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Experimental Study of Conical Fluidized Bed Using Radioisotope Based Technique

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Background of the study:
Gas-solid conical fluidized bed are used for several application like drying, food processing, granulation, combustion, gasification, coating of nuclear fuel particles, crystallization, catalytic cracking, sulphide ores sedimentation and particle classification etc. The design parameter for mentioned applications depends on the bed behaviour completely. However, research on conical fluidized bed shows that literature at in-situ condition is missing till date. So the investigation of conical gas-solid fluidized bed at in-situ condition is required for the basic understanding of the flow pattern and bed behaviour which can be implemented for better design and scale up of the column.

Methodology:
The radioisotope based technique known as radioactive particle Tracking (RPT) Technique and densitometry have been applied for the study of conical fluidized bed. In RPT technique one radioactive particle (glass bead in this case) is doped with scandium-46. This tracer particle is used as marker whose motion is tracked by using 10 NaI (Tl) scintillation detectors. The position of the tracer particle is reconstructed by using the count time series map recoded by each detector. Further post processing like particle position time series data, Lagrangian velocity time series, mean and rms velocities of the particle is calculated by using count time series map. The other technique densitometry is used to measure the chordal average solid volume fraction at different axial and radial locations of the bed.

Results:
The conical column used comprises of 0.8 m conical section height and 0.05 m diameter at bottom increasing along height till 0.2 m on top. Two different particles of diameter 0.6 mm and 1 mm having density 2500 kg/m3 are used. Both mono-dispersed and binary bed behaviour is studied to characterize the mixing and segregation. The bed composition has been varied as 0:100, 25:75, 50:50, 75:25 and 100:0 to visualize the effect of composition with velocity. The total weight of bed is kept constant for all the experiment. In binary fluidized bed both the particle are tracked individually. Both RPT and densitometry have been conducted for three different velocities (2umf, 3umf and 4umf of 1 mm particle). Figure 1 shows the variation of volume fraction with velocity at 25% of static bed height. Results indicate that the solid volume fraction becomes uniform with increase in velocity which signifies better mixing with increase in velocity.

Conclusion:
Mixing and segregation studies are performed in mono-dispersed and binary fluidized bed. It is observed that the volume fraction of solid particles shows uniform distribution with increasing velocity.

Country/Organization invited to participate

India

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