Should the Planet Pay the Price for Our Health?

Key Stage 4 Programme

Pupil Name

Handbook Designed by Dr. Berit S. Ahmad

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1			
2			
3			
4			
5			
6 (Feedback)			

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Write a summary of Life Cycle Assessment	
Tutorial 2	Benefits of recycling solvent	
Tutorial 3	Industrial case study and material balances	
Tutorial 4	Use of tertiary residue curve maps	
Tutorial 5	Final assignment	

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after midnight on	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

The Brilliant Club KS4 Programme – Pupil Feedback Report

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-Level
2:1	60-69	Performing to a good standard at AS-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Name of PhD Tutor	Dr. Berit S. Ahmad		
Title of Assignment			
Name of Pupil			
Name of School	Harris Academy Beckenham		
ORIGINAL MARK / 100		FINAL MARK / 100	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the PhD tutor should give an explanation in this section:

Learning Feedback Comment 1 - *Subject Knowledge*	
What you did in relation to this Key Learning Priority?	How you could improve in the future?
Learning Feedback Comment 2 – *Critical Thinking*	
What you did in relation to this Key Learning Priority?	How you could improve in the future?
Learning Feedback Comment 3 – *Written Communication*	
What you did in relation to this Key Learning Priority?	How you could improve in the future?
Resilience Comment	
How you showed learning resilience during the course?	How you could build learning resilience in the future?

Contents

Course Rationale	**P5**
Mark Scheme	**P6**
Glossary of Keywords	**P8**
Tutorial 1 Manufacturing of Life Saving Drugs	**P9**
Activity 1.1	**P9**
Activity 1.2	**P10**
Activity 1.3	**P10**
Homework 1	**P11**
Tutorial 2 Designing Chemical Processes	**P12**
Activity 2.1	**P12**
Activity 2.2	**P12**
Homework 2	**P13**
Tutorial 3 How Can Mathematics Help?	**P15**
Activity 3.1	**P15**
Activity 3.2	**P16**
Activity 3.3	**P17**
Homework 3	**P18**
Tutorial 4 Solvent Recovery Targeting	**P21**
Activity 4.1	**P22**
Activity 4.2	**P23**
Activity 4.3	**P24**
Homework 4	**P25**
Tutorial 5 Introducing Final Assignment	**P27**
Activity 5.1	**P27**
Homework 5	**P27**
Tutorial 6 Feedback Tutorial	**P29**
Reflection on feedback	**P29**
Appendices	**P31**
Referencing correctly	**P31**
Using the VLE	**P33**

Course Rationale

Together the pharmaceutical and specialty chemical industries make up more than 30% of the world's chemical market. In 2013 the UK pharmaceutical industry sold prescription drugs to the NHS worth more than £6.5 billion. One of the many challenges faced by this industry is the widespread use of solvent, a liquid used to dissolve other substances to aid in the chemistry. Solvent is used in a broad spectrum of unit operations from reaction (where the chemistry takes place and products are made) and separation (where the products are separated from the solvent) to washing and equipment cleaning. This course will provide an introduction to some of the analysis and design tools that can facilitate assessment and reduction of the environmental impacts of chemical manufacturing systems. In particular, we will be studying ways to improve recovery and recycling of solvents, and apply these techniques to an industrial case study.

The course will encourage the students to think critically about the trade-offs we make when manufacturing life-saving drugs both in terms of environmental impact and cost, as well as provide insight into what techniques are available and used to aid our decision making when designing chemical plants. The students will develop skills involved in independent research and scientific writing, skills that are vital for assessment in university and will give students a head start in their future academic carrier. The home-work after each tutorial is closely related to the topics covered. The final assignment will require the pupils to write a technical/engineering style document reporting on findings in the industrial case study. The outline of the report is designed such that thoughtfully completed home-works can be incorporated into the final assessment.

All assignments must be typed. Use font Times New Roman size 12, and 1.5 line spacing.

