SUMMARY

Bubble columns are used as absorbers, strippers, reactors, fermenters, etc. in chemical process industries. Biotechnology, food processing and pharmaceutical processes also used bubble column and often process highly viscous liquid. The advantage of the tapered bubble column with small taper angle lies in the fact that the residence time of the bubble can be increased in comparison to the cylindrical or rectangular column. The hydrodynamic parameters of a bubble column depend on the operating conditions, geometry and physiochemical properties of the phases and the gas distributor system. Design and scale up of bubble column are of difficult task due to interaction of gas-liquid, shear at the interface and the wall and the hydrodynamic are not fully understood. This report is presented in five chapters and the content of each are outlined below.

CHAPTER-1

This chapter describes the significance of problem. The hydrodynamic aspects using Newtonian liquids in bubble column have been reviewed extensively. The importance and object of the present investigation are critically analyzed.

CHAPTER-2

This chapter deals with experimental set-up, procedure of the system used. Two different taper bubble columns are fabricated and the experiments are reported.

CHAPTER-3

This chapter deals with the experimental investigation on the hydrodynamic study for using both bubble columns. Four different dilute solutions of Sodium Carboxymethyl

Cellulose (SCMC) salt (0.2 - 0.8 kg/m^3) are used as the non-Newtonian liquids. The flow pattern in intermittent in nature in the experimental condition. The following hydrodynamic effects were investigated,

(a) Effect of gas holdup with gas flow rate at different bed height;

(b) Effect of gas holdup with gas flow rate at different SCMC concentration;

(c) Effect of gas holdup with gas flow rate at different distributor hole diameter;

(d) Effect of gas holdup with gas flow rate at different size of column;

(e) Effect of frictional pressure drop with gas flow rate at different bed height;

(f) Effect of frictional pressure drop with gas flow rate at different SCMC concentration;

(g) Effect of frictional pressure drop with gas flow rate at different distributor hole diameter;

(h) Effect of frictional pressure drop with gas flow rate at different size of column.

The experimental data on the two-phase gas holdup and frictional pressure drop are compared with the correlations available in literature, but none of these correlations are acceptable. Hence, empirical correlations have been developed to calculate the gas holdup and frictional pressure drop in terms of physical and dynamic variables of the system as,

$$\varepsilon_g = 3.857X10^{-4}\,\mathrm{Re}_g^{0.743\pm0.017}\,N_{pl}^{-0.009\pm0.003}\left(\frac{H_0}{D_C}\right)^{-0.565\pm0.038}\left(\frac{D_n}{D_C}\right)^{0.149\pm0.063}\theta^{-0.706\pm0.028}$$

$$\frac{\Delta P_f}{\rho_l g \Delta Z} = 8.071X10^{-4}\,\mathrm{Re}_g^{0.890\pm0.018}\,N_{pl}^{0.009\pm0.003}\left(\frac{H_0}{D_C}\right)^{-0.350\pm0.040}\left(\frac{D_n}{D_C}\right)^{0.209\pm0.067}\theta^{-0.381\pm0.030}$$

A detailed statistical analysis has been shown that the correlations developed are of acceptable accuracy.

CHAPTER-4

This chapter deals with the Artificial Neural Network with multilayer perceptron with one hidden layer and four different transfer functions with Backpropagation algorithm have been used to analyze the experimental data on gas holdup and frictional pressure drop.

CHAPTER- 5

This chapter deals with the experimental investigation on the effect of bulk liquid properties such as density, surface tension, and viscosity, etc., superficial gas flow rate and electrolyte on gas holdup in Newtonian liquids using larger tapered bubble column (TB2). In this work distilled water and NaCl solutions were taken as stagnant phase and air as continuous phase and flow was almost entirely heterogeneous. The following hydrodynamic effects were investigated,

(a) Effect of gas holdup with gas flow rate at different liquid height;

(b) Effect of gas flow rate on gas holdup with different concentration of electrolyte.