CHAPTER I
INTRODUCTION

Nowadays, plastics have become a very important materials, and it is estimated that 100 million tones of plastics are produced world-wide each year, due to having a lot of advantages that overcome the conventional materials people have ever used, such as cheap price, light weight, strength, long life and easy to make in a desirable shape. However, plastics also have some disadvantages such as, hard to degrade, have very high cost and very difficult to recycle, so the waste that occurs from these plastics can cause very serious problem to the world.

Polyethylene is one of the most widely used plastics because it is simplest in the preparation and most inexpensive. This polymer can be obtained by the polymerization of ethylene monomers, due to this fact, its name polyethylene or PE was made. The very wide range of polyethylene properties, such as, flexible or very stiff, tough or very strong, transparent or opaque makes this polymer have variety of applications, for example, fibers, tubes, films and sheets, but the most important application of PE is for packaging materials.

Pyrolysis is the thermal degradation reaction of a substance under the atmosphere with the absence of oxygen or air, to form lower molecular weight substances. In these days, pyrolysis reaction is an alternative way to dispose plastic wastes by converting them to the valuable molecular weight products used for petrochemical feedstock. By pyrolysis, this way is better than the conventional methods, such as, landfill and incineration because pyrolysis can change invaluable to valuable things.

However, pyrolysis of waste polymers for chemical recycling also have some problems that the degradation of macromolecules needs high temperatures and thus requires a considerable amount of energy. Pyrolysis of plastic waste material can be divided into two ways; thermal pyrolysis and catalytic pyrolysis. In the thermal degradation of polyolefins, many hydrocarbons having a wide distribution of carbon atom numbers are formed. In contrast, the oils produced by the catalytic degradation are known to contain a relatively narrow distribution of hydrocarbons. In addition, catalytic degradation has an advantage of a lower temperature of degradation than thermal degradation.

Many researchers have studied about thermal degradation of polyethylene (HDPE, LDPE) (Miln *et al.*, 1999; Mastral *et al.*, 2001) and for mixed plastics (Elizabeth *et al.*, 1997; Demirbas *et al.*, 2004). Products after themal degradation or non-catalytic pyrolysis were gas fraction, liquid fraction, and residue. The liquid product should undergo further processing in petrochemical refining and the gas can be used directly as fuel. Catalytic pyrolysis is the short cut way to obtain the higher quality of the products. Many types of catalysts such as MCM-41 (Marcilla *et al.*, 2001; Grieken *et al.*, 2001; Seddegi *et al.*, 2001 and Julil, 2002), ZSM-5 (Marcilla *et al.*, 2001; Bagri *et al.*, 2002; Seo *et al.*, 2003) and SAPO-37 (Fernandes *et al.*, 2002) were employed and studied for the catalytic activity and the effect of catalyst on product composition. The advantages of using catalysts were: (1) better quality of waxy products (Grieken *et al.*, 2001), (2) lower amount of alkane product (Julil, 2002), (3) lower range of carbom number (Fernandes *et al.*, 2002), (4) lower the decomposition temperature of plastic (Marcilla *et al.*, 2002) and (5) less residue production and increase the liquid production (Seo *et al.*, 2003).

In this work, catalytic pyrolysis of polyethylene was investigated using the superacid catalyst (SO_4^{2-}/ZrO_2) and superbasic catalyst (KNO_3/ZrO_2). Products obtained from using each type of catalysts, both commercial and synthesized one, were analyzed for their compositions and compared to investigate catalytic effects.