McMaster Chemical Engineering (McChem Inc.)
1280 Main Street West
Hamilton, Ontario, L8S 4L7
Canada
http://learnche.mcmaster.ca

To:	Colleagues in Chemical Engineering 4N04
cc:	Myrto Korogiannaki, Heera Marway, Tyler Homer, and Dr. Thomas Marlin
Date:	29 October 2014
From:	Kevin Dunn
Subject:	**Memo 3: more details on the self-directed learning project**

Self-directed learning / Life-long learning

As mentioned in a prior memo, that because technology is continually changing, you must, as an engineering professional, keep engaging in life-long learning. This activity involves **identifying what you do not know**, what you need to learn, setting goals, and checking your achievements. In Chemical Engineering 4N04 we will refer to that process as Self-Directed Learning (SDL).

Let's recognize this project is not entirely "self-directed" since the instructor, the TAs and our external reviewer, Dr. Thomas Marlin, are providing direction. However, the project will help you build key learning and project management skills for engineering practice.

Meetings with your managers

In the coming week you will be meeting with myself, and in some meetings the TAs and/or Dr. Marlin may be present.

The meeting must have a written agenda, distributed ahead of time, be well-organized and chaired appropriately. The purpose of the meeting is for your group to:

1. clarify the work you need to perform on your project
2. demonstrate that your group has a plan in place to meet the deadlines, showing how you will all fairly contribute to reaching the SDL deliverables
3. obtain any answers to questions related to the SDL deliverables.

This meeting is graded, counting 15% of the SDL project grade. Grades are given for group attendance; quality of the agenda; quality of the follow-up minutes that are emailed to myself, the quality of your answers in the meeting.

Hints

Some questions you should consider in your groups to help guide your preparation:

- What is the operating principle of the major equipment (compressor, fired heaters, reactor, molten-salt loop, distillation column, switch condenser)? What is inside it; can you describe how it works to another engineering colleague? You may have covered each of these units in prior courses, and should be able to explain this. Are you sure every heat exchanger is a shell-and-tube exchanger?
- Pumps need motors; have you costed the pump and motor separately or together? Which other resources have you used for capital costs? (the Woods book does not everything you need).
- There are several pieces of equipment not shown on the block flow diagram that are required to make this process operable and environmentally sound and sustainable.

- Where will you add the necessary equipment to get flexibility in the flowsheet? What sort of steering tools and equipment are required?
- Demonstrate that you have considered reliability in the flowsheet by judicious use of redundant valves, pumps and units that require it (not everything is simply duplicated!)
- Which units are the most reliable in the flowsheet; which are the least reliable?
- What is driving material flow through the process (demonstrate that the driving forces make sense)?
- Where does everything coming into the process end up? If you had to draw a total mass balance boundary around the flowsheet, what species are leaving as product, and what as by-product? Which environmental and sustainability aspects must you consider, based on this overall balance?
- How are you going to detect and pick up process changes such as fouling, catalyst deactivation, reduced efficiency in pumps and distillation columns?
- How is the operating window found for various units in the flowsheet? What quantities would you select to plot on the x- and y-axes to start figuring out these various operating windows? Which ranges are reasonable to use?
- How will you start-up and shut down the the process? What is the exact sequencing for it? How are integrated units, such as furnaces, recycle streams and heat exchangers operated during this time? Which materials do you need to have pre-loaded in the units to get them to work when starting up? Follow the flowsheet from beginning to end, and critically evaluate how you will start up and shut down the process.
- What alternative ways are there of producing the product? Consider each major unit in the flowsheet; what alternative device could it be replaced with?
- Which other reliable and reputable references and resources have you found regarding the production of phthalic anhydride from naphthalene? What description of the reactors and distillation column do they give? Do those references describe a flowsheet that has similar operating temperatures and pressures to the ones shown in this flowsheet?
- In these references, what is inside the distillation column? What do you notice about the operating conditions for the columns?
- What values/parameters will you require to determine the ongoing **operating cost** for each unit? These values will have to appear in every period of your economic analysis.
- Where are the safety systems (or deficiencies in the safety systems)? Alarms, interlocks, and relief values will have to be added. Where are they instrumented, how are they operated, and reacted to? Where is containment for the relief systems? [We have not covered the Safety topic yet, but be aware that these issues must appear in your final report.]
- On which units would you run a HAZOP on this flowsheet?
- Do you observe the need for improving the process flow diagram? Can you add utility/energy integration (steam, electricity, chilled water), or consider different operating points to gain higher efficiencies?
- What special characteristics will you have to take into account to consider reducing the production of phthalic anhydride to half the production capacity? *Hint*: It is not just moving the feed flow to 50% of the prior value.

Sincerely,

Kevin Dunn