DWSIM Simulation

(Mobile Version) – Part #8 by Keren Perulu

Simulation of Heat Exchanger Using “Heater” and “Cooler” Blocks

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Objective

Develop a simple process flow sheet to simulate heat exchanger using "heater" and "cooler" blocks and determine the heat duty and exit temperature of a stream.

Data:

Problem statement (Adapted from Example 13.7, Seider et. al., 2008)

Hot Stream Fluid: Styrene

Molar Flow rate = 150000 lb/h

Inlet Temperature = 300 deg F

Exit Temperature = 178 deg F

Pressure = 50 psia

Cold Stream Fluid: Toluene

Molar Flow rate = 125000 lb/h

Inlet Temperature = 100 deg F

Pressure = 90 psia

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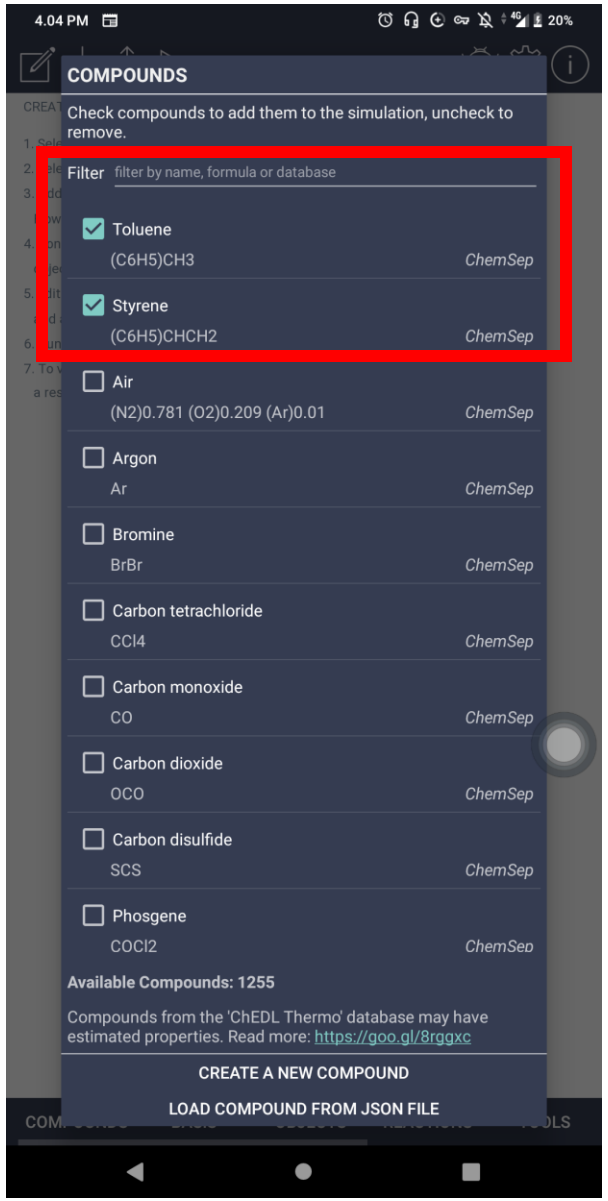
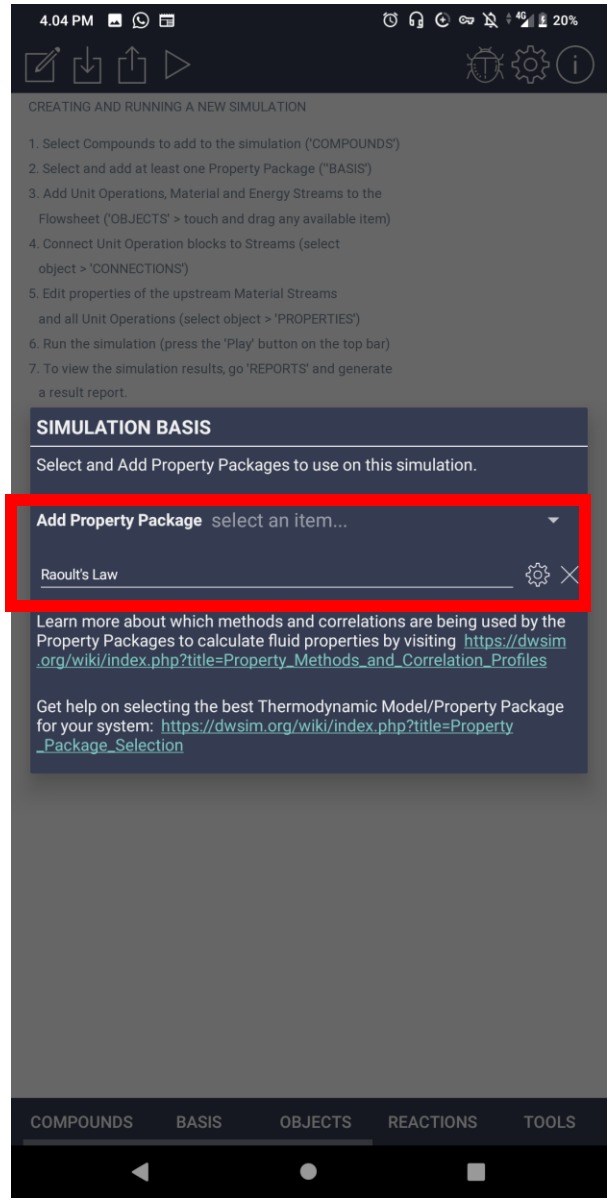
Procedure