Mark Scheme Table

	Skills	1st (70-100)	2:1 (60-69)	2:2 (50-59)
Subject knowledge	Knowledge and Understanding	o All content included is relevant to the general topic and to the specific question. o Good understanding of all the relevant topics. o Scientific terms are defined and used accurately.	o Most of the content included is relevant to the general topic and to the specific question. o Good understanding of most of the relevant topics. o Scientific terms are used accurately but not always clearly defined.	o Some of the content included is relevant to the general topic and to the specific question. o Good understanding on some of the relevant topics. o Scientific terms are used mostly accurately with occasional confusion or not defined.
Critical thinking	Research and Evidence	o Use evidence and calculations to support claims and ideas, consistently clearly and convincingly. o Data is effectively analysed and appropriate conclusions are reached.	o Use evidence and calculations to support claims and ideas, mostly clearly and convincingly. o Data is analysed and the conclusions that are reached are mostly appropriate.	o Use evidence and calculations to support claims and ideas, at times clearly and convincingly. o There is an attempt to analyse data and reach conclusions.
	Developing an Argument	o A position is clearly established in relation to the question, and is developed effectively and consistently throughout the report. o Content is analysed effectively to support the argument.	o A position is established in relation to the question, and is well-developed in most of the report. o Analysis of content to support the argument.	o A position is established in relation to the question, and is well-developed in parts of the report. o Some analysis of content to support the argument.
	Critical Evaluation	o Moved beyond description to an assessment of the value or significance of what is described. o Evaluative points are consistently justified.	o Mostly description but some assessment of the value or significance of what is described. o Evaluative points are mostly justified.	o Only description with minimal assessment of the value or significance of what is described. o Evaluative points are at times justified.
Written communication	Structure and Presentation	o Ideas are presented in paragraphs and arranged in a logical structure that is appropriate for the assignment. o The introduction clearly outlines how the report will deal with the issues. o The conclusion summarises all the main points clearly. o All calculations, formulas and methods are clearly structured, clear to follow and correct. o All tables and graphs are well constructed including appropriate headings and units. o All sources are referenced correctly.	o Ideas are presented in paragraphs and arranged in a structure that is mostly appropriate for the assignment. o The introduction adequately describes how the report will deal with the issues. o The conclusion summarises most of the main points clearly. o Calculations, formulas and methods are mostly structured, clear to follow and correct. o Most tables and graphs are well constructed. o Most sources are referenced correctly.	o Ideas are presented in paragraphs and arranged in a structure. o The introduction mentions how the report will deal with the issues. o The conclusion summarises some of the main points clearly. o Calculations, formulas and methods are not always structured, clear to follow and correct. o Some tables and graphs are well constructed but contains some errors. o Some sources are referenced correctly.

	Language and Style	○ No spelling, grammar or punctuation errors. ○ Units and significant figures are presented accurately throughout. ○ Writing style consistently clear, appropriate for scientific documents and easy to follow. ○ Accurate and consistent use of technical language and vocabulary.	○ Minimal spelling, grammar or punctuation errors. ○ Units and significant figures are presented accurately throughout. ○ Writing style mostly clear, appropriate for scientific documents and easy to follow. ○ Some attempts of using technical language and vocabulary, but not always accurate.	○ Some spelling, grammar or punctuation errors. ○ Units and significant figures are presented accurately throughout with occasional errors. ○ Writing style moderately clear, appropriate for scientific documents and easy to follow. ○ Use of simple language and vocabulary effectively, but lack use of technical language.

Glossary of Keywords

Word	Definition	In a sentence

Tutorial 1 – Manufacturing of Life Saving Drugs

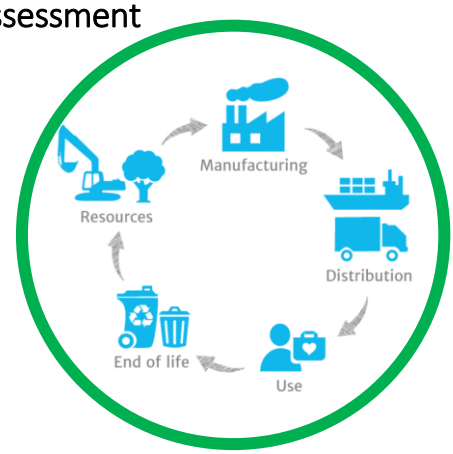
What is the Purpose of Tutorial 1?

