CHAPTER I
INTRODUCTION

The motivation behind this research originates from the problem of mineral precipitation occurring during matrix acidizing of petroleum reservoirs. Mineral precipitation has been a considerable economic problem for many years in the petroleum industry. In matrix acidizing, acid is injected into the porous reservoir formation to remove pore blockage and thereby increase permeability near the well bore. Here, the acid dissolves minerals in the formation matrix to open the pore space blocked by fines resulting from fines migrating through the porous formation. The injected acid reacts with zeolite minerals found in the formation. The consequences of mineral precipitation include a decline in well productivity, re-drilling a well bore, or in worst cases the abandonment of a well.

Typically, a sandstone reservoir is composed of roughly 85% quartz, which is considered to be inert to stimulation fluids (e.g., un-dissolvable). Approximately 10% of a formation is composed of alumino-silicates (e.g., zeolites and feldspars), which are considered to be dissolvable. The remaining 5% is composed of clay minerals (e.g., kaolinite or montmorrillonite), which are considered to be dissolvable as well.

Most petroleum reservoirs are found in sandstone formation. In a number of offshore oil wells, the discovery of the common occurrence of the zeolite mineral analcime as sandstone cement has contributed to an overhaul of standard completion and stimulation procedures in the field. Analcime is a low density hydrated mineral with strong tendency to form hydrated gel in concentrated hydrochloric acid. This property creates a serious potential for permature spending of acid and formation of silicate gels or scale which can potentially damage the near wellbore region. A fundamental understanding of zeolite dissolution and precipitation phenomena is critical for improving the deliverability of petroleum reservoirs.

Much of previous research has been focused on the dissolution of layered aluminu-silicate mineral rather than zeolites. Only a few of them have been conducted for dissolution of zeolite. The solubility and the stability of analcime in different types of solution have been studied (Wilkin and Barnes, 1998). The dissolution and growth of analcime were also studied to understand the kinetics and mechanism of reaction occur (Murphy *et al.*, 1996; Hartman and Fogler, 2005).The types of the acid used were mostly inorganic acids such as hydrochloric acid, hydrofluoric acid or mixture of these acids (Kline and Fogler, 1981; Gdanski, 2000; Underdown *et al.*, 1990; Hartman and Fogler, 2005). However, many researchers have encountered the problem with silica and alumina precipitation. Recently, the use of organic acids and some chelating agents such acetic acid, citric acid and EDTA (or mixtures) have been investigated as potential stimulation fluids (Fredd and Fogler, 1998; Shucart, 1997; Roger, *et al.,* 1998).

In this study, the kinetics of the dissolution of analcime in HCl and citric acid were studied by using the initial rate method. Different amounts of analcime were used to study the dissolution and precipitation of analcime at different concentrations of acid. The effect of temperature was also examined. Furthermore, the effect of citrate ion on silicate precipitation during analcime dissolution was investigated.