# KM 331 PROSES BENZETİM PROGRAMLARI DERS NOTLARI [1-4]

# Kaynaklar

- 1. Chemcad User Guide and Tutorial, Chemstations, Inc. Version 6.1.
- 2. Aspen Technology, Inc., Apsen HYSYS ® Version 7.
- 3. ChemCad Eğitim Notları, Chemstations, Inc- Houston, TX, USA.
- A Guide for Getting Started in Aspen HYSYS Dinu Ajikutira, Sr. Director, Engineering Product Marketing, Aspen Technology, Inc.

# ChemCad 'de Borulandirma ve Pompa Uygulamalari

#### **Problem Statement:**



In the piping network shown above, water at 77F and 14.7 psi is fed at 2509 lbmol/h to a pump whose characteristic equation is as shown below:  $\Delta p = a - bQ_A^2, a = 72 psi, b = 0.0042 psi/(gpm)^2$ 

Pipes A, B and C are made of schedule 40, commercial steel and the pipeline parameters and elevations are as shown below:

Node	Elevation, ft
1	0
2	0
3	25
4	80
5	60

Pipe	D, in	L, ft
А	3.068	80
В	2.067	300
С	2.067	500

If the pressure at inlets of the two discharge tanks (nodes 4 and 5 in the diagram above) is 14.7 psi, report the flowrates and pressures at each of the five nodes using CHEMCAD simulation.

#### **Procedure:**

Step 1: Creating the flow sheet

- Step 2: Entering the components and formatting engineering units
- Step 3: Entering the feed stream composition
- Step 4: Entering the pump specs
- Step 5: Entering the pipe simulator specs
- Step 6: Entering the node specs
- Step 7: Running the simulation and retrieving the results

#### **Step 1: Creating the flow sheet**

The supply tank is just a source of water for the pump and can be ignored for the purposes of the simulation. Select and click *feed*, *pump*, *pipe simulators* (*three*) and *product(two)* icons on the workspace. Also click on *node* (icon in the  $10^{\text{th}}$  row and third column). This *node* icon needs to be present before and after each pump and pipe when simulating a piping network. So we need five nodes for our flowsheet consisting of three pipes. For the purposes of this simulation, we can ignore the discharge tanks and just use product icons in their place. Connect all the icons using *stream* as shown in the following figure. Click once on the **S**/G icon on the menu bar to switch the simulation mode from *Edit Simulation* to *Run Simulation*.



#### Step 2: Entering the components and formatting engineering units

Go to the *Thermophysical* on the menu bar and click on *Components List*. water from the CHEMCAD components list and add it to the component list. Go to the *Format* menu and click on *Engineering Units* and select the desired units for such properties as temperature, pressure etc. Use *SI* option to convert all units at the same time. Click OK to continue.

#### **Step 3: Entering the feed stream composition**

Double click on the feed stream and enter the feed information (temperature=77 F, pressure=14.7 psi, water flow rate=2509 lbmol/h) given in the problem statement. Click once on *Flash* to get the feed stream enthalpy and vapor fraction in feed at the feed conditions.



# **Step 4: Entering Pump Specs**

Double click on *Pump*.

Under the specifications page, select *Enter characteristic eqn* for *mode*. Select *psia* for *Pressure units* and *gpm* for *liq. vol. rate units*. Enter 72 for A and 0.0042 for B. Efficiency can be left blank as that information is not provided in the problem statement. (the default value for efficiency is 100%). Click on OK to continue.



# **Step 5: Entering the pipe simulator specs**

Double click on the first pipe simulator (Pipe A according to problem statement and unit operation 4 in my CHEMCAD simulation).

Specifications: Method: Select option 2, Single phase flow

Sizing option: Select option 5, Given size, Pin and Pout, calc flow rate

*Pipe Diameter:* Convert the given diameter for Pipe A into feet using F6 key on the keyboard and enter the value in feet in this box (0.256 ft)

Pipe Schedule: Enter 40

Pipe Length: Enter 80 ft

*Elevation change:* Leave this blank, CHEMCAD calculates this automatically based on the specs given to *nodes*.

*Roughness factor:* Leave this blank

#### Pipe Material: Select commercial steel

Click on *OK* to continue.

Similarly, complete step 5 for pipes B and C.



