Instytut Inżynierii Chemicznej

Adres artykułu: https://iich.gliwice.pl/pl/artykul/multi-scale-approaches-in-bubble-column-fluid-dynamics

Multi-scale approaches in bubble column fluid dynamics

Data publikacji:	10.09.2022
Tytuł publikacji:	Multi-scale approaches in bubble column fluid dynamics
Autorzy:	Stoyan Nedeltchev, et al.
Informacje o czasopiśmie:	Chemical Engineering Research and Design

Bubble columns are widely used as contacting devices and multiphase reactors in process and chemical industries. Their “baseline” layout involves a vessel wherein the gas phase is injected into a stagnant liquid phase in the form of “dispersed bubbles” or “coalescence-induced structures”. This “baseline” layout can be modified by including internal heat exchangers (to control the heat transfer and reaction rates) and a solid-phase (a catalyst), and by applying co-current/counter-current liquid circulation (to increase the mass transfer rate). Even in the “baseline” layout, the coupling between the phases gives rise to rich, fascinating and mysterious fluid dynamics phenomena. Indeed, it is recognized that the “global-scale” is imposed by the “local-scale” and that the coupling between the two scales emerges in the flow patterns (flow regimes). The “bubble-scale” (i.e., the bubble motion and turbulent eddies that control heat and mass transfer), influences the medium-scale (i.e., turbulent eddies that transport the dispersed phase) and the large-scale (i.e., circulation cells and central plume oscillations) circulation, thereby characterizing the “reactor-scale”. Unfortunately, the precise definitions behind multi-scale connections have not been unveiled thus far. Although it is thought that the “bubble-scale” is determined by the connection of three local parameters (namely, the liquid velocity, void fraction, and bubble sizes), a precise and analytical description of the connections between the “local-scale” parameters as well as their upscaling towards the “reactor-scale” in the different flow regimes is elusive to date. For this reason, bubble columns are still modeled using macroscopic methods (i.e., empirical or semi-empirical correlations), rather than physical-based approaches; this is a major shortcoming as empirical/semi-empirical correlations can hardly be applied beyond the range of operating conditions and

system designs over which they were obtained.

Metryczka

Opublikował w BIP:	Marek Tańczyk
Data opublikowania:	08.05.2026 14:41
Liczba wyświetleń:	5