Recent Status of Application of Radioisotope in Industry

Jinho Moon, Jang-Guen Park, Sung-Hee Jung
Radioisotope research division, Korea Atomic Energy Research Institute, 111 989beon-gil, Yuseong-gu, Daejeon, Korea, 34057
**Corresponding author: jinhomoon@kaeri.re.kr*

1. Introduction

Today radioisotope techniques are used extensively throughout the world for troubleshooting an optimization of industrial process plants. Radioisotope techniques are very competitive and they are largely applied for troubleshooting and a process analysis of technical complexes, for continuously operating industrial plants [1]. The success of this application is attributed to its unique ability to provide information which otherwise cannot be obtained by alternate techniques. The radioisotope techniques includes radiotracer and sealed sources application for process diagnosis. Traditionally, radioisotopes in an industrial sector have played a unique role as a tracer, helping engineers diagnose their process plants without posing any interference [2]. This is very important because tracers are the only way to obtain information regarding dynamic details on process units. Most of the radiotracers emit gamma radiation that is intensive enough to penetrate steel walls and insulators of process units under study. Their chemical and physical status should be compatible with those of the process flow to be traced because tracers are supposed to represent the movement of process materials as its definition. Radioisotopes to be used as tracers can be produced from research nuclear reactors or particle accelerators, but when no facilities are available for production, radiopharmaceutical portable radionuclide generators can be good alternatives.

One of the most widely used sealed source application is column scanning [3]. This is a technique used to carry out an internal inspection of any process equipment, without interrupting its production. A collimated beam of penetrating gamma rays is allowed to pass through the shell of a column, which is then modified by the column internals and emitted out the other side. By measuring the intensity of the transmitted radiation, valuable information can be obtained about the densities of the materials present inside the column. The higher the density of the material, the lesser the amount of radiation that gets through.

2. Methods and Results

2.1 Radiotracer experiments in steel industry

Radiotracer experiments have been carried out to measure the residence time distribution of fuel and raw material mixers in sintering process of steelworks. The mixer is 4 meters in diameter and 18 meters in length, and about 160 tons of fuel and raw material remain inside. As a radiotracer, Ga-68 was eluted from the Ge/Ga generator. 2 inch NaI detectors were installed at the input and output of the mixers. The residence time was measured while changing the feed rate of fuel and raw material (Fig. 1). Mean residence time of 1st mixer and 2nd mixer is 165 sec and 185 sec, respectively (Table I). However, no change was observed with feed rate.

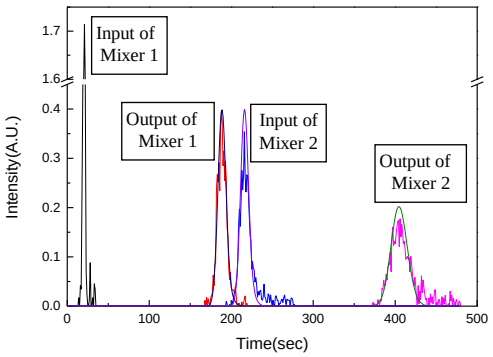

Fig. 1. Residence time distribution curve of mixers

Table I: Mean residence time with varying feed rate

Feed rate (ton/hr)	# of Mixer	MRT (sec)
980	1	166.1
	2	188.1
1100	1	164.7
	2	183.5
1250	1	165.6
	2	183.5

2.2 Fabrication of New Automatic Column Scanner

A new automatic column scanner has been developed for more precise measurement. By replacing the single channel analyzer based radiation measurement board with a multi-channel analyzer based measurement board, the spectral measurement of gamma radiation is possible. In addition, the positions of source and detector can be corrected in real time by changing the step motors to servo motors. In order to evaluate the performance of the newly developed column scanner, the vertical density distribution was measured on a 50 meter of tray column of an oil refinery. 90mCi of Co-60 was used as the radiation source. The vertical scan interval was 5cm and the counting time was 5 sec each step. The positions of source and detector were strategically determined in

such a way that downcomers were not placed in the passage of the radiation in order to get straightforward interpretation from the measurements. The minimum values at each tray were almost consistence over the scan ranges, which means the source and the detector were kept at the same levels throughout the scanning. Every tray was identified simply by comparing with the drawing of the column (Fig. 2).

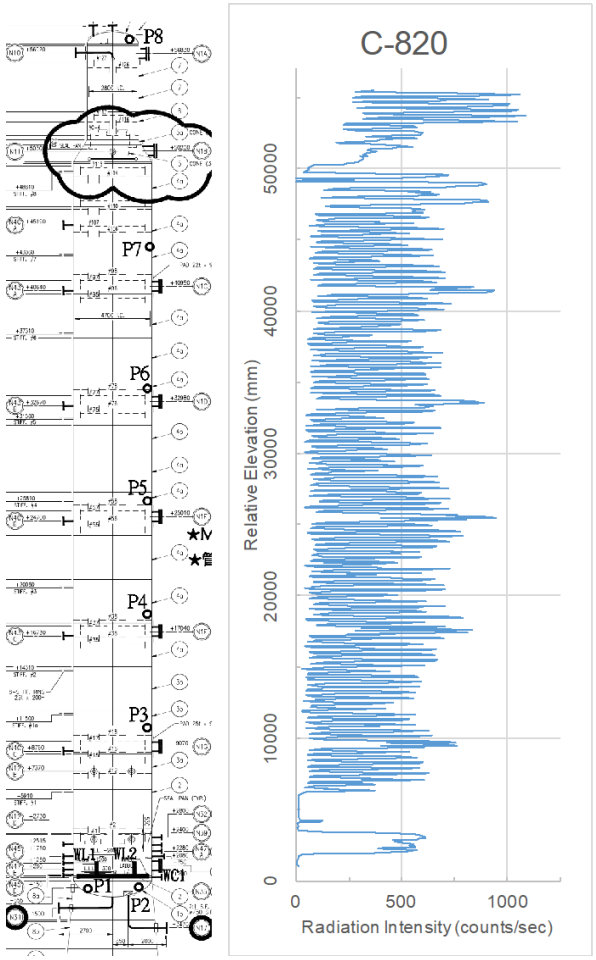

Fig. 2. Vertical density profile of column

3. Conclusions

Radiotracer experiments have been carried out to measure the residence time distribution of fuel and raw material mixers in sintering process of steelworks. Mean residence time of 1st mixer and 2nd mixer is 165 sec and 185 sec, respectively. A new automatic column scanner has been developed for more precise measurement. To evaluate the performance of the newly developed column scanner, the vertical density distribution was measured on a tray column.

REFERENCES

[1] J.S. Charlton, Radioisotope Techniques for Problem solving in Industrial Process Plants, Leonard Hill, London, 1986.

[2] IAEA, Analytical Application of Nuclear Techniques, IAEA, Vienna, p. 129, 2004.

[3] W.A.N Severance, DuPont Co., Advances in Radiation Scanning of Distillation Columns, Chemical Engineering Progress, Vol. 77, p. 38, 1981.