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WISEST

women in scholarship, engineering, science & technology

"WISEST is a University of Alberta-based organization whose vision is to strengthen science by increasing gender diversity and to enhance choices in science, engineering, scholarship and technology for women of all ages..." [WISEST](#)

Each summer the Petroleum Thermodynamics Research Group hosts a WISEST student in our laboratory. This is an opportunity for WISEST students to test out engineering as a career and provides an opportunity for research team members to mentor others – an enriching and rewarding experience.

2008, Christina Law...../2

Christina Law

Sponsor: Alberta Research Council

“It allowed me to gain a first hand experience about some of the things that go on in engineering”

Chemical and Materials Engineering
Research Poster:

Interactions between Heavy Oil Fractions and Solvent Systems



“For my WISEST Summer Research Project, I was placed in the department of Chemical and Materials Engineering. I worked with Kasra Nikooyeh, a PhD student on observing the interactions of heavy oil fractions in solvent systems, in this case toluene and n-decane. Using an Paar DMA5000 oscillating tube densimeter, I obtained density measurements at 20, 50 and 80 degrees Celsius. This value was then used in a calculation to determine the specific partial molar volume. Molar volume is the volume a substance takes up per mole, and partial molar volume is the change in volume per mole of substance added to a solution. When these two values are compared, we can determine what kind of interaction is taking place between the molecules of the solute and the solvent. For example, if the partial molar volume is less than the molar volume, meaning that the volume increase is less than the total volume added, then we can determine that there is an attractive force between the molecules, resulting in a higher density, and lower volume than expected in an ideal solution. Whereas if the partial molar volume is greater than the molar volume, we can conclude that there is a repulsive force between the molecules, which is why the change in volume would actually be larger than the volume of solute added to the solution. However, because we are using heavy oil fractions, (Maya and Athabasca Asphaltenes, Athabasca bitumen, Athabasca bitumen vacuum bottoms and Athabasca maltenes) we cannot calculate their partial molar volumes because mole fractions and molar volumes of the heavy oil fractions are not definitive. This is why we use the density measurements to calculate the specific partial molar volumes, which is in volume per unit mass rather than per mole.

For this lab, I made solutions of each heavy oil fraction at infinite dilution, and took the density measurements at the different temperatures. These solutions ranged in concentration between 100 to

1000 ppm. The importance of infinite dilution is to ensure that the molecules of the solute do not aggregate. This allows us to obtain results strictly involving the interaction between the solute and solvent, preventing the solute molecules from interacting with each other. By plotting these values on a graph, the slope, y-intercept, and inverse density values, could be used to determine the specific partial molar volume. Based on our results, we were able to conclude that there is an attraction between the toluene molecules and the different solutes used. However, the results for the n-decane were inconclusive. The n-decane solutions were difficult to deal with because the solute would remain as a solid in the solution, and so frequent agitation was required to maintain the solid particles suspended within the solvent.

Studying the interactions of heavy oil fractions in solvent systems is important because it allows us to learn more about the properties of the different heavy oils. By knowing more about these properties, better methods of transportation and extraction of these resources can be developed. Increased efficiency results in decreased costs, making the study of heavy oil fractions beneficial to everyone.

This program was an incredible experience. It allowed me to gain a first hand experience about some of the things that go on in engineering, and furthermore, I was able to take a look at a variety of other fields related to the sciences which was not only interesting and mind opening, but fun and exciting as well.”

*Article/Picture Courtesy of WISEST
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