Validation of Computational Fluid Dynamics Codes using Radiotracer Residence Time Distribution Analysis of Stirred vessels.

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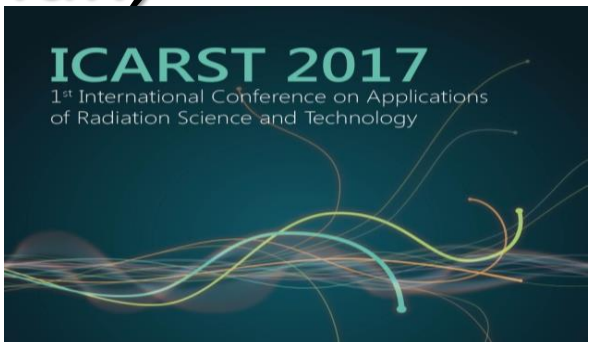

Introduction

- Radiotracer residence time distribution (RTD): an experimental tool study the performance of industrial process reactors.

- RTD is used for:
  - Troubleshooting,
  - Check the validity of design data.

- The main concern during RTD investigation:
  - accurate formulation of the experimental distribution curve.

Objectives of study

- The final RTD results depends on the accuracy of the experimental RTD formulation.
- Hence the need to generated the RTD curve d using CFD and compare simulation and experimental results.
- In other words, to validate CFD codes using results of experimental RTD formulation.

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Methodology : Experimental RTD

- Experimental RTD was conducted in a gold leaching tank to determine the MRT

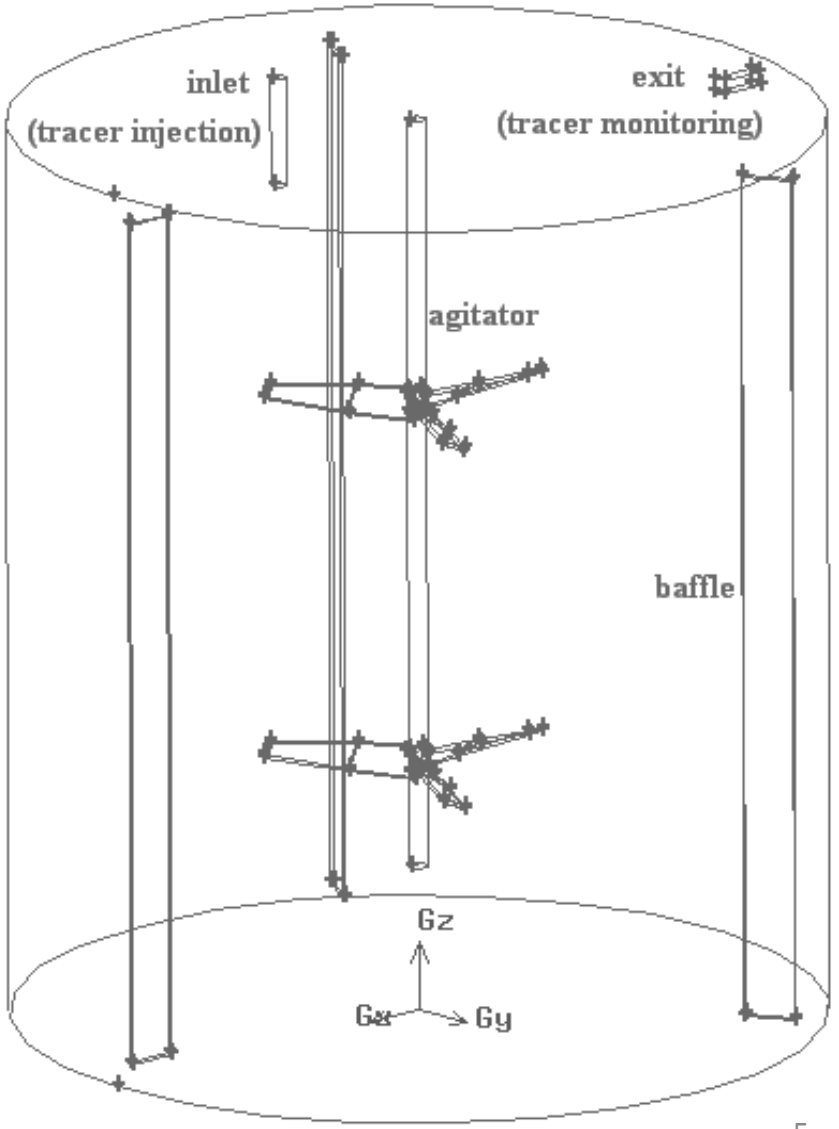
  Dagadu et. al (2014)

- Radiotracer used: I-131 (mixed with $Na_2S_2O_3$)

- MRT Calculated from the method of moments

- MRTs:
  - Theoretical: 257mins.
  - Experimental: 212 mins.

