PREFACE

The concentration of carbon dioxide, methane, and nitrous oxide are all known to be increasing in the atmosphere. In recent years, other greenhouse gases, principally chlorofluorocarbons (CFCs), have been added in significant quantities to the atmosphere. There are many uncertainties in deducing the consequential climatic effects. Typically, it is estimated that increased concentrations of these gases since 1860 may have raised global mean surface temperatures by 0.5°C or so, and the projected concentration could produce a warming of about 1.5°C over the next 40 years (Mitchell, 1989). Therefore, it is required to develop highly efficient and cost effective equipments, which are capable of removing harmful substances like fine particulate matter, green house and toxic gases from industrial gaseous effluents.

Jet ejector is one of the devices for gas liquid contacting, which utilizes a liquid media to absorb objectionable gases and particulates from industrial gaseous effluents. Ejector type scrubbers utilize a high velocity fluid jet for bringing the liquid and gas into intimate contact with each other.

To design jet ejector (single or multi nozzle), for efficient absorption of gaseous species with simultaneous chemical reaction of species present in liquid mathematical models are required.

Rigorous literature review of gas-liquid contactors suggests that mass transfer with chemical reaction in jet ejector is nearly unexposed.

The current research work on mass transfer with chemical reaction between two phases (gas and liquid), using single and multi nozzle jet ejector as gas-liquid contactor is presented in the thesis emphasizing on the following:

- Most recent literature survey in the area of mass transfer characteristics for designing jet ejector
- The experimental study of rate of absorption with chemical reaction in single/multi nozzle jet ejector (laboratory scale and industrial scale) using chlorine-aqueous sodium hydroxide system.
- Model single/multi nozzle jet ejector for absorption with chemical reaction.

- The models to determine rate constant and mass transfer (absorption) rate for Cl_2 – aqueous NaOH reaction system.
- The mathematical model to study the effect of different diffusivity ratio on enhancement factor for absorption of chlorine-aqueous sodium hydroxide system.
- The numerical model for multi nozzle jet ejector to predict the conversion.
- Mathematical models to determine interfacial area, and mass transfer coefficient for single and multi nozzle jet ejector for absorption with chemical reaction
- The mathematical models to predict mass transfer characteristics in multi nozzle jet ejector using Cl_2 - aqueous $NaOH$ solution in laboratory and industrial scale ejector
- The statistical models for determining removal efficiency of Cl_2 by aqueous sodium hydroxide solution.

Present thesis consists of **Five Chapters.**

Chapter One covers introductory part.

Chapter Two deals with literature survey.

The phenomenon of jet behavior is described in **Section One**. This section includes review of the published work about jet breakup length, type of regimes of jet breakup: the effect of different parameters like pressure, turbulence, liquid viscosity on jet behavior and also the effect of different dimensionless numbers like Reynolds number, Webber number, Ohnesorge number on jet behavior.

Section Two deals with the different methods for measuring bubble size and bubble size distribution.

Effect of different parameters on the performance of the jet ejector is described in **Section Three**. Literatures in the areas like prediction of pressure drop, effect of different parameters like collection efficiency, optimisation of ejector venturi scrubber, effect of ejector geometry, operating pressure and gas density on ejector performance are reviewed in this section.

Section Four deals with literature review of:

- The estimation of mass transfer characteristics of gas-liquid contactors.

- The physico-chemical factors, hydrodynamic factors effecting mass transfer characteristics and chemical methods of determining interfacial area are also reviewed in this section.

Chapter Three describes the experimental setup and procedures for studying mass transfer with chemical reaction using single/multi nozzle jet ejector system. The data are reported for three experimental setups: single nozzle horizontal jet ejector, multi nozzle vertical jet ejector and multi nozzle vertical industrial scale jet ejector.

Chapter Four deals with modeling and simulation of mass transfer characteristics with chemical reaction in single/multi nozzle jet ejector. This chapter is divided in to five sections:

Section one deals with determination of rate constant and mass transfer (absorption) rate for Cl_2 – aqueous NaOH reaction system. The rate constant predicted by the proposed model is in good agreement with experimental data. The proposed model for rate of absorption of chlorine in aqueous $NaOH$ solution is solved by using MATLAB software and compared with experimental results.

In section two mathematical model to study the effect of different diffusivity ratio on enhancement factor for absorption of chlorine-aqueous sodium hydroxide system has been developed.

Section three is devoted to the development of the numerical model for multi nozzle jet ejector to predict the conversion. The model was verified by the experimental data.

Section four is devoted to mass transfer characteristics in multi nozzle jet ejector. The mathematical models developed to determine interfacial area and mass transfer coefficient and validated with experimental data.

Section five deals with statistical simulation of the removal efficiency of chlorine gas by varying parameters: gas concentration and the scrubbing liquid concentration.

Chapter Five includes suggestions for the future scope of the work.

References and Appendices are given at the end.