- To understand how life saving drugs are made.
- Understand the roles of Environmental policies and regulations.
- To introduce the concept of Life Cycle Assessment.
- Discussion: Profit versus the Environment – The moral dilemma.

Activity 1.1 – How are life saving drugs made?

Activity 1.2 – Understanding the roles of environmental policies and regulations

Activity 1.3 – Life Cycle Assessment



	LCA Stages	Definition
1	Extraction of Resources	
2	Manufacture of Product	
3	Distribution	
4	Use of Product	
5	Disposal of Product	

Tutorial 1 Homework – Write a summary of Life Cycle Assessment

Based on the literature handed out in today's tutorial, write a 300 word summary on the purpose of Life Cycle Assessment, including a description of its five phases.

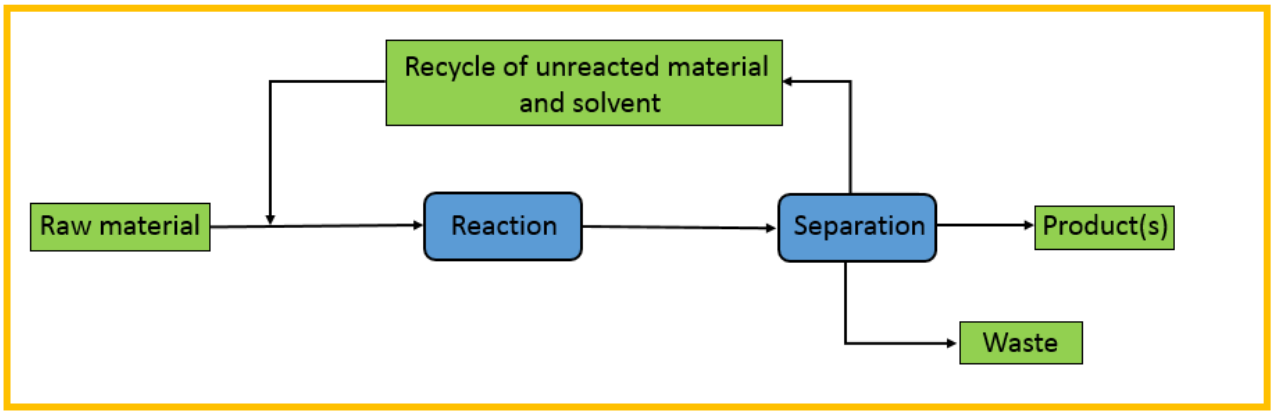
This is how you should cite the articles:

Curran, Mary. (2015). Life Cycle Assessment: A Systems Approach to Environmental Management and Sustainability. Chemical Engineering Progress. 11. 26-35.

Curran, M. A., 2016. Life Cycle Assessment. Kirk-Othmer Encyclopedia of Chemical Technology. 1-28.

Notes

Tutorial 2 – Designing Chemical Processes



What is the Purpose of Tutorial 2?

- To understand how different parameters and trade-offs influence our decision making.
- To understand what a chemical process may look like.
- Introduce the role of solvents in the manufacturing of drugs.
- To understand the purpose and obstacles to recycling solvent.

Activity 2.1 – Understanding trade-offs

Use Google Maps to look at options for traveling from Harris Academy Beckenham and the London Eye. Variables to consider are modes of transportation, distance, time, time of day, etc. Complete the table below. Include pros and cons. Which travel option would you chose and why?

