CHAPTER I
INTRODUCTION

1.1 Introduction

Natural gas, with its board range of applications, has been one of the most important energy sources for various industries, partly because of its cleanliness, inexpensive cost, high flame temperature and obviously high heating value. Moreover, natural gas is also used as raw materials in petrochemical industry. However, natural gas often contains water and impurities that must be removed before it can be fully utilized. Water content in natural gas ranges from ppm level to approximately 5 vol. % (Speight, 1993) depending on its pressure, temperature and regional composition. The presence of water can cause very serious problems like corrosion of piping systems of gas refinery units and other related downstream processes, and poisoning to the catalysts (Campbell, 1992).

Although there are several techniques for dehydrating natural gas, an adsorption process has been proven to be the most favorable method used in practice, nowadays. That is because of its low investment cost and the efficiency of adsorbents is totally acceptable (Yang, 1987). The choice of an adsorbent depends on its physical properties such as specific surface area, mechanical resistance, and pore size distribution (Ying and Benziger, 1993). The pore size distribution is of prime importance because natural gas being trapped contains heavy hydrocarbons and any other impurities. So, removal of all unneeded impurities with an all-in-one process by the applied adsorbent of large pore diameter is the dream process.

One of the widely used adsorbents is molecular sieve, which is the well-known adsorbent for wide variety processes. Molecular sieve possesses high water adsorption capacities, but it is usually rather expensive (Campbell, 1992). Silica gel and alumina have approximately the same water adsorption capacity and normally alumina requires less heat to regenerate than that of silica gel. This means using alumina in the dehydration process will result in less severe operating condition, less capital and operating cost, and absolutely more economical way for the overall process.

Alumina properties strongly depend on its preparation method (Pierre *et al.*, 1998). Currently, commercial alumina has been synthesized through several techniques such as activation of aluminum hydroxide but its outcome properties, for example total surface area, is still not effective as desired. Recent study has shown that alumina prepared by sol-gel technique yields good and consistent properties (Ishiguro *et al.*, 1990). With the sol-gel technique, alumina has a significant improvement in their physical properties, which are higher surface area and more homogeneous pore size distribution (CauQui and Rodriguze-IzQuierdo, 1992). Therefore, alumina prepared by the sol-gel technique may be an excellent alternative for the natural gas dehydration process. But before that, many questions, like effects of calcination time and calcination temperature on the alumina adsorption capacity and effects of competitive adsorption between hydrocarbons and water on alumina surface, need to be answered.

1.2 Research Objectives

This work focused on the effects of calcination temperature and calcination time on physical properties, like water adsorption capacity, of alumina prepared by the sol-gel technique. The competitive adsorption behavior of water and hydrocarbons on the sol-gel alumina was also studied through the simulated natural gas experiment.