CHAPTER I
INTRODUCTION

The motivation behind this research originates from the problem of asphaltene deposition during oil production. As time has progressed, reservoirs of conventional light crude oil have been depleted, driving exploration towards heavier crude oil reservoirs. The oil industry is facing more difficult operations and the importance of the asphaltene deposition problem has significantly increased.

Asphaltene precipitation can occur at any point during production where the stabilizing equilibrium has been altered. Changes in temperature, pressure, and chemical composition of oil induced by production and enhanced oil recovery processes such as CO_2 flooding, acid stimulation and mixing a crude oil with diluents and other oils, are some of the destabilizing forces (Islam 1994; Kleinitz and Andersen 1998).

Many of the difficulties encountered in oil production, transportation, and processing are related to the precipitation of asphaltenes in crude oils. Reservoir damage, reduction of well productivity, and plugging of the tubing and production facilities are some of the adverse consequences of asphaltene precipitation. For example, the processing of asphaltenic oil in refinery operations causes storage capacity loss, equipment fouling, and catalyst deactivation, along with various process and control problems (Wattana 2004).

Precipitation and deposition of asphaltenes inside oil wells reduces the permeability of the reservoir causing partial or complete blockage of the reservoir, and thus resulting in the damage of the reservoir and a loss of crude oil recovery (Kokal and Sayegh 1995). The economic impacts of the asphaltene problem are tremendous. The deposition can cause a loss of oil production rate of up to 3000 barrels per day and the blockage over a few days can cost approximately over half a million dollars (Adialalis 1982). The serious economic nature of the problems associated with asphaltenes has motivated numerous investigations on asphaltenes. However, the scope of studies carried out on asphaltene from a particular crude oil is limited due to the complex nature of asphaltenes and variation of their properties from one crude oil to another (Wattana 2004).

Previous research in the area of asphaltene deposition has been conducted by Broseta *et al.* (2000) and Wang *et al.* (2004). The experimental method involved the pumping of a mixture of crude oil and precipitant into a capillary at a constant flow rate and measuring the pressure drop across the capillary. The pressure-drop across the capillary increased as asphaltenes deposit inside the capillary. By measuring the increase in pressure drop, the thickness of asphaltene deposits can be estimated. However, experimental results of Wang *et al.* (2004) have shown that wax was found with asphaltene deposits. Therefore, it can not be concluded with certainty that the increase in pressure drop was due to asphaltene deposits only. The effectiveness of the experimental design used by Wang *et al.* (2004) is also open to debate because asphaltenes could have precipitated before entering the capillary, in which case they would not deposit inside the capillary.

The aim of this research is to develop an improved capillary flow technique to investigate asphaltene deposition by building on the work of Broseta *et al.* (2000) and Wang *et al.* (2004). The prime improvement made is in the design of the mixing system, which reduced the residence time between the mixing and entrance of the crude-heptane mixture into the capillary, thereby eliminating the precipitation of asphaltenes before entering the capillary. By using a wax-free crude oil, the potential effects of wax on deposition are eliminated, allowing for the deposition of solely asphaltenes to be examined.