CHAPTER I
INTRODUCTION

The major energy of the world comes from fossil fuel, especially oil which nowadays we encounter with the price increasing. Moreover, air pollution's effect on global warming has become a critical problem for the world, so new sources of energy become interesting in place of oil. Among new sources of energy, natural gas is considered because it burns cleaner than other fossil fuels, resulting in natural gas being used for electricity generation and the raw material in the petrochemical industry, as well as energy for vehicles. Natural gas is a complex mixture of combustible hydrocarbon gases and impurities. Water is a one type of undesired impurities in natural gas, so dehydration of natural gas, which is an important part for the natural gas conditioning process, is employed to remove the water associated with natural gas in vapor form in order to reduce problems of corrosion, hydrate formation, and freezing at low temperatures in the pipeline.

There are two common methods used for removing water from natural gas. One method is glycol dehydration. Another method is solid-desiccant dehydration (Berger, 1980). In this work, the dehydration process by using a solid desiccant is selected to remove water vapor. And, in order to improve the adsorption capacity, purification capability, and lifetime of the adsorbent, a multi-layer adsorber has been developed by optimally combining the advantages of each adsorbent. Alumina is easily regenerated at low heat and has a high equilibrium capacity; while molecular sieve zeolites provide a high water adsorption capacity at relatively low humidity (Uttamaroop, 2004). Therefore, these adsorbents are used to help each other to remove water in this process.

The removal of water from a natural gas stream using a multi-layer adsorber can be observed by using a modeling of breakthrough time based on mass balance. Moreover, the model can predict the proper time to operate the adsorption process. In order to determine the breakthrough time, the equilibrium adsorptions of water on solid adsorbents need to be studied. Deactivation of an adsorbent as a result of either pore mouth closure, window blocking, coking, or hydrothermal decrystallization causes a loss in adsorption capacity, and cannot be avoided in the real operation.

Therefore, in this work, the equilibrium isotherm and physical properties of adsorbents, along with increasing degree of deactivation need to be determined. Moreover, the change in interstitial velocity due to pressure drop along the adsorber was applied in the breakthrough time model. The parameters in the breakthrough time equation changing with the percentage of deactivation were investigated to modify the breakthrough time model in accordance with deactivation. Finally, the method of lines (MOLs) with central finite difference and Runge-Kutta 4^{th} are employed to solve the partial differential equations for the theoretical breakthrough curve. FORTRAN language was utilized in numerical solving.