Chemical Engineering 475

Unit Operations Lab
Section 2

Introduction

Hard Work + The Spirit

Face the future with optimism. I believe we are standing on the threshold of a new era of growth, prosperity, and abundance. Barring a calamity or unexpected international crisis, I think the next few years will bring a resurgence in the economy as new discoveries are made in communication, ***medicine***, ***energy***, ***transportation***, physics, ***computer technology***, and ***other fields*** of endeavor.

Many of these discoveries, as in the past, will be ***the result of the Spirit whispering insights into and enlightening the minds of truth-seeking individuals***. Many of these discoveries will be made for the purpose of helping to bring to pass the purposes and work of God and the quickening of the building of His kingdom on earth today. With these discoveries and advances will come new employment opportunities and prosperity *for those who work hard and especially to those who strive to keep the commandments of God*. This has been the case in other significant periods of national and international economic growth.

-Elder M. Russell Ballard

BYU Idaho Commencement Remarks

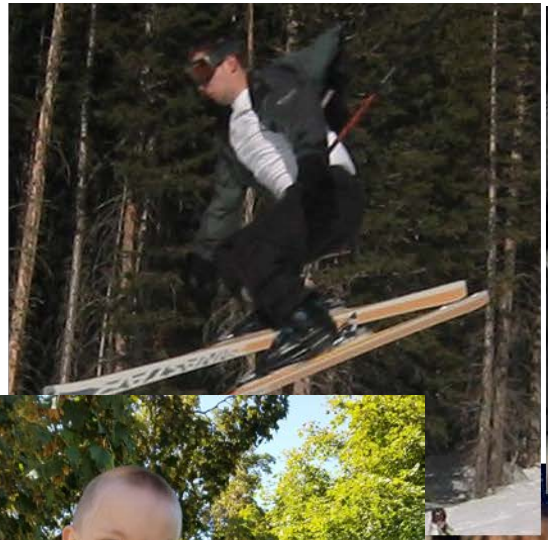
April 6, 2012

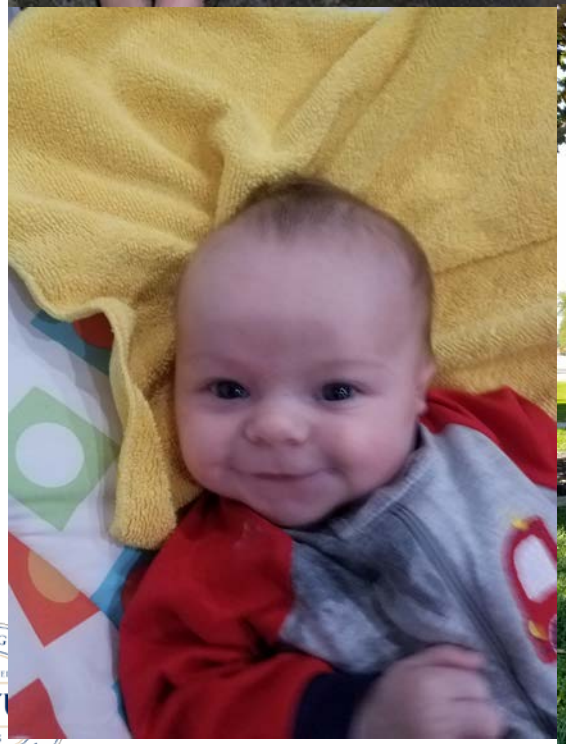
YOUR Destiny

"I am both hopeful and expectant that from this university there will rise brilliant stars in drama, literature, music, art, science, and all the scholarly graces. This university can be the refining host for many such individuals who in the future, long after they have left this campus, can lift and inspire others around the globe." –Spencer W. Kimball

"As I reread 'Education for Eternity' and the now-familiar charge to become a "refining host' for 'brilliant stars,' it struck me that President Kimball was thinking primarily about the accomplishments of BYU students, not faculty. After all, it is our students whose achievements will bless the world "long after they have left this campus." Likewise, it is our students who make up BYU's orchestras, orchestras that President Kimball predicts will one day rival in quality the Philadelphia Orchestra and the New York Philharmonic.[14] This does not mean that President Kimball lacks high expectations for faculty scholarship and creative work... It does mean that he anticipated that BYU's greatest contributions will come through its students." -John Tanner

Family





I am Ironman!

