CHAPTER I
INTRODUCTION

Natural gas is an important energy source and raw material for petrochemical industries. Natural gas produced from reservoirs is unavoidably saturated with water. Significant amounts of water in natural gas may reduce its heating value and pipeline capacities. Moreover, the presence of water in natural gas can lead to the decrease of catalyst activity or poisoning of catalyst, accelerated corrosion, and plugging lines by ice or hydrate formation.

Although there are several current methods available for water removal from natural gas, an adsorption process using solid desiccants has proven to be the most practical method. The process can reduce the amount of water from natural gas to as low as 1 ppm. Moreover, because of their great drying ability, solid desiccants can be employed where high drying efficiencies are required. Adsorbents with high affinity and capacity for water can be used for selective adsorption of water from natural gas. However, a highly polar surface and a high specific area are the main requirements for an efficient desiccant (Perason and Grant, 1992).

At present, zeolites, activated alumina, and silica gel have all been used for natural gas dehydration (Perason and Grant, 1992). Zeolites can adsorb water in a much higher quantity than the other adsorbents. With an increase of temperature, water adsorption capacity of zeolites decreases but not so sharply as with silica gel or aluminum oxide. Zeolites have low hydraulic resistance. Zeolites have ability to separate gases or liquids by molecular sizes. (Tsitsishvili *et al.*, 1992). However, a high temperature greater than 300°C required for regeneration is the major disadvantage of zeolites, which makes their use uneconomical where only a moderately low dew point is required. By contrast, alumina and silica gel have the advantage of having higher equilibrium capacity and of being more easily regenerated by

less energy (Perason and Grant, 1992). Despite a few disadvantages as mentioned, a zeolite called, clinoptilolite, is a promising adsorbent as it is naturally available. However, with its origin, inconsistencies of its properties and a low water adsorption capacity are expected.

To improve clinoptilolite water adsorption capacity, several modification techniques can be applied to change water-zeolite interactions, which directly govern the adsorption capacity. In this study, effect of thermal treatment, acid treatment, ion exchange, and acid treatment prior to ion exchange method on the water adsorption capacity of the zeolite were investigated. Moreover, adsorption behaviors of water and natural gas on the unmodified and modified clinoptilolites were also studied.