Mixing and mass transfer in gas-liquid-solid systems

A. Ferreira, José Teixeira

IBB-Institute for Biotechnology and Bioengineering, Centre of Biological Engineering, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal.

The wide application of gas–liquid–solid systems in various industrial processes such as chemical, petrochemical, biochemical and environmental is a strong evidence of their increasing importance and, as a consequence, many research groups working with bubble columns, fluidized beds, airlift reactors, bubbly flows and flotation columns, are interested in their study.

Despite all the research efforts, the knowledge about the effects of solids on gas–liquid system and the respective physical mechanisms are not yet clarified. A clear understanding of the hydrodynamics of the gas–liquid–solid systems is needed to improve the design and operation of the processes involving these systems. This is particularly true in the field of bioengineering where three-phase flow reactors, such as three-phase airlift reactors with immobilized biomass, are encountered. The presence of the solid phase can influence the gas–liquid mixture in different ways such as bubble rise and formation, radial and axial profiles, mixing and dispersion, gas holdup and flow regimes and mass transfer.

Results on the effect of the solid phase on regime transition and mass transfer properties in g-l-s systems [1] together with the development of measurement techniques [2] that allow a better insight of the local flow structure and a better understanding of the various interactions between phases will be presented.

[1] P.C. Mena, M.C. Ruzicka, F.A. Rocha, J.A. Teixeira, J. Drahoš “Effect of solids on homogeneous–heterogeneous flow regime transition in bubble columns”, Chemical Engineering Science, Volume 60, Issue 22, November 2005, Pages 6013-6026

[2] P.C. Mena, F.A. Rocha, J.A. Teixeira, P. Sechet, A. Cartellier, “Measurement of gas phase characteristics using a monofibre optical probe in a three-phase flow”, Chemical Engineering Science, Volume 63, Issue 16, August 2008, Pages 4100-4115