Schedule for Today

- Introduction
- Syllabus
- Notebooks
- Lab Tour/Safety Map
- LabVIEW Tutorial
- LabVIEW Assignment

Course Guidance

- TA: Johnny Williams
- http://uolab.groups.et.byu.net/che475.htm
- UO Lab has a reputation…
- Meant to be “industry simulator”
  - Writing is not a side-note in engineering!
  - Statistics are how data is validated
  - Great experience for real world applications
  - Find your own answers as much as possible!!!
- Open-Ended Problems
- Plagiarism/Ethics

Better Learning

"Make it Stick, The science of successful learning"

- Based on hundreds of rigorous studies
  - Re-reading/highlighting is least effective!
  - Most effective learning methods include:
    - Grouping knowledge into "concepts or principles"
    - Delayed Recall (i.e. quizzes/self quizzes)
    - Solving unfamiliar problems
    - Struggling through HARD problems
  - It's easy to ask for help first… DON'T!!!!

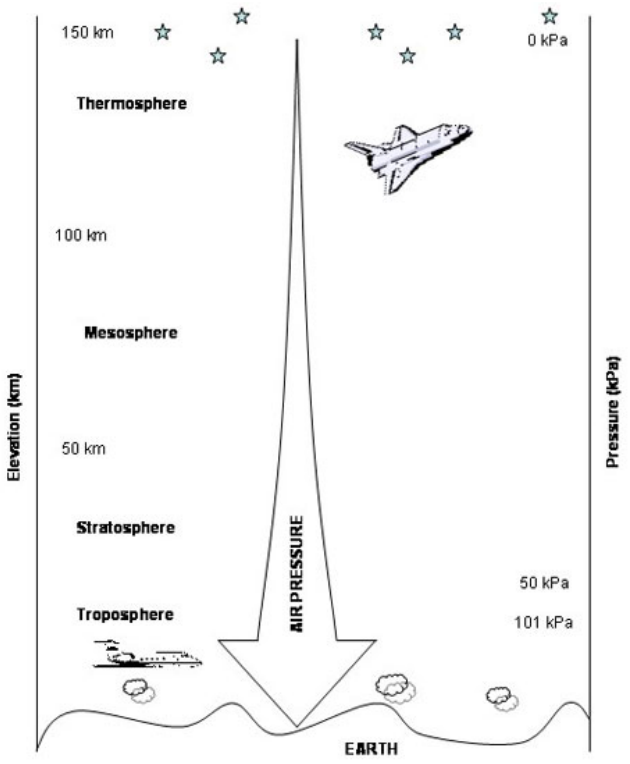
Open-Ended Problems (OEP)

- The world is made up of open-ended problems:
  - Who should I marry?
  - What is the average flight velocity of a coconut-laden swallow?
  - What is the best catalyst for a TCC?
  - How far could Aragorn safely toss a dwarf?
  - What do I need to power a geothermal microwave emitter?
  - What is the best investment strategy?
  - How can I optimize my errands and child transportation?
  - Should we resurrect the dinosaurs?
  - What is the best thermodynamic system for a nuclear power plant?
  - Seriously… how are they bringing Dr. Strange Back??

- No “exact, right” answer, though you can provide a reasonably close solution, and develop understanding.
- Key is to know HOW to solve, then check results
- School vs. the world (OEPs) – like swinging a baseball bat

Methodology

1. Find what the problem actually asking for
2. Draw a sketch of the problem region of interest
3. What physical laws/phenomena apply to the problem?
4. What equations can be used to represent the problem?
5. What variables/values do we know? What do we ***need*** to know?



Methodology (continued)

6. What assumptions need to/can be made?
7. What physical properties should be used?
8. Calculate the answer
9. **MOST IMPORTANT: CHECK AND VERIFY THE ANSWER!!**
   - Sanity check – is it reasonable?
   - Max/min check – is the range of solutions reasonable
   - Redo without an assumption – was assumption valid?
   - Check against known value – is it similar to other related problems?
   - Increase complexity and solve again – was simplicity justified?
   - Many, many, more!

