



Contribution ID: 28

Type: Oral

RPT Study on a Vertical Impeller Mixer

Tuesday, 25 April 2017 16:45 (15 minutes)

Radiotracer techniques have been widely applied in various fields of industry in order to diagnose plant processes during operation. This is possible because radioisotopes can selectively label certain process media and represent their movements. Recently, radioisotopes have been successfully used as tracers in the investigations for clarifiers and digesters in wastewater treatment plants. Quantitative information about the performance and flow patterns of digesters and clarifiers were obtained without posing any disturbance to the systems

themselves. More recently, studies were conducted to show the feasibility of radiotracer techniques in investigating the particle velocity in fluidized bed reactors compared with the techniques based on optical fibre probes and borescopic particle image velocimetry [1]. It has been well described that

radioisotope technologies are somewhat superior to others in terms of the limitations in the measurements caused by the signal cross-correlation and minimum measurable flow velocity and vertical angle. CFD simulations on a digester with an internal airlift loop were performed to study the influence of the geometric design on the flow pattern, location of circulation and stagnant regions, liquid velocity profiles, and volume of dead zones, and are subsequently

compared with experimental data obtained by radioactive particle tracking [2]. CFD simulations must be developed for individual situations because multiphase systems have very complicated physics and are difficult to fully understand. Once the CFD predictions are validated with experimental measurement data, the predicted hydrodynamic parameters can be quantified and used in the design selection and optimization of systems [3].

A vertical impeller devised to move up and down along the axis of a cylindrical digester is believed to generate a mixing flow inside, saving the energy for operating the process since the downward movement can be accomplished with the gravitational force. However, the flow pattern and mixing characteristics as a function of the operation parameters of the vertical impeller have not been

investigated. In a preliminary study, a radiotracer experiment was carried out for a pilot-scale digester equipped with a vertical impeller. Unfortunately, tomographic measurements that can reveal the flow in 2-dimensions cannot be applied due to the size of the digester. The flow was roughly guessed from the data collected from radiation probes installed inside the digester. In the present paper, as a subsequent study, a smaller lab-scale digester was built for further tomographic investigations. Radiotracers were injected into it for SPECT and RPT studies that provide local information on the flow and multidimensional visual images.

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[2] M. S. Vesvikar and M. Al-Dahhan, Biotechnol. Bioeng., **89**, 719–732 (2005).\

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Country/Organization invited to participate

Korea, Republic of

Primary author: Mr JUNG, Sung-Hee (Korea Atomic Energy Research Institute, Korea, Republic of)

Co-authors: Mr PARK, Jang-Geun (Korea Atomic Energy Research Institute, Korea, Republic of); Mr MOON, Jinho (Korea Atomic Energy Research Institute, Korea, Republic of)

Presenter: Mr JUNG, Sung-Hee (Korea Atomic Energy Research Institute, Korea, Republic of)

Session Classification: B07

Track Classification: RADIATION TECHNOLOGIES FOR MEASUREMENT