Mode of Transportation	Time	Cost	Pros	Cons
Car				
Bus / train				
By foot				
By bike				

Activity 2.2 – Trade-offs versus constraints

Write a paragraph explaining the difference between trade-offs and constraints. Use the production of life-saving drugs and the use of solvent in the manufacturing as an example of how constraints and trade-offs may effect our process design.

Tutorial 2 Homework – Benefits of recycling solvent

Imagine that you are a chemical engineer working for a pharmaceutical company. Write a persuasive paragraph of about 300 words for why the company should recover and recycle as much solvents as possible. Explain the benefits of recycling solvents, and use convincing arguments for why it is beneficial for the company to have a "green" profile. Cite any relevant sources.

Notes

Tutorial 3 – How Can Mathematics Help?

Conservation of Mass:
"What goes in, must come out!"

What is the Purpose of Tutorial 3?

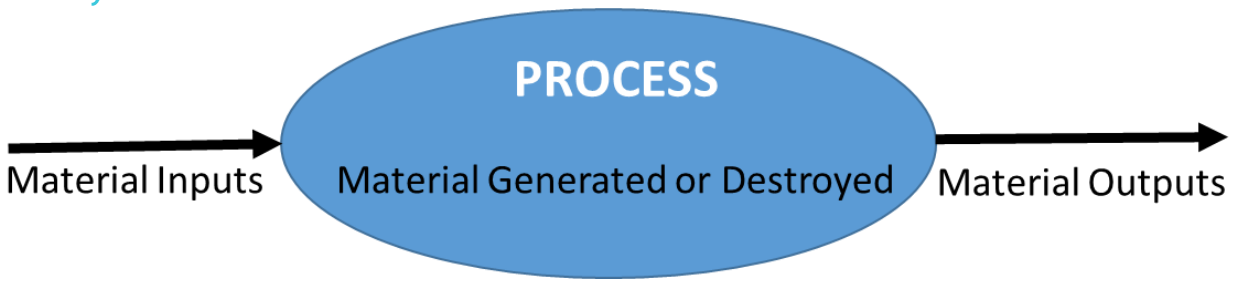
- To discuss the difference between batch processes and continuous processes.
- To understand how material balances work.
- To introduce the industrial case study.

Activity 3.1 – Batch versus continuous processing

Definition of a Continuous Process:

Definition of a Batch process:

