Title: **Research project on mixing of multiphase systems**
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Within the frame of the research project on mixing of multiphase systems, systematic experimental studies of gas hold up were carried out for heterogeneous systems produced in the agitated vessel and external-loop air lift column. Two- and three phase systems (gas – liquid and gas –solid – liquid) were tested in the agitated vessel and two phase gas – liquid system was investigated in the air-lift column. Gas hold up is the simplest measure of the mass transfer process occurring in the different physical and chemical systems produced in the columns and agitated vessels, as well as in chemical and biochemical reactors.

The agitated vessel used for the experiments had an inner diameter of 0,288 m and a capacity of 0,0187 m^3, while the air-lift column had an inner diameter of 0,11 m at the riser section and 0,065 m at the down-comer section with a capacity of 0,027 m^3.

At the agitated vessel, the measurements were conducted for the gas-liquid and gas-solid-liquid systems in the baffled agitated vessel with the high-speed impeller. Two shapes of the baffles (planar baffles and tubular baffles) and two types of high- speed impeller (Rushton turbine and A 315 impeller) were tested. In these systems liquid phase was the continuous one, whilst gas and solid were the dispersed ones. The liquid phase was distilled water and an aqueous solution of sodium chloride (NaCl) with concentration of c_{NaCl} = 0,6 [kmol/m^3]. Gas phase was air. Solid phase was two different concentration of polyethylene, 1% and 2,5% on mass, who had a density of ρ_p = 955 [kg/m^3] and the diameter of the particles was d_p = 3,025 mm.

For the agitated vessel, in the gas-liquid systems the measurements were done at the agitator speed $n > n_{CD}$ (higher than the speed for complete dispersion) whilst for the gas-solid-liquid systems were done at $n > n_{JD}$ (higher than the critical impeller speed). This is summarized in an approximate mean of 15 values of rotation speed at each of the measured systems. The measurements were done with five different gas flow rates for each series, within the range of Vg ($1{,}11 \cdot 10^{-4} – 3{,}33 \cdot 10^{-4}$ m^3/s).

For the external-loop air-lift column, measurements were only be performed on gas-liquid system. Continuous liquid phase was distilled water and dispersed phase was air. The measurements were be made at different gas flow for each system, within the range of Vg ($5{,}62 \cdot 10^{-5} – 3{,}25 \cdot 10^{-4}$ m^3/s).

For each experimental series, the gas hold up results were presented graphically. Based on the results obtained the effect of liquid phase, solid presence and its concentration, operating parameters (impeller speed and gas flow rate), baffles construction, impeller type and reactor type on the gas hold up will be determined. The effect of the operating parameters, i.e., impeller speed n and gas flow rate V_g on the gas hold up φ was analysed using dimensionless gas flow number Kg. Comparison of the data for the systems with the distilled water and aqueous solution of the electrolyte as continuous liquid phases enabled to evaluate an effect of the capability to coalesce of gas bubbles on gas hold up in the heterogeneous systems. An effect of the solid phase presence in the gas – liquid system on gas hold up was evaluated comparing the results obtained for both agitated two phase and three phase systems. The effects of the baffle shape as well as the fluid circulation, generated by radial flow Rushton turbine and mixed flow A 315 impeller, on the gas hold up were also analysed. The effect of the reactor type on the gas hold up was estimated comparing the gas hold up results in gas – liquid system, obtained for both agitated vessel and external-loop air-lift column.