Rigorous Distillation

Spoken Tutorial Project
http://spoken-tutorial.org

National Mission on Education through ICT
http://sakshat.ac.in

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Learning Objectives

We will simulate a rigorous distillation column:

- **Specify column pressure profile**
- **Specify tray efficiencies**
- **Check if product compositions are achieved**
- **View column profiles**

System Requirements

- **DWSIM 3.4**
- **Any OS: Windows, Linux, Mac OS X or FOSSEE OS on ARM**

Prerequisites

To practice this tutorial you should know

- **How to open a file in DWSIM**
- **How to add components to a flowsheet**
- **How to select thermodynamic packages**
- **How to add material, energy streams**

Prerequisite Tutorials and Files

- **http://spoken-tutorial.org gives details of prerequisite tutorials**
- **The prerequisite tutorials are available at this website**
- **All associated files are also available at this site**

Problem Solved in a Prerequisite Tutorial: shortcut-end.dwxml

Components	Benzene, Toluene	
Feed	Flow rate	100 Kmol/h
	Mole fraction	$x_F = 0.4$
	Temperature	Saturated liq.
	Pressure	1 atm
Reflux ratio	2	
Product	Distillate	$x_D = 0.95$
	Bottoms	$x_B = 0.05$

We get the following solution:

Parameter	Value
Min. reflux ratio	1.47
Min. no. of stages	7
Actual no. of stages	14
Optimal feed location	6
Bottoms product rate	61.1 kmol/h

Our solution approach

- **Thermodynamics: Raoult's law**
- **Method: Fenske-Underwood-Gilliland**

Summary

- We learnt how to simulate a rigorous Distillation column:
- Specified pressure profile
- Found out where to give tray efficiencies
- Verify the column profiles

Assignment 1: Constant Pressure

- **Repeat the calculations for a constant column pressure of 1atm.**
- **That is, with reboiler pressure = 1 atm.**
- **Do you see major changes in the results?**

Assignment 2: Increase Reflux

- **Simulate the distillation column at a constant pressure of 1atm.**
- **That is, the reboiler pressure also is at 1atm.**
- **If the reflux ratio is increased beyond 2, does the purity improve?**
- **What reflux ratio should you use, if the actual purity is as desired.**
- **In a future tutorial, we will show how sensitivity analysis can help do this**

Assignment 3: Increase Trays

- **Simulate the column at reflux ratio = 2.**
- **Keep the column pressure constant at 1atm.**
- **Increase the number of trays by 1.**
- **As the number of trays has changed, you have to use the interpolate option.**
- **This was mentioned earlier also.**
- **With a larger number of trays, has the purity increased?**

Assignment 4: Condenser Composition

- **Verify the following relationship:**
- **Composition of vapour flow to the condenser = distillate product composition**
- **Explain why this equation has to be satisfied.**

Assignment 5: Consistency check of reboiler

- **Check the consistency of compositions, temperature and pressure at the reboiler.**
- **Do this through an equivalent flash calculation.**

Assignment 6: Different Solution Methods

- **Solve the distillation column by different solution methods**
- **Compare the answers**
- **Compare the computation times**

About the Spoken Tutorial Project

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The Spoken Tutorial Project Team

- **Conducts workshops using spoken tutorials**
- **Gives certificates to those who pass an online test**
- **For more details, please write to contact@spoken-tutorial.org**

Forum to answer questions

- **Do you have questions in THIS Spoken Tutorial?**
- **Choose the minute and second where you have the question.**
- **Explain your question briefly.**
- **Someone from the FOSSEE team will answer them.**

Please visit http://forums.spoken-tutorial.org/

Textbook Companion Project

- **The FOSSEE team coordinates coding of solved examples of popular books**
- **We give honorarium and certificate to those who do this**

For more details, please visit this site:

http://dwsim.fossee.in/Textbook_Companion_Project

Lab Migration Project

- **The FOSSEE team helps migrate commercial simulator labs to DWSIM**
- **We give honorarium and certificates to those who do this**

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http://dwsim.fossee.in/lab-migration-project

Acknowledgements

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- **More information on this mission is available at**

  http://spoken-tutorial.org/NMEICT-Intro

Thanks!

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