**ME 332 Design Project 2**

**Fall 2016**

Due: November XX, 2016 by 12:00 pm to Rogers 334 (no late assignments)

Please slide the assignment under the door, or place on the shelving at the entrance to the room

**Problem:**

As part of your work in a small laboratory, you have identified a need to cool a 200 liter batch of a boiling solution down to 30 degrees C as quickly as possible, preferably in under 10 minutes. Unfortunately, your laboratory does not have a suitable heat exchanger available for use, and your project has a limited budget for purchasing new equipment. Thinking quickly, you decide to create a low cost heat exchanger using commercially available tubing and parts to cool your solution.

The solution will initially be kept in a cylindrical steel container approximately 0.5 m in diameter, with walls approximately 2 mm thick. The height of the cylinder is approximately 1 m. The container has a removable lid. The cylinder will be secured in place during the entire cooling process.

The ambient temperature at the laboratory is approximately 20 degrees C.

**You will need to determine:**

1. A cost effective method of cooling the solution of cooling the solution within the prescribed time.
2. The time that it will take for your solution to cool from 100 degrees C to 20 degrees C.
3. If the solution remains in bulk, the average temperature of the solution every 30 seconds.
4. The temperature of the inlet and outlet of the heat exchanger every 30 seconds.

**Assumptions:**

1. Assume that all properties of the solution are similar to water.
2. The material surfaces in the laboratory can be approximated as a gray condition.
3. The container that the solution has been placed in is not initially pressurized.
4. Assume that the container and the solution are initially at a uniform temperature throughout.

**Hints:**

1. You may make modifications to the steel container in any way necessary to support your design, however the modifications should also be cost effective.
2. The container may be either suspended in the air via a support stand, or placed on the ground. The available surfaces on the ground are either concrete or wood, and may be approximated as a semi-infinite solid.
3. The solution does not have to remain in the same container.
4. “Low cost” is purposefully not defined, however your solution is intended to be reasonable. Pumps, fans, fins, and materials, etc. will all add to the total cost of your solution.

**Deliverables:**

1. A detailed report containing a schematic of your proposed design for cooling the solution.
2. A spreadsheet and graph of the temperature every 30 seconds. If your design cools the solution too quickly to make a graph that accurately represents the temperature trends when graphed every 30 seconds, please graph the temperature in more frequent intervals.
3. Send the TA (Andrew Alferman, [alfermaa@oregonstate.edu)](mailto:alfermaa@oregonstate.edu)) an electronic copy of any spreadsheet or code used for your analysis.

**Report:**

Your report will be graded for being professional and complete. It is to be no longer than 2 pages (not including any appendices). You must convey the approach that you used, and identify any assumptions. Your report must include these sections for full credit: objective, approach (e.g. what equations or correlations did you use), design constraints, assumptions, performance (e.g. what rate of cooling did you obtain), and conclusions. Please include a schematic of your design in an appendix.

**Spreadsheet:**

Email a completed spreadsheet with the required temperature values and any code developed to Andrew Alferman ([alfermaa@oregonstate.edu)](mailto:alfermaa@oregonstate.edu)) by the deadline. Please include “ME 332 Design Project 2” in the subject line. Save worksheet as “LastName\_FirstName ME332 Design Project 2 Worksheet”.

**Grading:**

Correctness of your math and cost effectiveness of the solution: 20%

Correct approach: 45%

Professional report: 35%

**Expectations:**

You are encouraged to work with one partner in completing this assignment. However, you and your partner are to do your work individually (i.e. you cannot copy from other groups). You will submit one set of deliverables.