tracer group has won an international bid for interwell tracer tests to be performed in local oil fields and earned more than US$2 million. CANTI has been developed as an independent and self-reliant centre.


Tracer injection preparations by CANTI at an offshore oil field

Sealed Gamma Sources for Scanning Distillation Columns

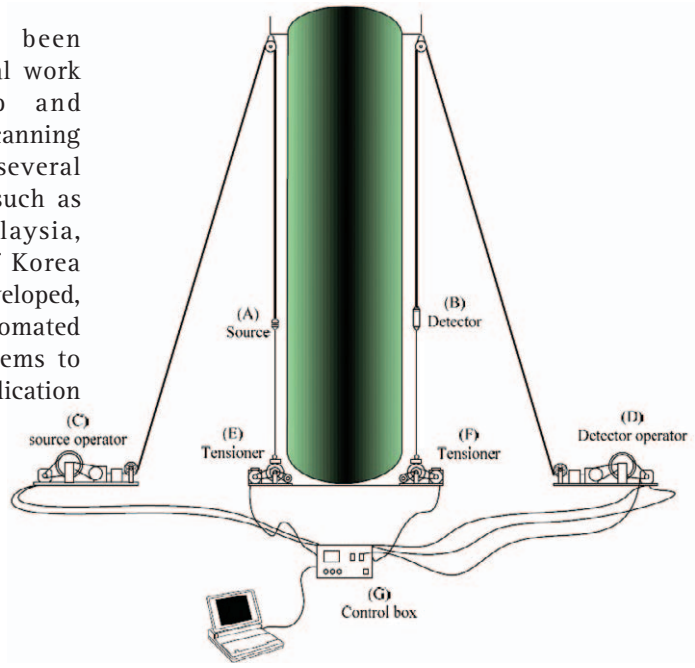
The Fundamentals: distillation columns are essential and critical components in the operation of chemical, petrochemical and petroleum plants. If these units begin to show evidence that they are not working to specification or some malfunction is suspected, then diagnostic procedures have to be brought in rapidly so that the required remedial actions can be carried out promptly.

Gamma radiation has great penetrating power and can pass through significant thickness of steel and other metals and construction materials. Detection of the changes in intensity of gamma radiation as it passes through a distillation column provides a picture of the internal structures and arrangements inside the column and most importantly can be undertaken while the column is operating. This basic principle has been the basis for the technique behind the scanning of industrial distillation columns, which over many years has been demonstrated to achieve reliable identification and the localization of faults or malfunctioning. Follow up actions by the plant organization, with timely repairs and consequent restoration of normal functioning of the column, returns the operations to the desired state and a timely diagnosis results in significant cost savings.

Unlike the IWTT, where the tracer materials are introduced into the injection fluid, the radioactive materials used in column scanning are sealed in capsules and cannot make physical contact with either the plant or the materials being processed. Only their gamma radiation is utilized. Often, this radioisotope application is the *only* way by which the necessary information about the distillation column performance could be obtained.

Member States' Innovations in Column Scanning

Project teams have been carrying out additional work to further develop and improve the column scanning operation. Teams in several RCA Member States, such as India, Indonesia, Malaysia, Pakistan, Republic of Korea and Thailand, have developed, or are developing, automated column scanning systems to further commercial application of this technique.



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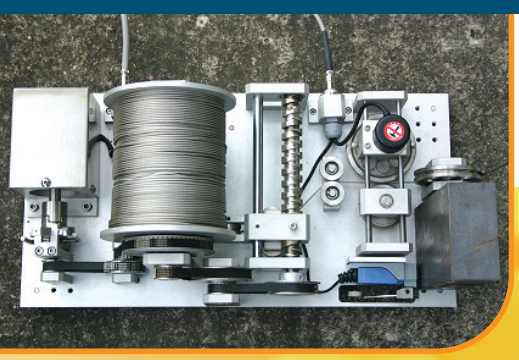

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