Journal of Labelled Compounds and Radiopharmaceuticals
J Label Compd Radiopharm 2007; **50**: 605–606.
Published online in Wiley InterScience
(www.interscience.wiley.com). DOI: 10.1002/jlcr.1299

JLCR

Short Research Article

The identification of flooding phenomenon in a column of refinery process by gamma absorption technique†

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Received 3 July 2006; Revised 23 January 2007; Accepted 31 January 2007

Keywords: preflash tower; gamma-ray source; density profile; automatic gamma scanner

Introduction

Today radioisotope techniques are used extensively throughout the world for troubleshooting and 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. The success of this application is attributed to its unique ability to provide information which otherwise cannot be obtained by alternate techniques. Gamma scanning 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 vessel, which is then modified by the vessel 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 vessel. The higher the density of the material, the lesser the amount of radiation that gets through.[1]

A diagnosis by using a sealed gamma-ray source (^{60}Co) was applied to the in-service inspection of a preflash tower in a refinery. The preflash tower is a facility for stripping out the lighter portions (C1–C6) of a crude oil by a preheating before the remainder enters the atmospheric distillation column. The operation efficiency of this facility was varied according to change of the inflow rates. The objective of the present work is to investigate the operating condition in which a flooding phenomenon happens, and the structural soundness of the trays in the internal process.

Results and discussion

Gamma radiation counts were measured by a detector (BGO) positioned diametrically outside the tower wall, opposite to the gamma source, with a regular space as the detector and the source were concurrently lowered. A total of two scans were implemented according to the differential pressure between the top and the bottom of a tower (ΔP). The preflash column had an internal diameter of 4.7 m, and the experimental range was between tray numbers 2 and 26 (21 m). Transmitted radiation counts were measured and then transformed to the density profile of an internal media by application of Lambert–Beer's law ($I = I_0 \times \mathrm{Exp}(-\mu\rho t)$).[2,3] The experiment results are shown in Figure 1, the x-axis stands for the unit mass along the path length of the gamma ray and the y-axis is the relative level within the experiment area. In the figure, the regular attenuation peaks coincide tray positions. Under the condition of $\Delta P =$ about 0.24 kg/cm^2 all the trays in the drawing were identified successfully at the exact positions in the real column by the measurement. No symptoms of abnormalities such as tray failures, weeping or flooding were found. However, in the case of $\Delta P = 0.28$–0.33 kg/cm^2, the phenomenon of flooding happened especially at the region of tray numbers 17–24 when considering that much less gamma rays are transmitted through a liquid phase compared to a vapour. And the flooded area increased upward with time. This suggests that the first place in which flooding happened was around tray number 24. Diagnosis technique of a preflash column by using a gamma radiation source has been proved to be an effective and reliable method for providing information on the

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†Proceedings of the Ninth International Symposium on the Synthesis and Applications of Isotopically Labelled Compounds, Edinburgh, 16–20 July 2006.

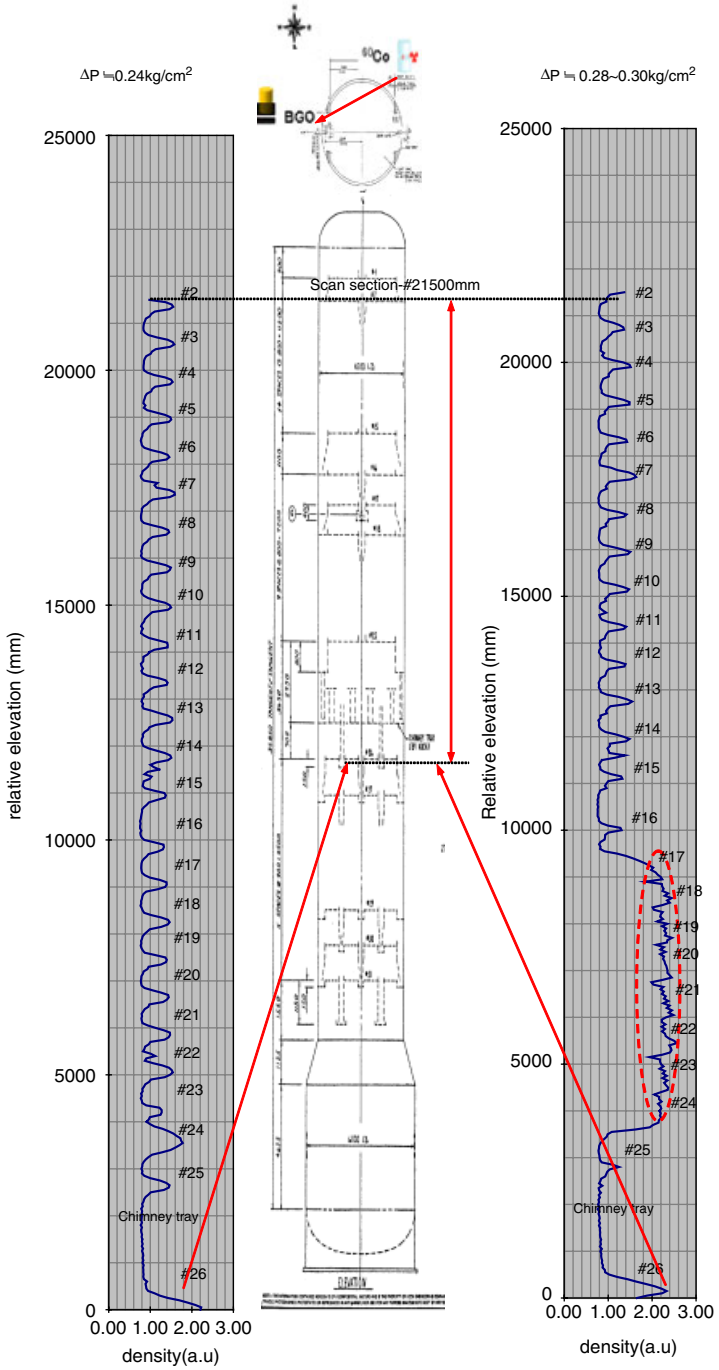

Figure 1 The density profile of internal media by using sealed source (^{60}Co) according to the differential pressure (ΔP). This figure is available in colour online at www.interscience.wiley.com

structural soundness, flooding phenomenon and its localization in the column.

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