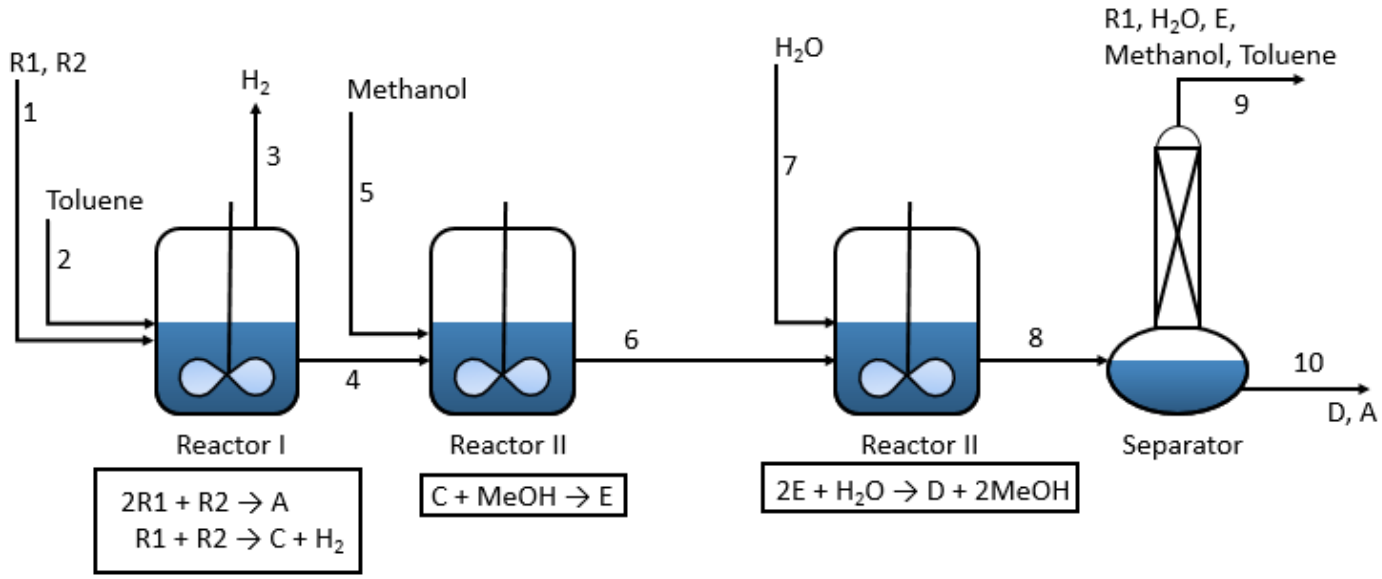
Activity 3.2 – Material balances



Problem: A chemical plant produces an aqueous solution of sodium hydroxide that is 20.0% NaOH by mass. The company desires to produce a batch of 8.0% NaOH solution by diluting the 20.0% solution with pure water. How much each of pure water and 20.0% NaOH is required to produce 2310 kg of the 8.0% NaOH solution?

Activity 3.3 – Introducing the industrial case study

Production of Siloxane Monomer



Complete the table below by answering the following questions about the process:

a) Of the input streams, which streams supply raw material and which streams supply solvents?
b) Of the output streams, which are products and which are waste streams?

For each entry in the table, include the stream number and the specific materials (components) in the stream.

Input Streams				Output Streams			
Raw Material		Solvent		Product		Waste	

Tutorial 3 Homework – Industrial case study and material balances

Consider the process diagram of the production of siloxane monomer above when answering the following questions:

1. In Reactor I, assume that all the R2 added is used up in the reactions, while there will be excess R1 leaving the reactor. All the Hydrogen gas is vented off in Stream 3. Toluene is only added as a solvent, and do not get consumed in any of the reactions. Which components would you expect to find in Stream 4?

2. Calculate the composition as % by mass of Stream 4. Assume the following:
   i. Product A is removed from Stream 4, so you only need to include Toluene, C, and R1 in your calculations.
   ii. 320kg of R1 is added to Reactor I, and 90% is consumed in the reactions.
   iii. 400kg of Toluene is added to Reactor I.
   iv. 45% of the consumed R1 goes to make Product C.

3. In Reactor II Methanol is added as a solvent, but also serves as a reactant, labelled MeOH in the reaction. Assume that there is a lot of Methanol leaving the reactor. Which components would you expect to find in Stream 6?

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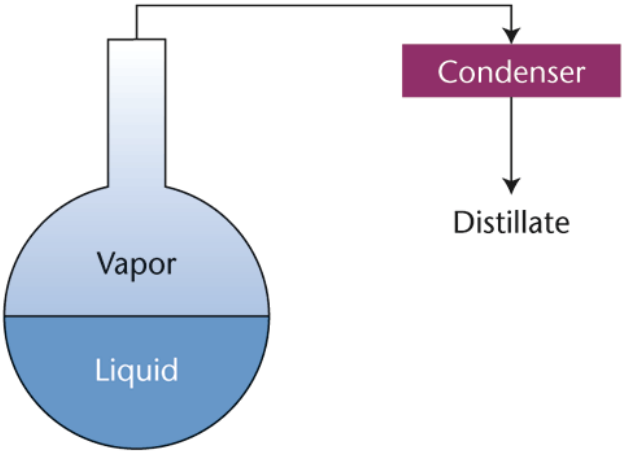
Tutorial 4 – Solvent Recovery Targeting

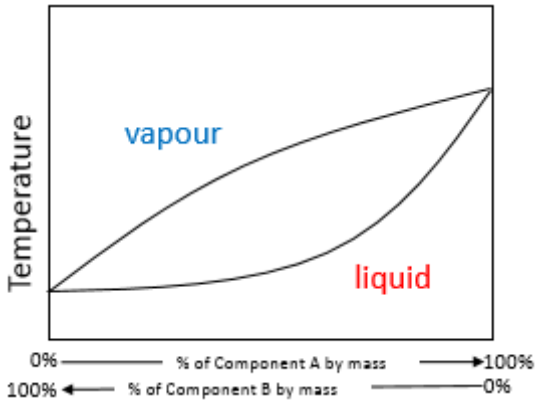


What is the Purpose of Tutorial 4?