1. Open the DWSIM app
2. On the home screen select the **COMPOUNDS** menu and Add the two components required for simulation - Toluene and Styrene. Ensure that all the components are added from the same property package. (Example: All the components are selected from the *Chemsep database*).
3. Specify the thermodynamic package.





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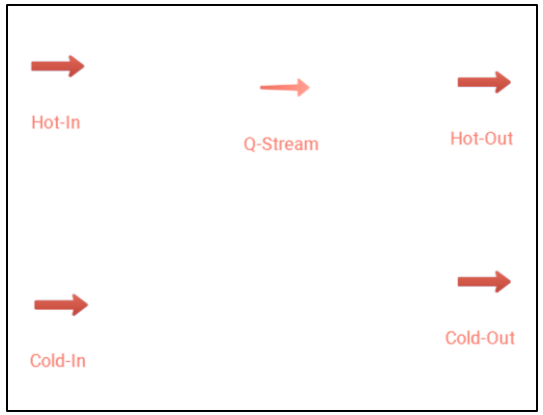
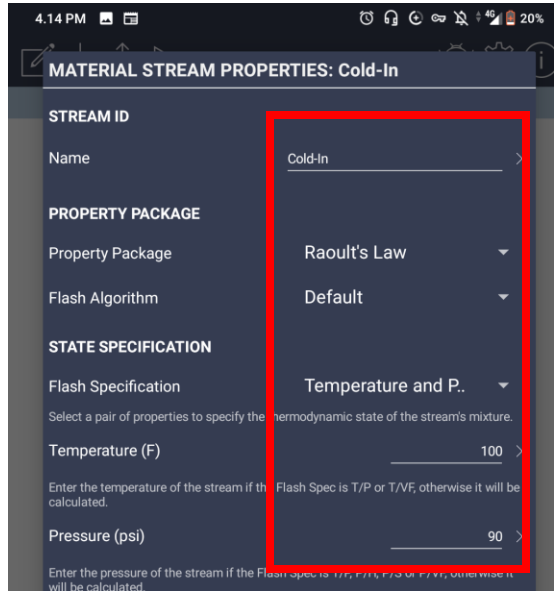
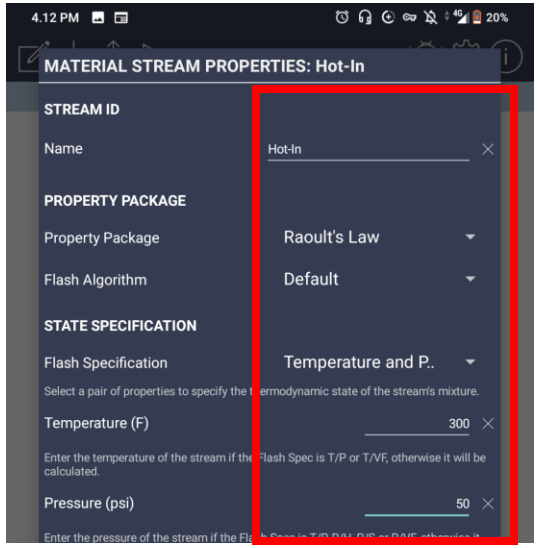
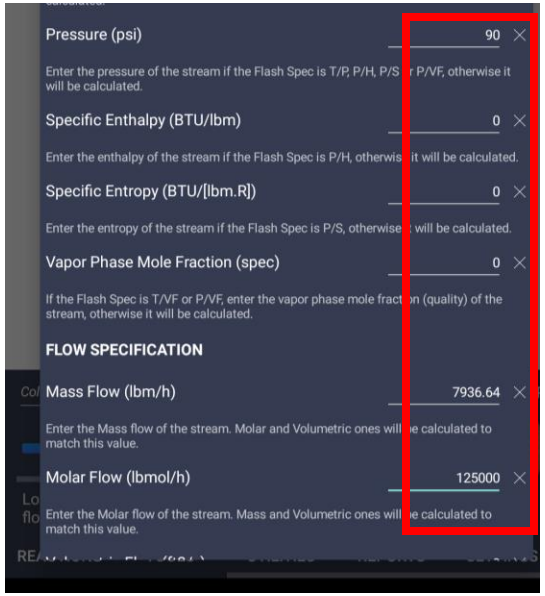
4. Drag and drop the Material streams from the object palette. Rename them as “Hot-In”, “Hot-Out”, and “Cold-In”, Cold-Out”.
5. Insert an Energy stream from the object pallet and Rename it as “Q-Stream”
6. Specify the feed compositions, flow rate, temperature and pressure for the inlet streams.

