

# Shell & Tube Heat Exchanger

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

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

Kaushik Datta & Priyam Nayak  
IIT Bombay

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# Learning Objectives

**In this tutorial, we will learn to:**



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- Simulate **Shell & Tube Heat Exchanger**



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- Calculate **Outlet stream temperatures**
- Calculate **Overall Heat Transfer Coefficient**
- Calculate **Heat Exchange Area**
- Calculate **Thermal Efficiency and**



# System Requirement





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- DWSIM v 4.3



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- Windows 7



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- DWSIM v 4.3
- Windows 7
- Any OS: Linux, Mac OS X or FOSSEE OS on ARM



# Prerequisites

To practice this tutorial, you should know



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- Add components to a **flowsheet**



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- Select **thermodynamic** packages



# Prerequisites

To practice this tutorial, you should know

- Add components to a **flowsheet**
- Select **thermodynamic** packages
- Add **material** stream and specify their properties



# Prerequisite Tutorials and Files

- <http://spoken-tutorial.org>
- You can access these tutorials and all the associated files from this site





# Compounds and Inlet stream conditions

Compounds	Water, Methanol	
Inlet Streams	Cold( $\text{H}_2\text{O}$ )	Hot( $\text{CH}_3\text{OH}$ )
Mass Flow	15000 kg/h	25000 kg/h
Mole Fraction	$x_{\text{CH}_3\text{OH}} = 0$	$x_{\text{CH}_3\text{OH}} = 1$
Mole Fraction	$x_{\text{H}_2\text{O}} = 1$	$x_{\text{H}_2\text{O}} = 0$
Temperature	$10^\circ\text{C}$	$80^\circ\text{C}$
Pressure	1 bar	5 bar



# Heat Exchanger Properties and Property Package

<b>Flow type</b>	<b>Counter Current</b>
<b>Overall HT Coefficient</b>	<b>450 W/[m<sup>2</sup>.K]</b>
<b>Heat Exchanger Area</b>	<b>250 m<sup>2</sup></b>
<b>Cold Fluid Pressure Drop</b>	<b>0.002 bar</b>
<b>Hot Fluid Pressure Drop</b>	<b>0.025 bar</b>
<b>Package</b>	<b>Raoult's Law</b>



# Shell & Tube Exchanger Properties

Type of Exchanger	2-8 Shell % Tube
Total no of tubes	2048
Tube Spacing	25 mm
Tube Layout	Square
Thermal Conductivity	60 W/mK
Tube Roughness	0.05 mm
Fouling Factor (Tube)	0.00035 Km <sup>2</sup> /W
Fouling Factor(Shell)	0.00035 Km <sup>2</sup> /W



# Shell & Tube Exchanger Properties

<b>External Diameter for tube</b>	<b>20 mm</b>
<b>Tube thickness</b>	<b>2.5 mm</b>
<b>Tube Length</b>	<b>5 m</b>
<b>Shell Internal Diameter</b>	<b>1000 mm</b>
<b>Baffle Spacing</b>	<b>250 mm</b>
<b>Baffle Cut</b>	<b>25%</b>
<b>Fluid in Shell</b>	<b>Methanol</b>



# Summary

In this tutorial, we have learnt to:

- Simulate Shell & Tube Heat Exchanger
- Calculate Outlet stream temperatures
- Calculate Overall Heat Transfer Coefficient
- Calculate Heat Exchange Area
- Calculate Thermal Efficiency and



# Assignment

Compounds	Toluene, Styrene	
Inlet Streams	Cold( $C_7H_8$ )	Hot( $C_8H_8$ )
Mass Flow	50000 kg/h	70000 kg/h
Mole Fraction	$x_{C_7H_8} = 1$	$x_{C_7H_8} = 0$
Mole Fraction	$x_{C_8H_8} = 0$	$x_{C_8H_8} = 1$
Temperature	$35^\circ C$	$150^\circ C$
Pressure	6.5 bar	3.5 bar



# Assignment

<b>Flow type</b>	<b>Counter Current</b>
<b>Cold Fluid Pressure Drop</b>	<b>0.002 bar</b>
<b>Hot Fluid Pressure Drop</b>	<b>0.025 bar</b>
<b>Package</b>	<b>UNIFAC</b>



# Assignment

<b>Type of Exchanger</b>	<b>2-16 Shell % Tube</b>
<b>Total no of tubes</b>	<b>1024</b>
<b>Tube Spacing</b>	<b>75 mm</b>
<b>Tube Layout</b>	<b>Square</b>
<b>Thermal Conductivity</b>	<b>70 W/mK</b>
<b>Tube Roughness</b>	<b>0.045 mm</b>
<b>Fouling Factor (Tube)</b>	<b>0 Km<sup>2</sup>/W</b>
<b>Fouling Factor(Shell)</b>	<b>0 Km<sup>2</sup>/W</b>





# Assignment

<b>External Diameter for tube</b>	<b>60 mm</b>
<b>Tube thickness</b>	<b>5 mm</b>
<b>Tube Length</b>	<b>5 m</b>
<b>Shell Internal Diameter</b>	<b>990.6 mm</b>
<b>Baffle Spacing</b>	<b>250 mm</b>
<b>Baffle Cut</b>	<b>25%</b>
<b>Fluid in Shell</b>	<b>Styrene</b>



# About the Spoken Tutorial Project

- Watch the video available at [http://spoken-tutorial.org/What\\_is\\_a\\_Spoken\\_Tutorial](http://spoken-tutorial.org/What_is_a_Spoken_Tutorial)
- It summarises the Spoken Tutorial project



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- If you do not have good bandwidth, you can download and watch it



# Spoken Tutorial Workshops

## 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](mailto:contact@spoken-tutorial.org)



# Forum for specific questions

- Do you have questions in this Spoken Tutorial?
- Please visit <http://forums.spoken-tutorial.org>
- Choose the minute and second where you have the question
- Explain your question briefly
- Someone from the FOSSEE team will answer them



# DWSIM Flowsheeting Project

- The FOSSEE team coordinates conversion of existing flow sheets
- We give honorarium and certificates for those who do this
- For more details, please visit this site  
<http://dwsim.fossee.in/flowsheeting-project>



# Textbook Companion Project

- The FOSSEE team coordinates coding of solved examples of popular books
- We give honorarium and certificates for 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 for those who do this
- For more details, please visit this site  
<http://dwsim.fossee.in/lab-migration-project>





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- **Spoken Tutorial and FOSSEE projects are funded by NMEICT, MHRD, Government of India**



# Thanks

- Thanks for joining