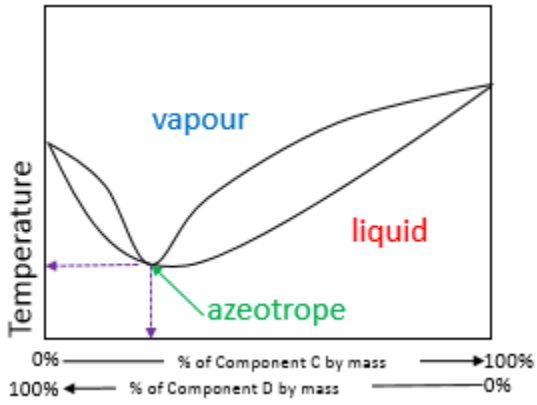
- To learn about batch distillation, and to understand how vapour-liquid equilibrium works.
- To understand the implications of azeotropes in a mixture.
- To introduce and learn how to extract information from tertiary residue curve maps.
- To learn how to use a residue curve map to determine the "best" distillation sequence.

Activity 4.1 - Vapour–liquid equilibrium phase diagrams

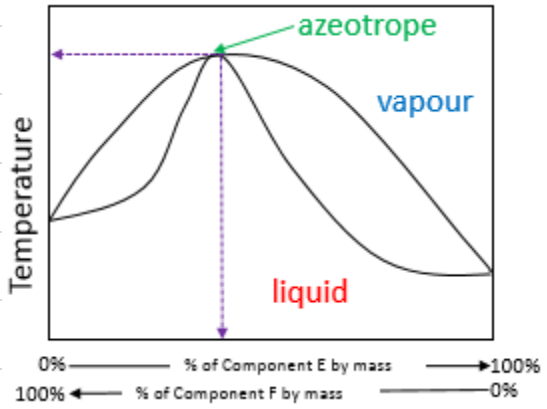
a) No azeotrope.



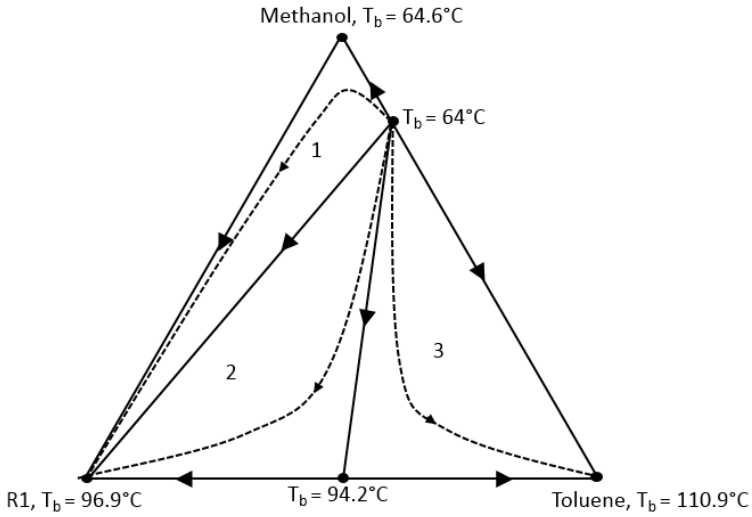
b) Minimum boiling azeotrope.