Quantity	Hot-In	Cold-In
Temperature, (°F)	300	100
Pressure, (psia)	50	90
Molar Flowrate (lb/h)	150000	125000
Composition (mass fraction)	Styrene: 1 Toluene: 0	Styrene: 0 Toluene: 1









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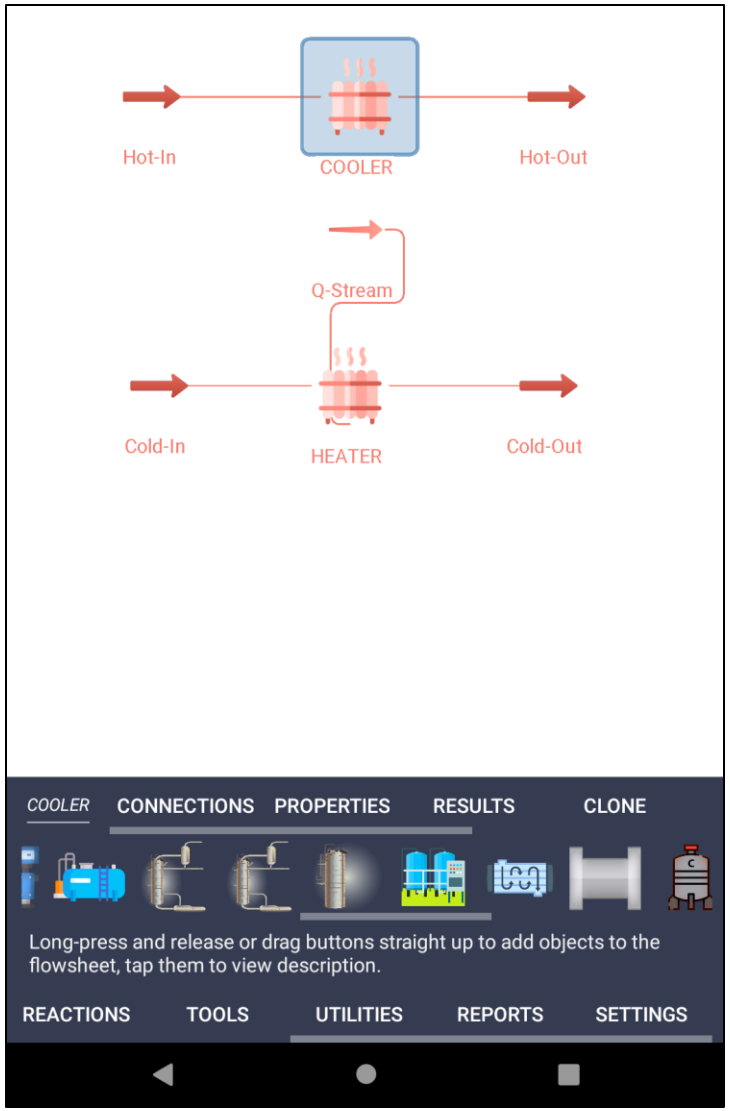
7. Below the **OBJECTS** tab, locate the "**Heater/Cooler**" block. Drag and drop into the flow sheet. Rename it "COOLER".
8. On clicking the cooler block. Under the "CONNECTIONS" tab, click the dropdown button and select the necessary connections. In the calculation parameter (**PROPERTIES** tab), specify the calculation as "Outlet temperature.
9. Now, add a block for Cooler. Drag and drop into the flow sheet. Rename it "HEATER". No need to give a separate energy stream for the heater. The "Q-stream" itself serves as an energy stream for this also. In the calculation parameter, specify the calculation as "Energy stream".
10. Once all the connections are given correctly, Simulate by pressing the "Solve flow sheet" button on the top corner of the screen.



