# CHAPTER I
# INTRODUCTION

The importance of petroleum recovery in carbonate formation is concerned as about one third of the world's petroleum reservoirs found in limestone (Hoefner and Fogler, 1985). Typically, the reduction of petroleum production is associated with a partial plugging in this formation around the wellbore. This restriction can be solved by acidizing treatment. The objective of carbonate acidizing is to improve flow through carbonate formations. There are two basic types of this treatment divided into two categories by injection rate and pressure. Injection rates above fracture pressure are termed as fracture acidizing, while those below fracture pressure are named as matrix acidizing (Economides, 1987). Acid fracturing is applicable in both damaged and undamaged carbonate formations. On the other hands, matrix acidizing is preferable only in damaged formation (Kalfayan, 1996). Although, matrix acidizing has a limit in technique, it is still useful to improve well performance. Matrix acidizing is generally applied to remove the effect of a formation reduction near the wellbore by enlarging the pore spaces and dissolving particles plugging these spaces (Fredd, 1998). Otherwise, this treatment can maintain or prevent water or undesired gas production.

In the matrix acidizing treatment operation, acid is continuous pumped into a formation where the remain petroleum found with pressure below the fracture pressure. The acid flows preferentially into the high permeability region causing the formation of highly large conductive flow channels called wormhole. This channel allows almost remain petroleum in that region to flow through easily. In other words, these channels are low resistant, then the fluid prefer to flow through them. Therefore, the structures of wormhole channels are important to be investigated for understanding this calcite dissolution phenomenon. Wormhole structures are significantly dependent upon both of the injection rates of acid and fluid-rock properties. Dissolution patterns typically range from the face dissolution at a low injection rate to uniform dissolution, resulting in ramified wormhole structures at a high injection rate (Fredd, 1998).

Various stimulating fluids are presented in carbonate matrix acidizing treatment. Hydrochloric acid is usually injected into the carbonate formation at a low injection rate. This strong acid causes the complete calcite dissolution or face dissolution due to its rapid reaction rate. Owing to this reason, the low injection rates are not essential to be economized. Although large amounts of acid are consumed, there is insignificant increase in the conductivity of the carbonate formation. Furthermore, this strong acid is highly corrosive chemical, which corrode on wellbore tubular goods. In addition, it provides the formation of asphaltic sludge, especially in the presence of FeII and FeIII ions (Jacob, 1989). This sludge may plug the carbonate formation and restrict productions after treatment. To avoid these problems, a variety of acid additives have been utilized. Their effectiveness is dependent upon the compatibility between acids and the solid formation. In other words, there are no universal additives for all acidizing problems (Harry, 1984). Chelating agents are employed to solve the problems causing by strong acids. However, there is a limitation of applying these acids due to the ability of dissolution. Retard acids such as oil external microemulsion systems containing HCl are also presented. This system is able to diffuse to the carbonate surface. Thus, it allows deeper penetration of live acid (Hoefner and Fogler, 1985). Nevertheless, the application of this process is limited due to its complicated mechanisms and controls.

Weak acids which are less corrosive are ideally suitable to use in the acidizing treatment since weak acids effectively form a wormhole channel. In the case of asphaltic sludge, weak acids negligible cause production restriction because of their acidity compared with strong acids (Jacob, 1989). Hence, they have been commonly used in well stimulation as a substitute for strong acid more than several years.

The objective of this research was to study the influence of weak acids on the flow and reaction in carbonate porous media. Especially, the dependence of the wormhole structures was presented as the relation of the dissolution rate and the fluid velocity, or the Damköhler number for flow and reaction. Furthermore, the weak acid properties, dissolution constant and pH were determined for insisting the advantage of Damköhler number in matrix acidizing treatment operations.