

# Mathematical model improves reactor efficiency

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During his PhD project at Eindhoven University of Technology, Dutch researcher Vinit Chilekar developed a mathematical model for the design of a so-called slurry bubble column. That is a reactor for large-scale chemical processes, in which a gas, a liquid or a solid are brought into contact with each other.

The model, developed in a Technology Foundation STW project, provides a reliable prediction of the gas-fluid mass transfer in the reactor. This facilitates the optimal design of a reactor and consequently the cheaper realisation of a chemical reaction. Companies such as Shell, DSM, Akzo Nobel and Sasol use this type of reactor for some of their processes.

From a technological and economic viewpoint a slurry-bubble column is a highly attractive reactor because it can be used to carry out chemical reactions on a large scale (sometimes thousands of litres). The reactor is equally suitable for wastewater treatment and for the production of diesel from hydrogen and carbon monoxide. These reactors have a simple construction and low operational costs.

In the project, Chilekar sought a way of incorporating the many factors that influence a reaction in a slurry bubble column into a mathematical model. For an optimal design of a slurry bubble column a reliable mathematical model is needed that accurately describes the transfer process of the gas from the rising gas bubbles to the fluid phase and from the fluid phase to the surface of the catalyst. The rate of the

reaction and therefore how large the reactor needs to be is mainly determined by the transfer of the gas to the fluid phase.

Chilekar carried out experiments in various slurry bubble columns with diameters of 15 to 60 cm. He varied factors such as the system pressure to determine, for example, the hydrodynamic parameters. He discovered that the gas-fluid mass transfer was mainly determined by the quantity of gas in the reactor and was further independent of the pressure of the system and the concentration of catalyst particles in the slurry. Eventually he developed the model that is now suitable to be used by companies to improve the design of slurry bubble columns.

Source: NWO

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