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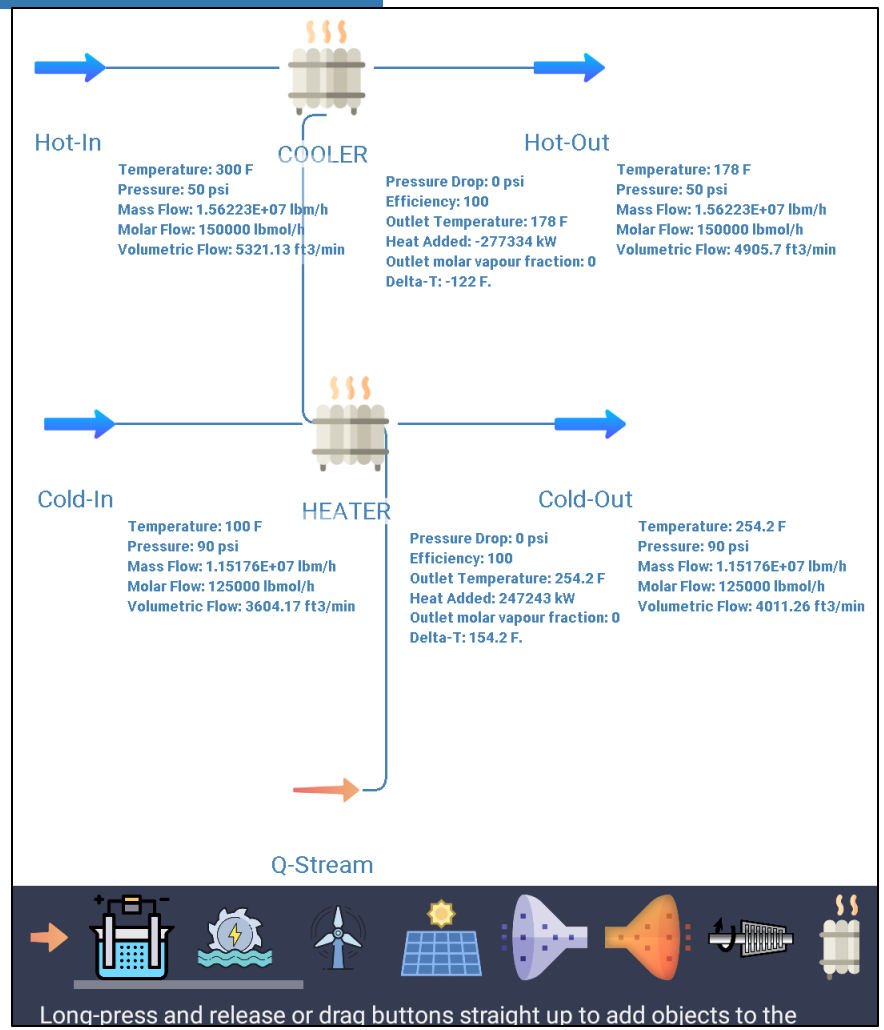

OBJECT REPORT: COOLER

View the calculation results report for the currently selected flowsheet object.

```
Object successfully calculated on 06/29/2024 16:41:48

Heater/Cooler: COOLER
Property Package: Raoult's Law

Inlet conditions

    Temperature: 300 F
    Pressure: 50 psi
    Mass flow: 1.56223E+07 lbm/h
    Volumetric flow: 5321.13 ft3/min
    Vapor fraction: 0
    Compounds: {Styrene; Toluene}
    Molar composition: {1; 0}

Calculation parameters

    Calculation mode: OutletTemperature
    Outlet temperature: 178 F
    Efficiency: 100
    Pressure drop: 0 psi

Results

    Outlet vapor mole fraction: 0
    Heat added/removed: -277334 kW
```

OBJECT REPORT: HEATER

View the calculation results report for the currently selected flowsheet object.

```
Object successfully calculated on 06/29/2024 16:41:35

Heater/Cooler: HEATER
Property Package: Raoult's Law

Inlet conditions

    Temperature: 100 F
    Pressure: 90 psi
    Mass flow: 1.15176E+07 lbm/h
    Volumetric flow: 3604.17 ft3/min
    Vapor fraction: 0
    Compounds: {Styrene; Toluene}
    Molar composition: {0; 1}

Calculation parameters

    Calculation mode: OutletTemperature
    Outlet temperature: 254.2 F
    Efficiency: 100
    Pressure drop: 0 psi

Results

    Outlet vapor mole fraction: 0
    Heat added/removed: 247243 kW
```

The simulation results can be viewed directly from each stream. You can also click on each stream/block for detailed information via the "**RESULTS**" tab. Detailed reports can be saved to PDF/TXT files on the "**REPORTS**" tab

Self-Learning Exercises:

1. Determine the exit temperature of hot (styrene) and cold (toluene) streams, if heat duty removed from the hot stream is 3 MW
2. How to perform simulation for a counter-current heat exchanger using two heaters?
3. Find out the inlet temperature of toluene if toluene should be heated to 250 deg F using the available styrene feed

#Thanks

Source:
PROCESS SIMULATION USING DWSIM: A Free and Open Source Chemical Process Simulator
By Dr. P. R. Naren Senior Assistant Professor, Chemical Engineering