

CHAPTER II

HISTORICAL BACKGROUND

2.1 Prominent scales

The prominent scales composed of several salts such as calcium carbonate, barium sulfate, strontium sulfate and/or calcium sulfate, have been widely found in the production systems. The formation of these scales occur because of the sudden change in fluid conditions and/or the mixing of incompatible brines. The continuous deposit of the scale eventually lead to the blockage of flow path resulting in the reduction of productivity. Moreover, the formation of radioactive scales, such as radium sulfate, may cause environmental problems. Therefore, it is important to control this scaling problem. This scaling problem can be solve by injecting a threshold scale inhibitor into a formation where they can control the formation of scale (Oddo and Tomson, 1990; and Browning and Fogler 1993).

2.2 Scale inhibitors

The mechanism of threshold scale inhibition has been studied by many researchers (Berkovitch-Yellin et al., 1985; Nancollas, 1985; and Liu and Nancollas, 1976). The previous observation showed that the scale inhibitor could reduce the tendency of the crystallization and the subsequent formation of scale by disrupting the thermodynamic stability of the growing nucleons and

interfering or blocking the growth processes of growing crystals (Graham, Boak and Sorbie, 1997).

The most important property of any oilfield scale inhibitor is the ability to prevent or to delay the crystal nucleation and growth of scale at threshold concentration.

The threshold scale inhibitors belong to one of the following chemical families.

1. Polymers
2. Esters of phosphoric acid
3. Phosphonates

Our study will focus on phosphonate inhibitors since they can inhibit scale formation at low concentration. Phosphonates are also stable over a wide range of temperature and pH. Hence, they can be applied in many reservoirs at different conditions. Moreover, phosphonates are able to inhibit many different types of scale formation (Vetter, 1972).

2.3 Fundamental of Squeeze treatment

Based on the major mechanisms that are employed for the retention of the inhibitor within the formation, the squeeze treatment are divided into two main types.

In adsorption squeeze treatment, inhibitor is retained by adsorption onto the reservoir rock and is released by desorption. Many laboratory and field studies have been performed. A number of research works have elucidated the physical-chemical mechanisms governing inhibitor adsorption and desorption as well as the effect of rock mineralogy, brine composition and the

characteristics of the inhibitor molecules on both the level of adsorption and the lifetime of the treatment (Sorbie et al., 1993; and Sorbie et al, 1994).

In precipitation squeeze treatment, the main inhibitor retention mechanism within the formation is through the formation of an insoluble inhibitor complex which may be in the form of a Ca^{2+} salt or a gel-like immiscible liquid phase. The precipitate is then dissolved and the residual mobile inhibitor solution is pushed back into the produced fluid when normal production is resumed (Browning and Fogler, 1993; Oddo and Tomson, 1990; and Oddo and Tomson, 1994).

2.4 Related works

Past research works involving squeeze treatment have generally focused on adsorption squeezes more than on precipitation squeezes. The precipitation squeezes have been believed to be undesirable because they may induce precipitation (pseudoscale which is what inhibitors are supposed to be preventing) in a reservoir system and, as a result, possibly damage the formation. However, precipitation treatments with inhibitors such as phosphonates and polyacrylic acids have been supplied in the field to enhance squeeze lifetime (Jonasson, 1992; Yuan et al., 1993; and Malandrio et al., 1995). It is claimed by a number of researchers that this type of process is capable of giving longer squeeze lifetimes compared with adsorption squeeze processes. A number of laboratory works have been shown that the significant formation damage due to the precipitate's formation is short-lived. Approximately 80% of the permeability was restored after a few postflush volume (Malandrio et al., 1995).

The physical-chemical mechanisms that govern the success of precipitation squeeze treatment are much less well understood than those of

the adsorption squeeze treatment. The factors governing the release of inhibitor from a precipitation squeeze are the dissolution rates of the precipitate from the reservoir, the extent of external and internal precipitate migration, and the pore plugging and changing flow patterns that occurred during the elution process. Traditionally, it has been held that the characteristic extended, flat inhibitor return curves observed in the field, are determined by the low solubility of the inhibitor in the produced water (Browning and Fogler, 1993 and Yuan et al, 1993). Recently, the previous observation have presented evidence for a polyphosphonate inhibitor suggesting that dissolution of the precipitate is a kinetically controlled process. The dissolution of precipitate densely packed in pore throats, which is mass transport-limited process, governs the long tailing region on the elution curve (Browning and Fogler, 1995; and Rerkpattanapipat, 1996).

Since the precipitation squeeze treatment promise for the longer lifetime treatments, the improved understanding of the basic mechanisms governing the precipitation/dissolution process will help in clarifying its potential and in defining the conditions under which it is best employed.