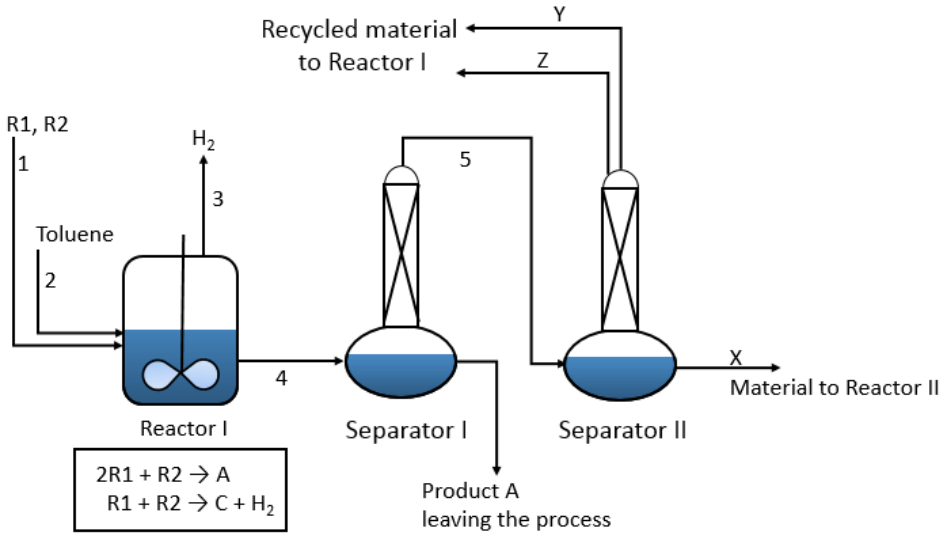
c) Maximum boiling azeotrope.

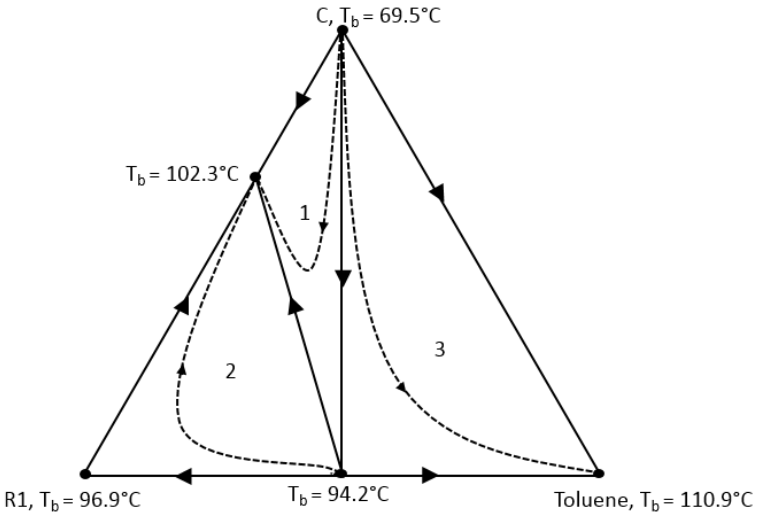


Activity 4.2 – Tertiary residue curve maps



Activity 4.3 – Improving the design: Integration of solvent recovery using batch distillation





Tutorial 4 Homework – **Use of tertiary residue curve maps**

For the siloxane monomer process, consider the proposed solvent recovery scheme discussed in Activity 4.3 in class. Assume that we separate out product A in Separator I. Hence, stream 5 consists of toluene, unreacted R1, and product C. We want to separate out pure C in Separator II, and also separate out Toluene and unreacted R1 which will be recycled back to Reactor I. Use the residue curve map for Toluene, R1, and C to answer the following questions:

1. For each distillation region, state the product sequence.
2. Which region(s) do we want the composition of the stream leaving Reactor 1 (Stream 5) to be located in to allow us to separate out pure component C?
3. Pick your recommended region and explain why you think it is the best option.
4. Assuming that the mass of Stream 5 is 540 kg, and that the composition is 70% Toluene, 25% C, and 0.05% R1, calculate the amount of material in Streams X, Y, and Z.
5. In the original process, Streams Y and Z would have ended up as part of Stream 9, which would require treatment in a special waste treatment facility at an additional cost. What is the % by mass reduction in waste by integrating solvent recycling into the process? Use the value for Stream 9 estimated in class.