Description of Leaching Tanks



Tracer Injection and Monitoring

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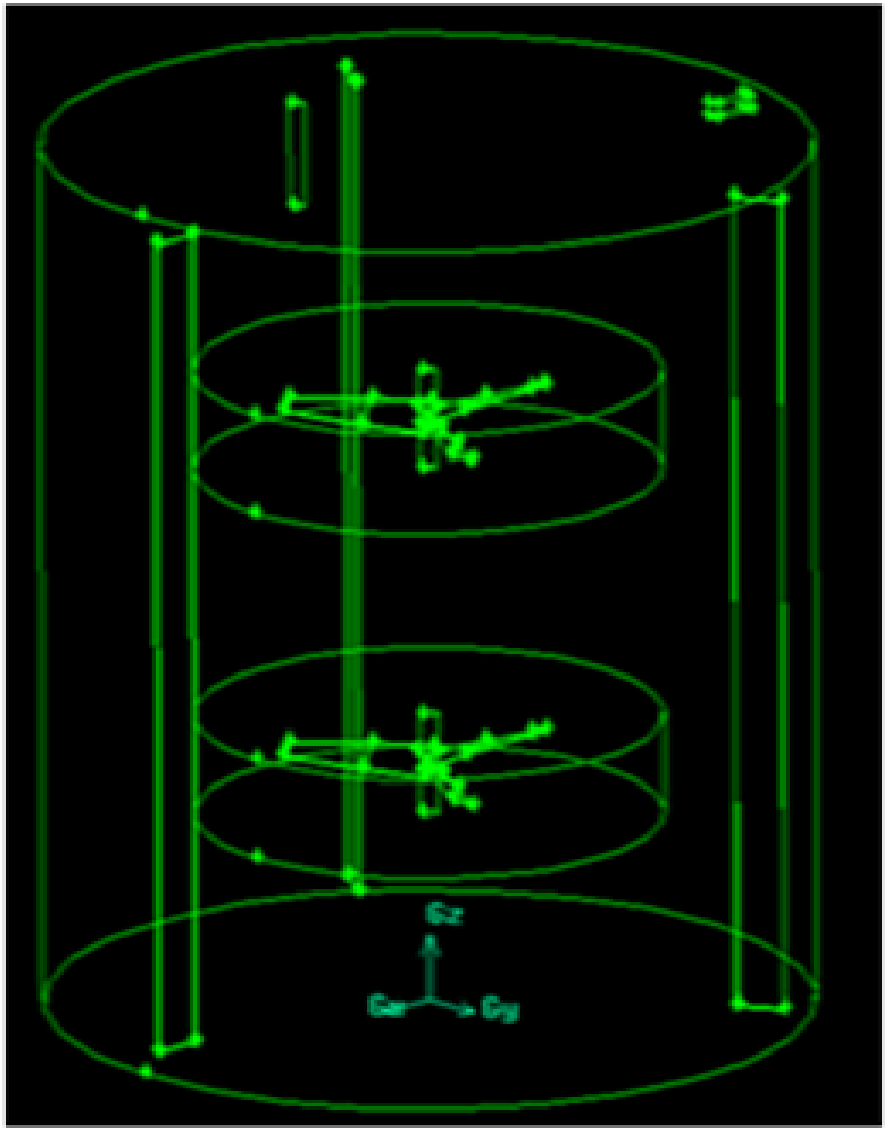
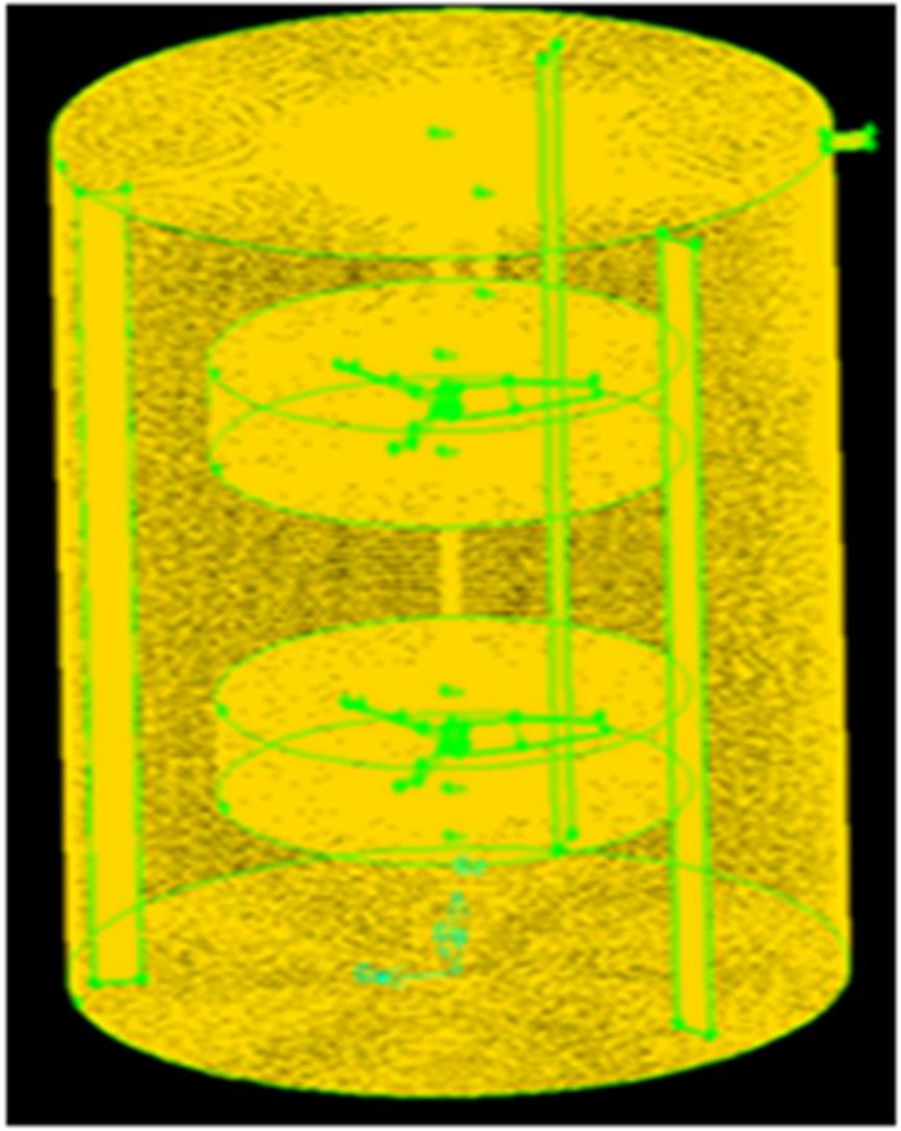
Methodology: CFD Simulation

