EXPERIMENTAL STUDY OF LIQUID DISPERSION IN BUBBLE COLUMN

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ABSTRACT - The main object of this study is to investigate the influence of column diameter and superficial gas velocity on liquid phase dispersion coefficients (axial and radial dispersion coefficients), mixing times, gas holdup, and bubble dynamics (bubble diameter and rise velocity). The liquid phase dispersion, gas holdup, and bubble dynamics ($D_b$ and $V_b^0$) were measured for the air-water system in bubble columns of two different diameters, 15 and 30 cm. The superficial gas velocity, $U_g$, was varied in the range 1-10 cm/s, spanning both the homogeneous and heterogeneous flow regimes. The height of liquid in the column was kept constant at 130 cm for the two column. Axial and radial dispersion coefficients and mixing times were measured at various axial and radial locations inside the columns ($Z = 25, 75, 125$ cm and $r/R = 0, 0.45, 0.85$), bubble dynamics were measured at three axial location ($Z=25, 75, 125$ cm). From the experimental data it was found that, the value of the radial dispersion coefficient ($D_{r,L}$) and axial dispersion coefficient ($D_{ax,L}$), gas holdup, bubble diameter and bubble rise velocity, increase with increasing superficial gas velocity. The results emphasise the significant influence of the column diameter on the hydrodynamics. Gas holdup showed a decrease with increasing column diameter, while the radial dispersion coefficient ($D_{r,L}$), axial dispersion coefficient ($D_{ax,L}$), bubble diameter and bubble rise velocity increased with increasing column diameter. A statistical analysis was performed to get a general correlations for the axial liquid dispersion coefficient as a function of the mixing time and dispersion height ($H_d$), this correlations are: $D_{ax,L}=0.15 \frac{H^2_d}{\theta_{0.3}}$ for 30 cm column diameter and $D_{ax,L}=0.11 \frac{H^2_d}{\theta_{0.3}}$ for 15 cm column diameter.

Keywords: Bubble column, axial dispersion, radial dispersion, gas hold-up, hydrodynamics.