STUDY OF MULTI-DETECTOR SCANNING METHOD FOR TROUBLESHOOTING OF DISTILLATION COLUMNS

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ABSTRACT

Conventionally gamma scanning is carried out using a gamma source and a single detector. Troubleshooting of distillation columns using single gamma profile does not give correct picture of the density distribution within the column plane. The paper describes the laboratory study which was carried out using multiple gamma detectors to give much better picture of the density variations within the column plane compared to the conventional gamma scan and thus improve the performance of gamma scanning method.

Keywords: Gamma Scanning, Distillation Column, Gamma Profile

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INTRODUCTION

Conventional gamma scanning is carried out using a gamma source and a single detector [1]. To identify problems in tray type distillation columns, scans are made across the diameter of the columns i.e. a detector is arranged diagonally opposite to the source in a plane, as shown in figure 1 below [2,3]. The commercial distillation columns are of different sizes [3]. The beam of gamma radiation, reaching up to detector, attenuates according to the density variations within its path [4]. The narrow radiation beam is focused and covers very small part of the column tray because of smaller detector size (~25mm in diameter) than the distillation columns (~1-4m in diameter) as seen in figure 1 below. Thus, larger part of the tray remains unseen by the detector.

Hence, it is quite possible that the damages outside the radiation beam may get unnoticed by the scanning. An additional area of the column plane can be covered by arranging more detectors (D1, D2, D4 & D5) in the chord of the column and by making the collimation fan beam type, as shown in the Fig. 2.

This scanning arrangement is referred here as multi-detector gamma scanning. It should give much better picture of the density variations within the column plane compared to the conventional technique as it covers much larger region of the column’s plane.

EXPERIMENTAL

Laboratory experiments were carried out using collimated gamma source (Cs-137, 13mCi, 662keV), three 1x1inch scintillation detectors (D1, D2 and D3) and 3-channel data acquisition system. First experiment was carried out using phantom of the column tray (2mm thick MS plate of 520mm diameter). The experimental arrangement is illustrated in figure 3 below. Out of three gamma detectors, one detector (D2) was...
The result of the second experiment is Multi-detector gamma attenuation profile as shown in figure 6 below. It is observed that there are total 5 attenuation peaks at elevations 0, 50, 105, 165 and 220mm respectively. These peaks correspond to the 5 trays of the column. The gap between the two peaks indicates the tray to tray distance. The actual distance between any two trays is 55mm, considering 5mm thickness of the tray and gap of 50mm. It is observed that the results obtained are accurate within the error of 5mm. Further it is observed that, four peaks of all the three profiles (D1, D2, D3) overlap at elevation 30mm shows that the tray is straight at position ‘A’. While, three separate peaks at elevation 85mm, 90mm and 95mm clearly indicates some abnormality i.e. tilted tray at position ‘B’.

RESULTS AND DISCUSSION

The Multi-detector gamma attenuation profile (D1, D2, and D3) of the first scan is shown in figure 5 below. In conventional gamma scanning readings of detector D2 are use for analysis. Accordingly it is observed that profile of D2 shows two attenuation peaks at 30mm and 90mm which corresponds to the tray at positions ‘A’ and ‘B’ respectively. It doesn’t indicate any abnormality (tilt of the tray). Further it is observed that, attenuation peak of all the three profiles (D1, D2, D3) overlaps at elevation 30mm shows that the tray is straight at position ‘A’. While, three separate peaks at elevation 85mm, 90mm and 95mm clearly indicates some abnormality i.e. tilted tray at position ‘B’.

CONCLUSION

The experimental study shows that the multi-detector gamma scanning method detected the tilt and dent in the tray successfully. Also, it detected the ‘spacer’ between the trays by comparing multiple attenuation profiles with each other and confirmed the straightness of the tray.

The multi-detector gamma scan provides additional useful information. This additional information can be use to improve the sensitivity and to enhance the performance of gamma scanning technique for troubleshooting of distillation columns.
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REFERENCES