CHAPTER I

INTRODUCTION

As reservoirs near to shore become depleted, new wells need to be drilled further offshore. The drive towards deep water production is evidenced by the data presented in Table 1.1

Table 1.1 World records for sub-sea petroleum production (Azevedo and Teixeira, 2003)

Year	Water depth (m)
1983	208
1987	492
1993	781
1995	1020
2000	1853

The table presents the water depth records established in sub-sea petroleum production wells in the last two decades (Azevedo and Teixeira, 2003). As new wells are drilled farther from the shore, the oil must be transported with longer pipelines along the cold ocean floor. This cold surrounding leads to a deposition of waxes inside the transport pipelines because the solubilities of high molecular weight paraffins or waxes in the crude oil decrease drastically with decreasing temperature. Figure 1.1 shows a cross section of the pipeline filled with the wax-oil gel.

Figure 1.1 Cross-sectional view of plugged pipeline.

The deposition of paraffinic waxes during the transportation of crude oil is responsible for losses of millions of dollars annually to the petroleum industry. Prevention and remediation of wax deposition in transport pipelines are vital to the production of crude oil and gas condensate. Insulation of the pipelines has been used to reduce a wax deposition problem. Removal of the deposited waxes can be done by using many techniques such as mechanical removal and chemical injection (Azevedo and Teixeira, 2003).

In order to avoid both over and under protective operational guidelines, high reliability from wax precipitation and deposition models is required. Onset precipitation temperatures or cloud point temperatures in n-alkane mixtures can be successfully predicted by thermodynamic model using Entropic free-volume and UNIQUAC model to describe the nonideality in liquid and solid phase respectively (Coutinho, 1999). However, this work has been known that the thermodynamic model only provides the excellent prediction for *n*-alkanes systems but it does not give a good prediction for systems containing nonparaffinic solvents. Wax molecules precipitate out from a complex crude oil which consists of a wide range of hydrocarbons such as paraffins, naphthenes, and aromatics. Therefore, this study focuses on the precipitation of wax in different types of solvents and the modification of the thermodynamic model (Coutinho, 1999) to predict the precipitation. The modification is made on the residual contribution to the liquid phase activity coefficient. Three different types of organic solvents, aromatics, *n*-alkanes and cycloalkanes, were used. The cloud point temperature which is one of the most used parameters to study wax precipitation was studied in this work. The cloud point temperature or wax apperance temperature (WAT) is directly related to the solubility of wax in a fluid and defined as the temperature at which the first detectable paraffin molecule precipitates out when the mixture is gradually cooled.