Engineering Moment - Flowrates

- What does 1 gallon per minute look like? What does 100 gallons per minute look like?

- How big of a pipe do I need to get 5 gallons per minute? 30 gallons per minute?

What is UO Lab?

- UO Lab is:
  - A place to see real-world equipment
  - A place to apply the theory seen in classes
  - A place to practice writing
  - A place to practice designing experiments
  - A place to think deeply about practical applications
  - A place where, like the real world, data are not always consistent, things don't always work, and THINKING is required

What is UO Lab?

- UO Lab is:
  - A place to practice safety
  - A place to learn “new” things
  - A place to have fun
  - A place to practice statistics
  - A place to practice teamwork
  - A place to learn to please a “boss”
  - A place to learn the questions that should be asked
  - An active-learning class

What isn’t UO Lab?

- UO Lab is NOT:
  - A writing class
  - A plant design class
  - A statistics class
  - A choose-your-own adventure class
  - A problem-based-learning class

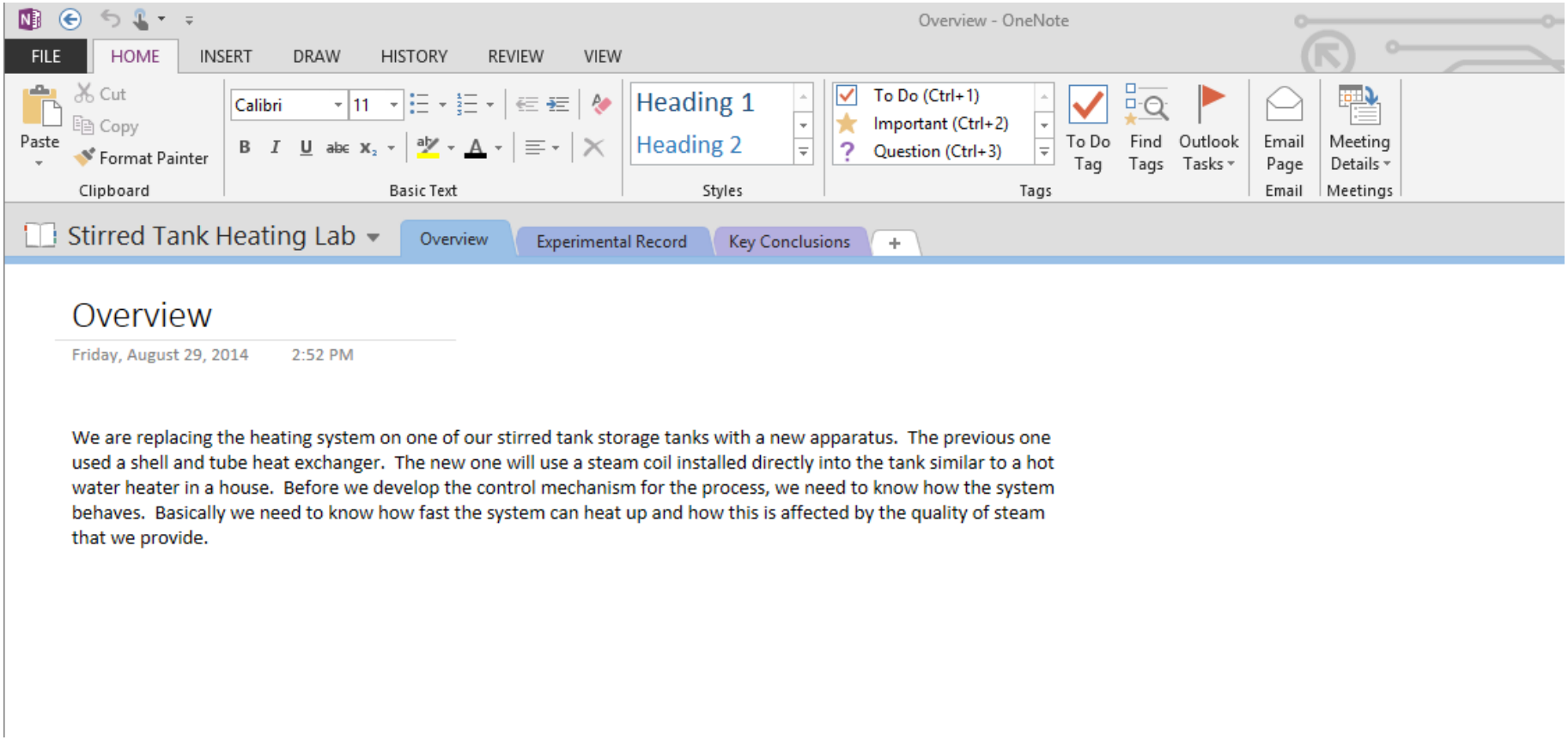
UO LAB IS A GREAT CLASS!!!!

