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Abstract

The understanding of the dynamic characteristic of gas-liquid flow and ability to control the extents of primary (in r-direction) and secondary (in θ-direction) flow is crucial to optimize the mixing efficiency of the Basic Oxygen Furnace (BOF) steelmaking process. The present work was carried out to study the dynamics of meandering bubble plumes on gas-induced liquid-phase mixing, numerically and experimentally, in a 6:1 scaled-down BOF vessel for different bottom tuyere configuration. Cold flow experiments were performed to measure the instantaneous and time-averaged gas volume fraction, and local mixing time at different gas mass flow rates using voidage and conductivity probes. 3D transient Euler-Lagrange (EL) simulations of dispersed gas-liquid flow were performed under cold flow conditions. The predicted instantaneous and time-averaged gas volume fraction and local as well as spatially-averaged mixing time were found in a satisfactory agreement with measurements. The effect of PCD (pitch-to circle-diameter ratio) on dynamics of gas-liquid flow and mixing was studied. It was found that mixing time was minimum when the eight bottom tuyeres were placed at the

PCD of 0.5. Further, modified bottom tuyere configurations that provide the flow variation in r-direction and in θ-direction were proposed. The mixing time was found to be reduced by 40-45 % than that of the conventional flow scheme. The experimentally verified computational model and the proposed STAR type configuration will be useful to improve mixing efficiency, hence steel quality in BOF vessels.