Notes

Tutorial 5 – Introducing Final Assignment

What is the Purpose of Tutorial 5?

- Discuss our options for solvent recycling in the industrial case study. What are the pros and cons?
- Introduce the final assignment

Activity 5.1 - Options for solvent recycling

Tutorial 5 Homework - Final assignment

For your final assignment you are going to write a technical/engineering style document reporting on our findings from the industrial case study. A template and specifications for required elements in the report will be provided.

Elements that are required includes:

- A summary on the purpose of Life Cycle Assessment
- The benefits of recycling solvent
- A description of batch distillation and how we can use tertiary residue curve maps to improve solvent recovery and recycling.
- Detailed description of the findings of the industrial case study.

You will have the opportunity to discuss your report with your tutor before submission. Speak to you tutor to arrange an individual meeting at a mutually convenient time.

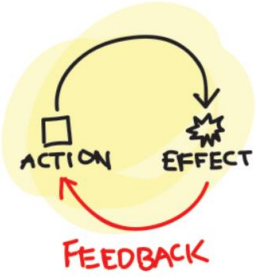
Notes

Tutorial 6 – Feedback Tutorial

"We all need people who will give us feedback.

That's how we improve."

- Bill Gates -



What is the Purpose of Tutorial 6?

- To receive feedback on final assignment.
- To share examples of best practice with the other pupils in your group.
- To write targets for improvement in school lessons.
- To reflect on the programme including what was enjoyed and what was challenging.

Final assignment feedback

What I did well…	What I could have improved on…
•	•
•	•
•	•

My target for future work is…

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?
• • • •

What did you find challenging about the programme?	How did you overcome these challenges?
• • • •	• • • •

Appendix 1 – Referencing correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps to prevent you losing marks, or failing, due to plagiarism.

When should I use a reference?

You should use a reference when you:

- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

1. **A marker in your assignment**: After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with a number, e.g. [1]. The next time you use a reference you should use the next number, e.g. [2].
2. **Bibliography**: This is just a list of the references you have used in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.

    a. **Websites** – Author (if possible), title of the web page, website address, [date you accessed it, in square brackets].

    E.g. Dan Snow, 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].

    b. **Books** – Author, date published, title of book (in italics), pages where the information came from.

    E.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.

    c. **Articles** – Author, 'title of the article' (with quotation marks), *where the article comes from* (newspaper, journal etc.), date of the article.

    E.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', Guardian, 10 July 2014.

Appendix 2 – Using the VLE

VLE username	
VLE password	

Please remember the following key details…

- You are able log into the VLE either through the link on our website (www.thebrilliantclub.org) or going directly to the VLE site at (https://portal.thebrilliantclub.org/sign-in).
- Please update your profile with your full name and email address- this will allow you to retrieve forgotten passwords or usernames
- If you forget your log-in details you can request them to be emailed to you by clicking the link on the VLE home page. (If you are still having problems you can email: schools@thebrilliantclub.org)

What is the VLE?

The VLE is a virtual learning environment for all pupils on Uni Pathways. It is used for:

- messaging your tutor
- submitting homework
- submitting your final assignment
- accessing resources for your tutorials
- finding out more information about university and careers

How should I use the VLE?

The VLE is a professional academic environment in which pupils are able to message their PhD Tutor. Here are a few things to consider:

- Ensure you keep a professional tone in the messages you send to your tutors.
- Ensure you always reply to your tutors in a timely manner.
- Thank your tutor for the effort they are putting in to give you your feedback etc.
- Submit all homework to your tutor on time.

IMPORTANT: Final assignment

- When you submit your final assignment, please remember that you need to do so through the 'My Activities' tab and not as an attachment to a message.

Notes

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