CHAPTER I
INTRODUCTION

Crude oils are complex mixtures of hydrocarbons that can be divided into several classes of materials: Saturates, Aromatics, Resins, and Asphaltenes. Asphaltenes are the fractions of crude oils that are soluble in aromatic solvents (i.e. toluene) and insoluble in an alkane, typically pentane or heptane. Generally, asphaltenes have been defined as heptane (n-C7) insoluble (C7-asphaltene) because the separation procedure of C7 – asphaltene is easy and the repeatability of the operation is precise (Tojima *et al.*, 1998). Moreover asphaltenes may be defined as the heaviest and most polar component of crude oil. The asphaltenes usually comprise condensed aromatic and naphthenic molecules having relatively high molecular weights ranging from several hundred to several thousand (Schechter, 1992). These molecules normally contain significant quantities of oxygen, nitrogen, and sulfur.

The asphaltic materials are generally thought to be colloidally dispersed in solution (Schechter, 1992). The solubility of asphaltenes in crude oils is probably related to the stability of their colloid aggregates or micelles. The colloids are dispersed by the adsorption of resins on the surface of the small particles (Socrates *et al.*, 1995). Because resin molecules and asphaltenes both contain various polar groups, the molecules of resin can be easily adsorbed onto the asphaltene particles and act as peptizing agents of colloid stabilizer by neutralization mechanism. Aromatic hydrocarbons (such as toluene) have proved to be a good dispersed medium for peptization of resin on asphaltenes (Lian *et al.*, 1994). Normally, resins known as maltenes are structurally similar to the materials composing the asphaltenes but have a lower molecular weight. If resins are desorbed or re-peptized from the asphaltene surface by addition of a low molecular weight paraffins, acids, or CO_2 , then the asphaltene particles begin flocculating to form larger entities (Altgelt and Boduszynski, 1994).

Under normal reservoir conditions, the crude oil is a single phase liquid. However, changing in temperature, pressure, and composition may cause crude oils to undergo phase changes. It is also possible that CO_2 injection to enhance the oil recovery will strip enough resins from the asphaltenes to cause precipitation. Asphaltene precipitates from the crude oil have been normally found either in or near the near wellbore regions of the formation.

Asphaltenes are well recognized around the world as manifested by the extensive economic damage. Asphaltene precipitation manifests itself in almost all facets of production, transportation and processing of crude oils (in-situ) formation damage deep inside the reservoir, precipitation at the wellhead, in pumps and tubing. They can block the pore throats which cause a reduction in permeability. Moreover asphaltene deposition also changes wettability characteristics, which can make the formation more oil-wet and change the relative-permeability relationships, and therefore it can reduce the oil production. In the wellbore and surface facilities, asphaltene deposits will gradually reduce the area for flow, resulting in the need of higher-pressure to maintain the oil production (Schechter, 1992).

Due to the serious economic nature of these problems, numerous studies have been carried out on asphaltene precipitation and dissolution. Various methods have been used to treat the asphaltene deposition problem. Solvent treatment method is commonly employed to clean up asphaltene deposit and to prevent their formation. Normally aromatic – based solvents (i.e. polyaromatics, toluene) are the most reliable and effective in removing asphaltenes from the near wellbore region. However, because of the environmental concerns, there are still ongoing projects to develop effective and non-hazardous substitutes for the chemical treatment of asphaltene precipitates and deposits. To this effect, studies on the dissolution of asphaltenes using non-aromatic solvents have been undertaken in recent years (Chang and Fogler, 1994).

Practically, there is always some amount of alkane involving during the asphaltene remediation using aromatic solvent in the well bore. Hence, the solvent mixture of aromatic and aliphatic solvents was used in dissolution study in order to imitate the real situation.

The research on the stabilization and dissolution of asphaltenes was conducted. The scope of this work covered the preparation and characterization of asphaltenes, the evaluation of the effectiveness of the toluene/heptane solution in asphaltene dissolution, determination of solubilities of asphaltenes and prediction of molecular weights of asphaltenes.