CHAPTER I
INTRODUCTION

The petroleum industry, which involves most human activities in everyday life, has been growing rapidly. A recovery process is commonly practiced to maximize the production as petroleum reserves are limited. Most oil reserves are generally mixed with water and natural gas. The process of primary oil recovery involves drilling a well and pumping oil. Normally after depletion period only 15% of the original oil in place can be recovered. To improve oil recovery, a fluid is injected into the reservoir to maintain the pressure in order to push the remaining oil contained in the reservoir toward the production wells. This is the secondary process for oil recovery.

However, during the water injection, reactions deriving from certain alkali with divalent ions such as calcium and magnesium in solution resulting from the mixing with the residing brines can usually occur along with the ion exchange process and dissolution process. All of these reactions including changes in the fluid conditions such as pH, temperature, and pressure contribute to the scale formation.

Scale nucleation can occur anywhere in the production system, around the wellbore formation and in the porous rock. This scale growth leads to the blockage of the flow path, damage to the production system, and decrease of reservoir productivity. When the production becomes economically unfeasible, the production system is shut down to clean up the scale. Acidization is one of the scale cleaning processes. Millions of dollars have been spent each year in the production system and in cleaning up the processing to tackle the scale problem.

In typical oil fields, gaseous hydrocarbons, which are the lightest, occupy the topmost of the reservoir, known as the "gas cap". The part just underneath occupied by liquid hydrocarbons is called the "oil zone". The part below the oil layer which is the porous rock formation containing only water is called the "aquifer".

The continuous injection of scale inhibitors with water flooding can solve the scale problem; however, it is so costly. Then, squeeze treatment is widely used. The inhibitor is injected into the formation and it can slow the crystal growth. This injection procedure is called the squeeze technique.

Threshold scale inhibitors are generally injected into the formation for commercial production. Figure 1.1 illustrates the basic model of the squeeze treatment process. A production well where a slug of scale inhibitor and brine overflush are primary injected into the formation and in shut-in production well for approximately 24 hours. During the shut-in period, there are three types of processes that show how scale inhibitors can be restrained in the formation : 1) adsorbed on to rock surface, 2) precipitated with cations within the formation, and 3) sit-in a small fracture in the formation.

The consequence of the shut-in period is that as the production process proceeds, the inhibitor is dissolved back to the produced fluid at proper concentration, which can inhibit scale formation. Figure 1.2 illustrates the concentration profiles of the scale inhibitor released for ideal and actual systems.

A limited amount of scale inhibitor is retained in the formation. In a production well after the shut-in period, the production is resumed and the fluid to dissolve inhibitor from the formation is injected. If the concentration of inhibitor in the produced fluid is lower than the required concentration, then the squeeze process is resumed. The length of time that inhibitors are released to the produced fluid at the minimum effective concentration (C_{min}) is called

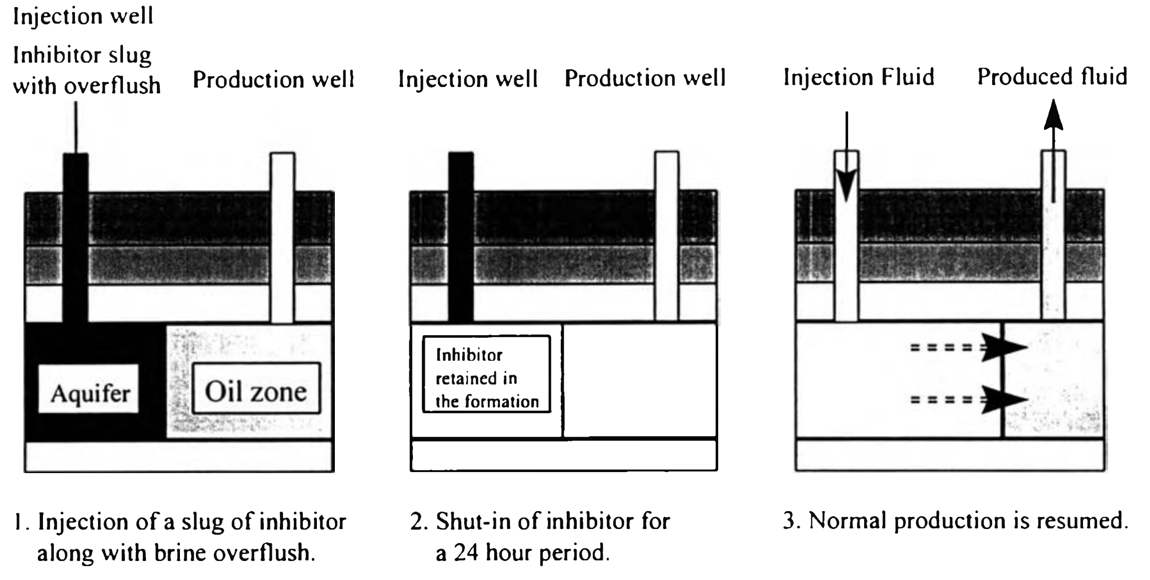

Figure 1.1 Schematic of the typical squeeze treatment process (Browning, 1993).

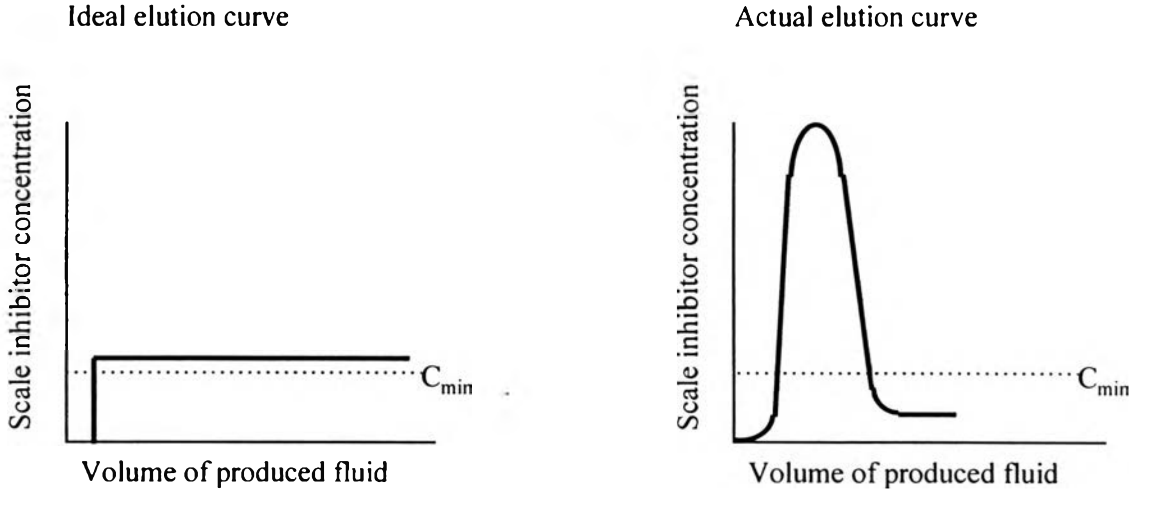

Figure 1.2 Comparison between the ideal elution curve and an actual elution curve (Browning, 1993).

'squeeze lifetime'. In order to minimize the loss of production time and the inhibitor cost, the squeeze technique with a particular scale inhibitor is needed to study to find out the optimum conditions. In an ideal process, the inhibitor should be continuously released to the production process at minimum effective concentrations for the longest period. However, scale inhibitors actually dissolve quickly during the early production process and their concentrations sharply drop below C_{min} which indicates the end of squeeze lifetime.