CHG 4343: Computer-Aided Design in Chemical Engineering

The Design Problem: Flash Separation

Code Due Date: December 1st by 4 pm[1]

Technical Report Due Date: December 11th by 4 pm

1 Introduction

Your chemical engineering consulting firm is working on their bid to design a massive petrochemical processing plant. You and your team of recently hired EITs were tasked with developing a simulation of a flash separation process as part of the broader design. The deadline to submit the bid is approaching fast, and other teams in your firm are constantly tweaking their portion of the process design. As such, the desired conditions in these flash tanks are always changing, such that your team's design must be able to accommodate any variety of flash separation scenarios. The general project specifications call for an object-oriented simulator that can read the given operating conditions for the flash operation and subsequently calculate the requested process outputs.

2 Project Objectives

The objectives of this project are three-fold:

1) to develop a JAVA-based simulator of a flash process;
2) to test and assess the robustness and flexibility of an anonymous group's simulator (more details of which will be provided at a later date); and
3) to write a detailed, technical report (see "Project Requirements and Details" document).

[1] Note: Your group will NOT be allowed to edit your code after this date.

The JAVA program must be able to perform the following calculations.

- Given the tank pressure, a specified constant operating temperature, the feed composition and flowrate, it can calculate the vapour and liquid product compositions and flowrates, as well as heat to maintain the operating temperature as specified.
- Given the tank pressure, the feed temperature, the feed composition and flowrate, it can calculate the adiabatic flash temperature of the mixture, the vapour and liquid product compositions and flowrates of the adiabatic flash.
- Given the tank pressure, flash temperature, feed composition and flowrate, it can calculate the adiabatic feed temperature, the vapour and liquid compositions and flowrates of the adiabatic flash.

All cases should consider the following:

- Ideal and non-ideal options to determine the vapour-liquid equilibrium data (K values);
- Bubble and dew point calculations to confirm that the flash separation is possible;
- Appropriate numerical methods and options.

The species mixture you will consider when testing and validating your design will consist of ethane, pentane, hexane, cyclohexane, water, and (non-condensable) nitrogen. However, **your design should be able to handle any number and type of chemical species**.

The program should be robust, generic, and extensible; and it should employ numerous aspects of object-oriented programming, including polymorphism, inheritance, interfaces, cloning, exception handling, and file I/O. (Note that your program may not *necessarily* incorporate all of these components to receive a passing grade, but the best project submissions will do so.) The validation must be thorough and convincing. As mentioned previously, this code will be submitted in late November and **cannot be edited** after the submission date.

3 Suggested Resources

For information on vapor/liquid equilibrium to determine the K values, please refer to your notes from *CHG 3326/3324 – Principles of Phase Equilibria and Chemical Reaction Equilibria/Fundamentals and Applications of Chemical Engineering Thermodynamics*. You may also consult any edition of the textbook by Smith et al. (Introduction to Chemical Engineering Thermodynamics)

Information on suitable numerical methods can be found in your notes from *CHG 3331 – Applications of Mathematical Methods to Chemical Engineering*. You may also consult the textbook by Chapra & Canale entitled Numerical Methods for Engineers (again, any edition will suffice).

You may also want to consult the following videos for inspiration on how to solve for flash separation:

- Adiabatic Flash of Binary Liquid by LearnChemE.
- Adiabatic Flash of Binary Liquid (Spreadsheet Solution) by LearnChemE.

4 Group Meetings

There will be two group meetings in which you and your team will meet with the teaching assistant to discuss progress on your project. You will be expected to have completed specified project milestones by each group meeting. Each group will need to submit to the assigned Brightspace assignment folder task allocation sheets and other requested materials **at least 24 hours** prior to each meeting.

All group members must attend the group meetings.

4.1 Meeting 1

Week of October 16

Requirements: a task allocation sheet, a plan of action, a preliminary code structure, and some initial coding must be submitted to the assigned Brightspace assignment folder in advance of the meeting.

4.2 Meeting 2

Week of November 13

Requirements: a task allocation sheet, a plan of action, the finalized code structure, and the majority of coding is to be submitted to the assigned Brightspace assignment folder in advance of the meeting.

5 Submission

Your final code must be submitted to the assigned Brightspace assignment folder and to Turnitin no later than 4 PM on December 1st.

The final report will be submitted through TurnItIn and to the assigned Brightspace assignment folder no later than 4 P.M. on December 11th. No other copies of the report will be accepted.

IMPORTANT: Please name your files according to the format in Table 1, or it will be assumed that your work was not submitted. This is done to facilitate navigation through dozens of files of submitted work.

Table 1: Format Requirements for Email Submissions

File	Naming Criterion
Report	Report_GROUPNUMBER.pdf
Compressed Folder Containing Code	Code_GROUPNUMBER.zip
Peer Evaluation	PeerEvaluation_LASTNAME
Additional Files	OneWordDescribingFile_GROUPNUMBER