YOU WILL GET OUT OF IT WHAT YOU PUT INTO IT!!!!

Syllabus

Notebooks

- Why?
- Is it applicable?
  - Grad School
  - PA Mines
- Personal and Institutional Memory
- Electronic Lab Notebooks are new norm
  - In our class, use Microsoft one-note (setup)
- Sections/pages
  - Overview
  - Experimental Record – Daily inclusions
    - Ambient temperature/pressure
    - Daily objective statement
    - Details of each experiment
    - Reasons for experiment
    - Raw Data
    - Observations
    - Sample Calculations
    - Graphs
    - Daily Summary
    - Signatures
  - Key Conclusions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Meeting Details
Meetings
Stirred Tank Heating Lab
Overview
Experimental Record
Key Conclusions
Overview
Friday, August 29, 2014 2:52 PM
We are replacing the heating system on one of our stirred tank storage tanks with a new apparatus. The previous one used a shell and tube heat exchanger. The new one will use a steam coil installed directly into the tank similar to a hot water heater in a house. Before we develop the control mechanism for the process, we need to know how the system behaves. Basically we need to know how fast the system can heat up and how this is affected by the quality of steam that we provide.

Day 2 - OneNote

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Thomas Knotts

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Stirred Tank Heating Lab ▾ Overview | Experimental Record | Key Conclusions

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Day 1

Day 2

Day 2

Tuesday, September 2, 2014 10:21 AM

Ambient Lab Conditions

Temperature: 20.1 °C
Pressure: 86.5 kPa

Daily Objective

Perform experiments to determine the overall heat transfer coefficient of the new heating system. Today we will hold the steam pressure fixed at 2.2 psig and perform as many experimental runs as time allows to obtain good statistical data.

Experiment 1

Steam Pressure: 2.2 psig

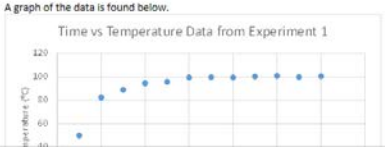
- We filled the tank with 300 gallons of water from the tap.
- The initial temperature of the water was 10 °C.
- We used a stop watch to time the data entry.
- We opened the steam valve at time t = 0.
- We recorded the temperature every 60 seconds.
- One person on the team watched the stop watch and called out when to read a data point.
- The second person read the temperature when time was marked and recorded the data.
- The data are below.