#### **Step 6: Entering node specs**

There are five nodes on our flow sheet, specifications of each one of the five are different and dependent on the two unit ops they are connected to. Usually, when the node is in the middle of the flow sheet, *Flow set by unit op* is preferred as the flowrate spec. When the node is in the beginning or end of the flow line, one can select *Free inlet stream* and *Free outlet stream* respectively. If the input node flowrate of the stream is the same as that of the output from the previous unit op, *Use current stream rate* is preferred. For more information on how each of these options specifically function, click on *help*. Provide 0.001 psi and 100 psi as the minimum and maximum bounds for pressure as and when applicable. Providing the minimum and maximum bounds will speed up the calculations. However, these are optional inputs and can be left blank.

# First node (Unit Op 1 on my flow sheet):

Double click on *node*. Choose *variable pressure* for *mode*. There is no elevation for this node according to the problem statement.

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Flowrate Options:

Inlet Stream: Stream 1

Select *Fixed mole rate* option and enter the value 2059 lbmol/hr as stated in the problem *Outlet Stream: Stream 2* 

Select *Flow set by UnitOp* option

Click OK to continue. (Ignore the no pressure estimation warning)

# Second node (Unit Op 3 on my flow sheet):

Double click on *node*. Choose *variable pressure* for *mode*. There is no elevation for this node according to the problem statement. Under *flowrate options*, select *Flow set by unit op* for both node inlet and node outlet as shown in the following figure.

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Click *OK* to continue. (Ignore the *no pressure estimation* warning)

# Third node (Unit Op 5 on my flow sheet):

Double click on *node*. Choose *variable pressure* for *mode*. There is an elevation of 25 ft for this node according to the problem statement. Enter this number in the corresponding box. Under *flowrate options*, select *Flow set by unit op* for both node inlet and the two node outlets as shown in the following figure.

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Click OK to continue. (Ignore the no pressure estimation warning)

# Fourth node (Unit Op 8 on my flowsheet):

Double click on *node*. Choose *fixed pressure* for *mode*. Enter 14.7 psi for the pressure at node as stated in the problem. There is an elevation of 80 ft for this node according to the problem statement. Enter this number in the corresponding box. Under *flowrate options*, select *Flow set by unit op* for node inlet and *Free Outlet Stream* for node outlet as shown in the following figure.

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# Fifth node (Unit Op 9 on my flowsheet):

Double click on *node*. Choose *fixed pressure* for *mode*. Enter 14.7 psi for the pressure at node as stated in the problem. There is an elevation of 60 ft for this node according to the problem statement. Enter this number in the corresponding box. Under *flowrate options*, select *Flow set by unit op* for node inlet and *Free Outlet Stream* for node outlet as shown in the following figure.

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#### Step 7: Running the simulation and retrieving the results

Now the simulation is ready to be run. Click once on  $\underline{R}$  to run the simulation. Alternatively, one can run the simulation by clicking on *Run* on the menu bar and selecting *Run all*. The status of the simulation can be found at the bottom left hand corner of the screen. The message, *Run Finished* appears in this place if the run is successfully completed. The stream properties can be retrieved by clicking *Results*, selecting *Stream compositions* and then *All streams*. The results obtained are shown below.

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Strea	m No.	1	2	3	4			
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Temp	F	77.0000*	77.0000	77.1118	77.1118			
Pres	psia	14.7000*	14.6982	52.2406	52.2406			
Enth	MMBtu/h	2.0337	2.0337	2.0388	2.0386			
Vapor	mole fraction	0.00000	0.00000	0.00000	0.00000			
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Water		45199.6328	45199.6406	45199.6406	45196.5391			
Strea	m No.	5	6	7	8			
Strea	m Name							
Temp	F	77.1118	77.1118	77.1118	77.1118			
Pres	psia	40.8299	40.8299	40.8299	14.7000			
Enth	MMBtu/h	2.0387	0.74718	1.2916	0.74718			
∀apoı	mole fraction	0.00000	0.00000	0.00000	0.00000			
Total	lbmol/h	2508.8281	919.5068	1589.4916	919.5068			
Total	. 116/h	45196.5391	16564.9141	28634.6895	16564.9141			
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Strea	m Name							
Тетр	F	77.1118	77.1118	77.1118				
Pres	psia	14.7000	14.7000	14.7000				
Enth	MMBtu/h	0.74718	1.2916	1.2916				
Vapor	mole fraction	0.00000	0.00000	0.00000				
Total	Lbmol/h	919.5068	1589.4916	1589.4916				
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