Bubbling fluidized beds are used extensively in energy and chemical industries because of their excellent heat and mass transfer characteristics. Recently, CFD has been identified as a useful tool for predicting reactor performance, but application to large scales continues to be challenging because of limitations on computational resources. Given that the hydrodynamics can largely be characterized by bubbles rising through the bed, a more feasible approach for investigating large-scale reactors is to quantify bubble dynamics and specifically, gas distribution in different phases - visible bubble flow, bubble-through flow and dense-phase flow.

In this study, 3D CFD simulations of bubbling fluidized beds are first conducted to establish the impact of scale (bed diameter) on the hydrodynamics. Using solids circulation and bubble statistics (1), it is established that wall effects cease to be significant in beds larger than 50 cm (bed aspect ratio less than 1). At this scale, simulations are then carried out for two distinct Geldart B particles and data is subsequently analyzed for gas-flow distribution in the bed. Bubble statistics are also compared with existing correlations and their relation to solids circulation and mixing is investigated. The physical model and numerical tool were developed and validated in previous studies (1,2), while 3D Bubble statistics are computed using MS3DATA (Multiphase Statistics using 3D Detection and Tracking Algorithm) (3). Accurate description of the gas-flow is crucial for large-scale combustor design since quantifying gas distribution will indicate both fuel rich zones as well as oxidant bypass through bubbles leading to inefficient performance.

REFERENCES