COLLEGE OF ENGINEERING
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Research and Creative Experience for Undergraduates Program (RCEU)
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Reactions at the Critical Point of Solution

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Introduction

Theory

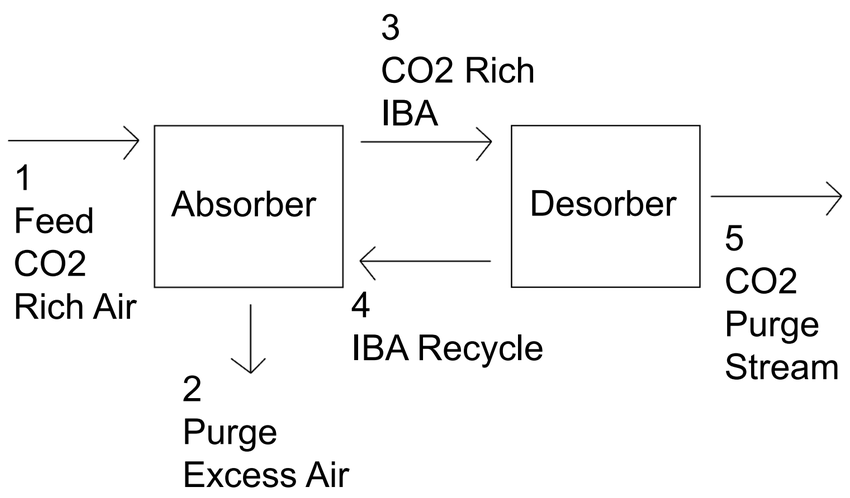
- In a system with three degrees of freedom, density variables, such as solubility, are expected to diverge when measured with respect to a field variable, such as temperature

Experiment

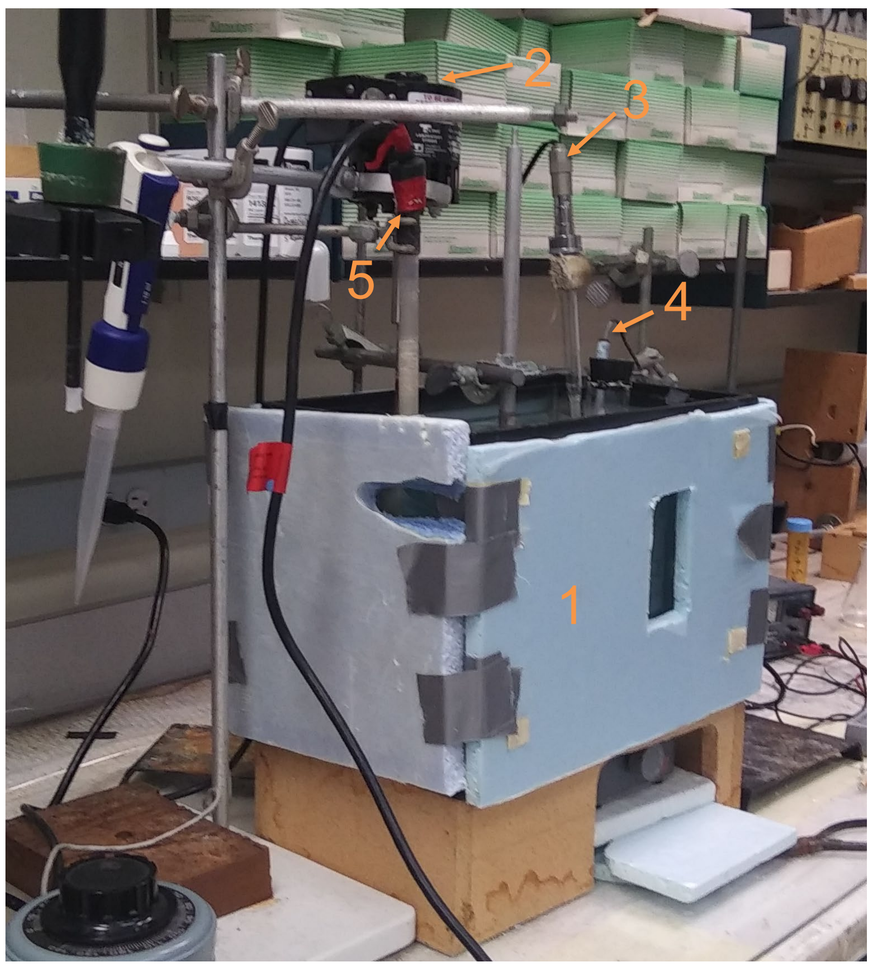
- Measure solubility of barium in isobutyric acid (IBA) and water mixture near the critical point and plot against temperature to see if the trend diverges

Methods

- Mix IBA and water at 38.8 mass percent IBA
- Add solid barium sulfate and stir bar
- Find local critical temperature
- Stir mixture for 24 hours
- Settle mixture for 24 hours
- Take three 5mL samples
- Raise the temperature, repeat stir, settle, and sample steps until enough samples have been taken (ongoing)
- Take samples to Western Kentucky University so Inductively Coupled Plasma Mass Spectroscopy can be used to determine barium concentration (ongoing)



1. Air containing CO2 is fed to the absorber. The CO2 is captured in a IBA-water mixture above its critical temperature
2. Air is removed in a purge stream
3. The IBA-water-CO2 mixture is sent to the desorber. It is cooled below the critical temperature and CO2 is released
4. The IBA-water mixture is recycled to the absorber
5. CO2 is removed from the system



The water bath used to hold the sample test tube

1. Insulation
2. Stirring Motor
3. Temperature Controller
4. Thermometer
5. Heating Element

Impact

One of the applications for critical phenomena our group is investigating is a process that uses the increased solubility of supercritical mixtures to capture CO2 from the atmosphere.

References

1. Baird, James K et al. “Phase Rule Classification of Physical and Chemical Critical Effects in Liquid Mixtures.” *Chemical physics letters* 729 (2019): 73–78. Web.

Acknowledgements

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