



## CHAPTER 1

### INTRODUCTION

Ever since the 1960's when pressure swing adsorption (PSA) was used to separate gases the PSA designs used were based on a two column system or a system based on more than two columns. Unfortunately such multi-column systems necessarily have complicated piping arrangements and gas flow control components and investment costs are function of the number of columns used. In order to reduce the complexities and investment costs of PSA systems Jones et al [1] patented a single column PSA system aimed at separating oxygen from air as well as separating other gases. In 1983 Fernandez and Kenny [2] wrote a publication based on a study of a single column PSA unit used to separate oxygen from air.

Both the Jones study and the Fernandez study were similar in that both experimental apparatuses used a single adsorption column. However major differences between both apparatuses were as follows :

(1) The Jones experiment used 40 - 80 mesh particles (0.0175 - 0.0351 cm ) and created a pressure drop inside the column whereas in the Fernandez experiment adsorbent particle of 0.1-0.2 cm were used and such sizes created absolutely no pressure drop in the column;

(2) The Jones apparatus was equipped with a product surge tank used to purge the column during blowdown whereas the Fernandez apparatus was not equipped with a product surge tank and only direct blowdown with no purge gas occurred ;

(3) The Jones experiment obtained an oxygen concentration in the product gas of some 90 percent whereas in the Fernandez experiments oxygen concentration up to only 40 percent were reported.

The importance of pressure drop on separation efficiency in the adsorption column as shown by the result of Jones is mentioned in a 1971 article by Turnock and Kadlec which appeared in the AIChE Journal [3]. It is also mentioned by Yang in his 1987 book [4].

In 1988 Sundaram and Wankat [5] presented a paper in Chemical Engineering Science modeling the phenomena of pressure drop in a single column PSA by modeling separately the pressurization and blowdown steps of the operation of an adsorption column filled with small size adsorbent particles. The paper however did not include a product surge tank to be used during blowdown.

This study takes up the importance of the pressure drop phenomena in single column PSA systems and essentially tries to create a mathematical model based on Sundaram and Wankat's article that can be used to simulate the operation of a system such as patented by Jones.