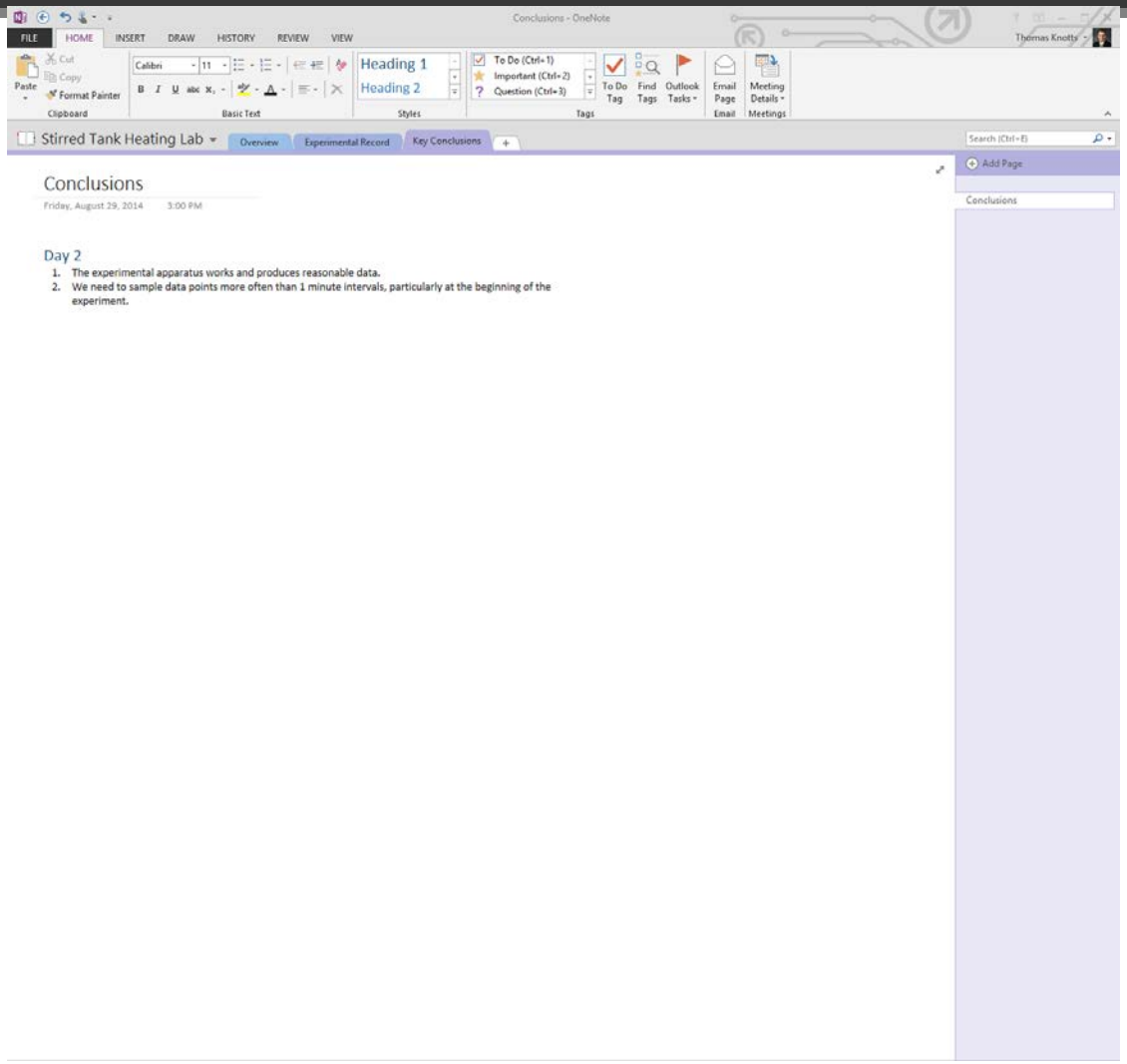
Time (min)	Temperature (°C)
0	16.0
1	49.9
2	82.3
3	88.9
4	94.6
5	95.8
6	99.6
7	99.8
8	99.6
9	100.3
10	100.9
11	99.9
12	100.5

Observations

- We stopped after 12 minutes as it seems like the system reached steady state.
- The speed at which the temperature achieved steady state surprised us. We expected it to take a longer time. It seems like our hot water heaters at home, that have a similar heating approach, take longer than this. Why?

A graph of the data is found below.




Conclusions - OneNote
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Meetings
Stirred Tank Heating Lab
Overview
Experimental Record
Key Conclusions
Search (Ctrl+E)
Add Page
Conclusions
Conclusions
Friday, August 29, 2014 3:00 PM
Day 2
1. The experimental apparatus works and produces reasonable data.
2. We need to sample data points more often than 1 minute intervals, particularly at the beginning of the experiment.

Lab Tour/Safety