CHAPTER I
INTRODUCTION

Water flooding is a common procedure used to enhance the secondary and tertiary oil recovery. The porous rock matrix of a petroleum reservoir is never completely homogeneous. In fact, there are numerous zones of high permeability that act as conduits for almost direct transfer of water from the injection well to the production well resulting in an unfavorable ratio between the water and oil. As the waterflood commences, the high and low permeability zones are both oil saturated. The waterflood follows the routes of least resistance that are the high-permeability zones and act as the energy force to push out any oil along this path. However, once the oil has been displaced from these high-permeability zones the water continues to follow the same routes. Consequently, the low-permeability zones still unswept and contain large amount of oil (Hankins and Harwell, 1997).

The process of blocking off the higher permeability zones and diverting the waterflood to other unswept zones is called selective plugging. In order to be effective, the plug must penetrate deep throughout the high-permeability zones. If the shallow plug established, the waterflood is initially blocked from the high-permeability zones and push out some oil. However, beyond the plug, the water returns to the high-permeability zones and much oil still remains in the low-permeability zones. With a deeper plug in the high-permeability zones, the waterflooding is forced to stay in the low-permeability zones and push oil out until most of the oil is drained. Figure 1.1 shows the schematic diagram of the effects of shallow and deep plugs on enhanced oil recovery.

Many blocking agents have been employed for reducing the permeability of the water swept zones. Although gels, colloidal dispersions,

and polymers have also been used, these applications generally do not penetrate deep into the formations. Flow is directed only over the treated region near the well-bore, but then re-enters the high permeability zones (Donalson *et al.*, 1989).

Currently, the new technique using the nanosized silica particles that are far more effective for plugging high-permeability zones than the organic polymers and gels is being investigated. It may be possible to sustain the growth of silica particles within the high-permeability zones of a petroleum reservoir. Consequently, sweep efficiency and production of oil are increased.

Therefore, the nanosized silica particles synthesized in W/O microemulsions were used to reduce the permeability of porous media in this study.

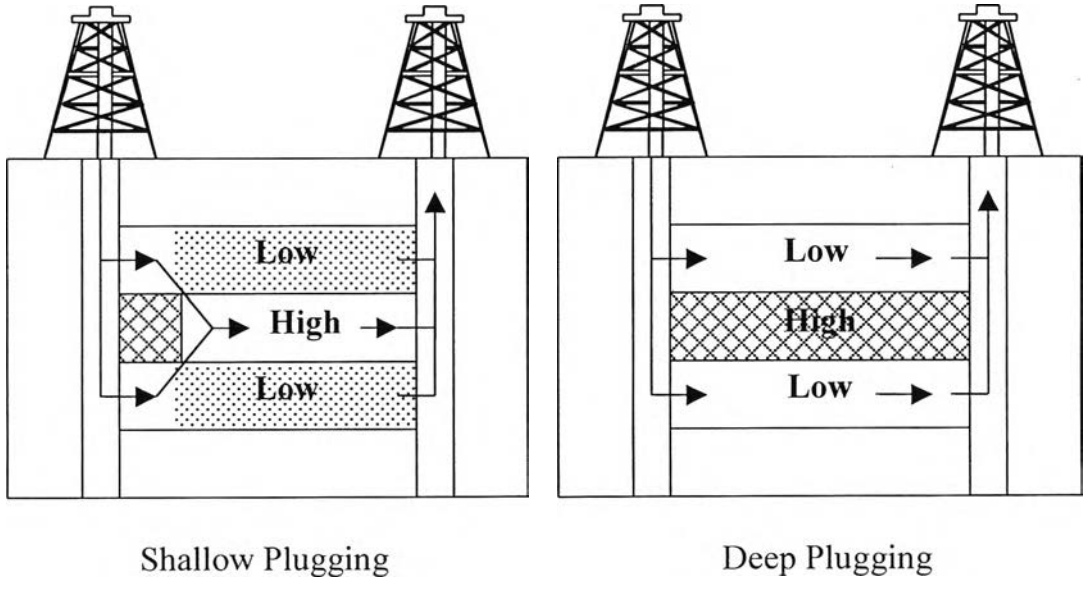

Figure 1.1 Schematic diagram of the effects of shallow and deep plugs on enhanced oil recovery. (Donaldson *et al.*, 1989)