- Flowfield in the leaching tank calculated to describe the flow structure and mixing.

- Models used:
  - Mixture model (recommended for slurry flows)
  - Standard k- ϵ model
  - MRF approach
- Dagadu et. al (2014) , (2015)

Computational Model





RTD Simulation

- Lagrangian particle tracking method was used to calculate the trajectories of massless tracer particles through a calculated flowfield.

- Dispersion of tracers due to turbulent eddies was calculated with the discrete random walk model under the stochastic tracking technique.

- Particle were tracked from the inlet to the outlet of the tank at a step time of 2 minutes.

RTD Simulation (cont'd)

- No of particles tracked =5760

  (required= 5000–10,000 , Bai et al., 2008)

- Particle concentration versus time curve generated.
  - Histogram of particle concentration against recorded particle RT.

- The curve was then normalized to obtain the RTD curve.

Results and Discussions

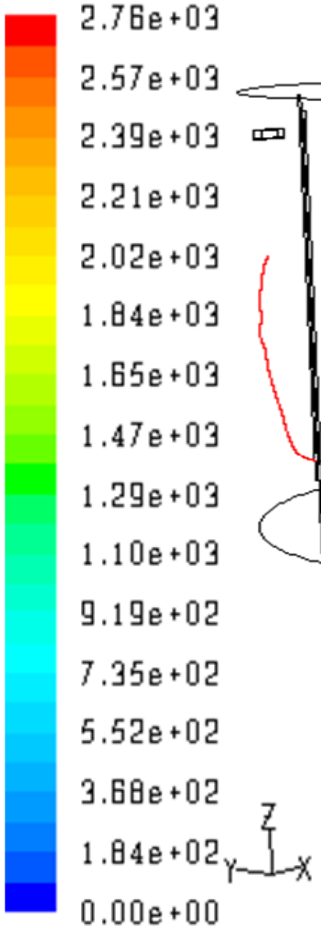
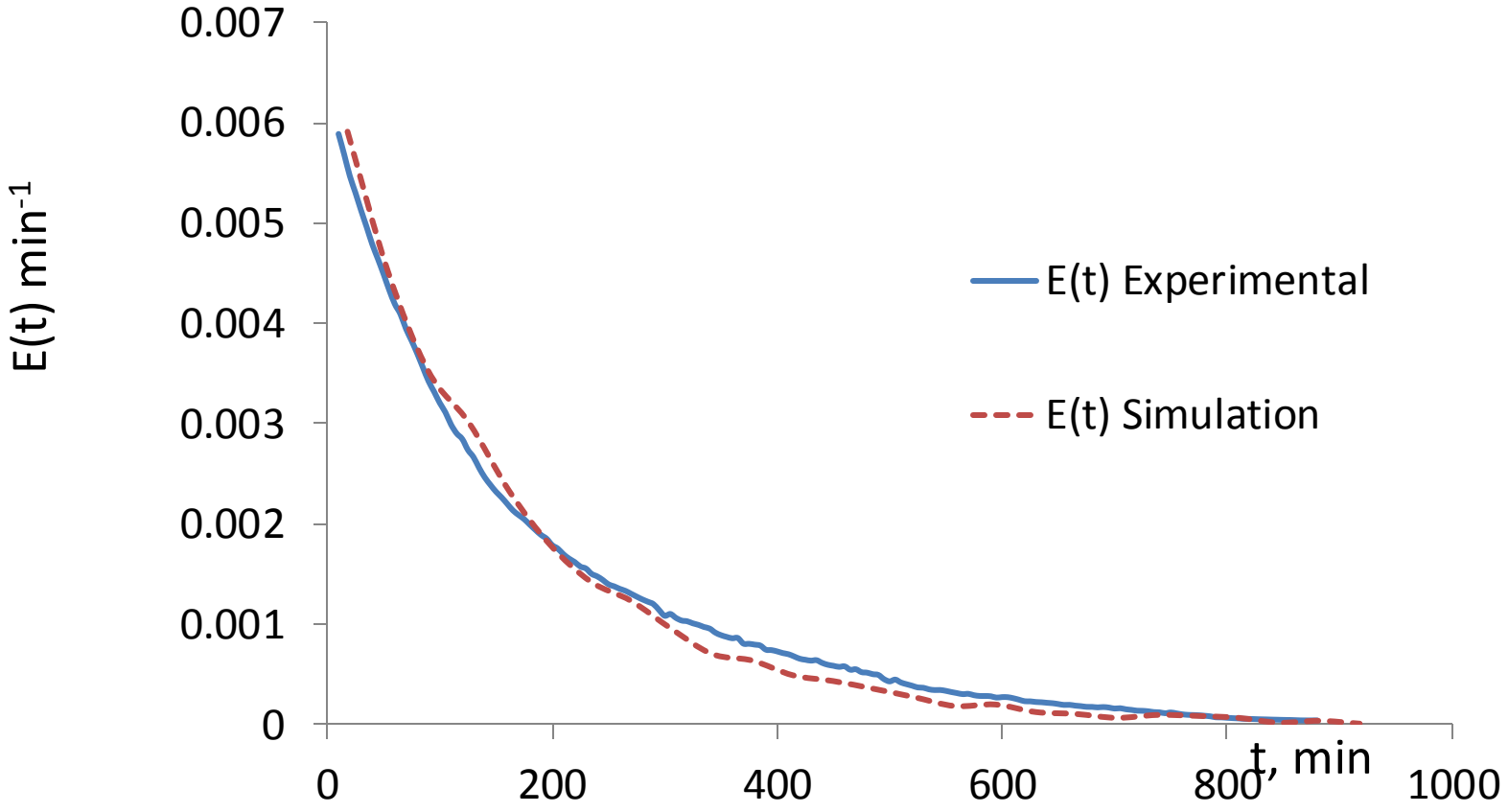


Figure 1. Particle trajectories coloured by particle residence time [s]:

Simulation vs Experimental RTDs



Exp. MRT = 212 min., Sim. MRT=205 min

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CONCLUSIONS

- The simulated RTD is in good agreement with experimental results.

- Particle tracking method also describes the flow structure in mixing vessels similar to plots of velocity vectors and contours of velocity as in previous works.

THANK YOU FOR YOUR ATTENTION!

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