



## Pumps Simulation





Example: Forty tons per hour of water with the temperature of 20 °C has to be pressured from 1 to 6 bar.

- a. Calculate the electricity requirement of the pump if its efficiency is 70%.
- b. The pump characteristic curve  $H=f(Q)$  provided by the producer is given in Table 4.1; considering the same efficiency as in point a, calculate the discharge pressure, head developed, and NPSH available.

**Table 4.1** Pump performance curve data

$Q$ (m <sup>3</sup> ·h <sup>-1</sup> )	10	20	30	40	50	60	70	80
$H$ (m)	60	57.5	55	53	50	47	42.5	37

Solution:

- 1. Define water as the component in component list under Property

Source Databank: HYSYS

Component	Type	Group
H2O	Pure Component	

Select: **Pure Components** Filter: **All Families**

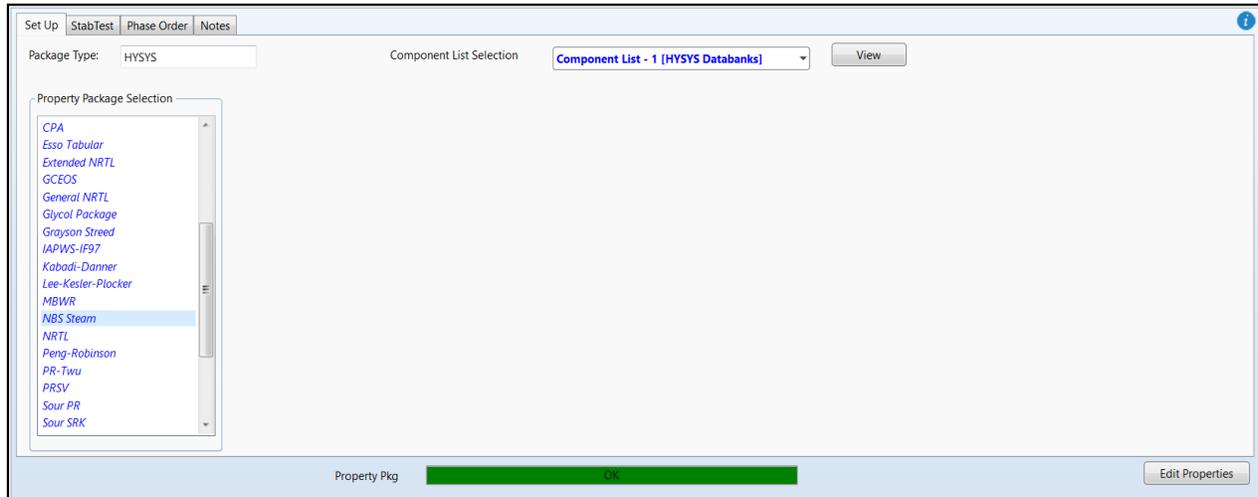
Search for: **Water** Search by: **Full Name/Synonym**

Simulation Name	Full Name / Synonym	Formula
No	Components	Match

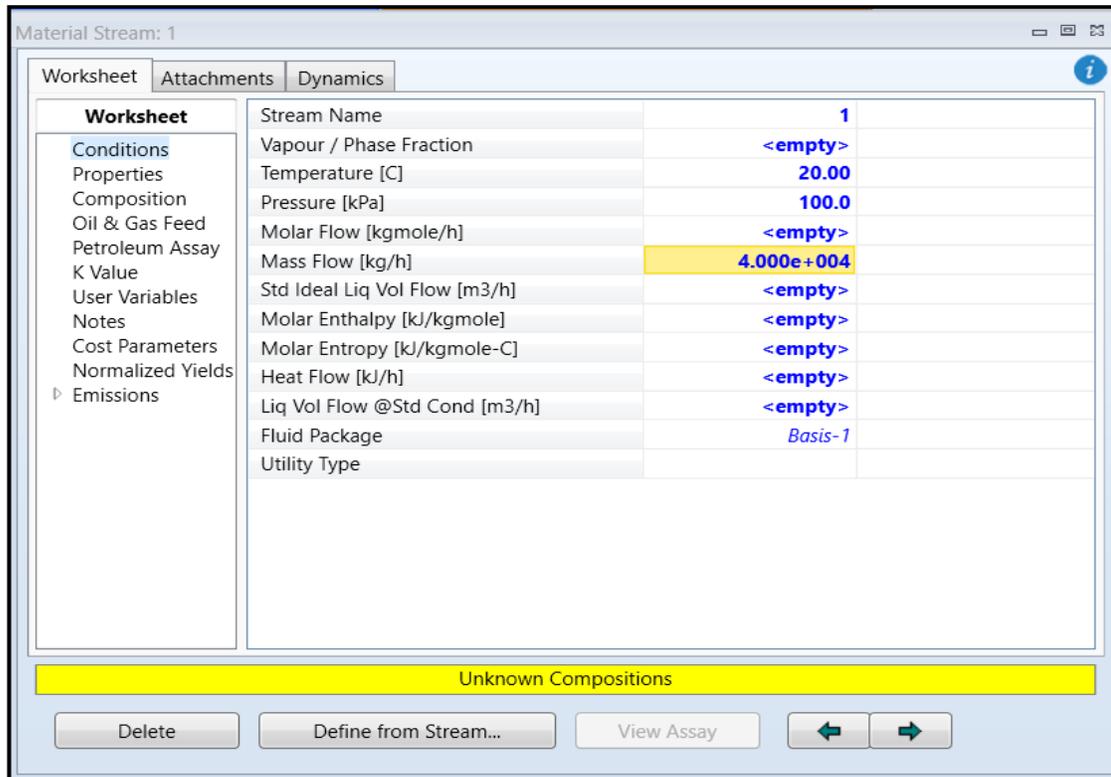
Status: **OK**



2. Select NBS Steam as the Fluid Package for water applications.



3. Enter Simulation Environment and create a material stream on the flowsheet.





Material Stream: 1

Worksheet Attachments Dynamics

**Worksheet**

- Conditions
- Properties
- Composition
- Oil & Gas Feed
- Petroleum Assay
- K Value
- User Variables
- Notes
- Cost Parameters
- Normalized Yields
- Emissions

	Mole Fractions	Aqueous Phase
H2O	1.0000	1.0000

Total: 1.00000

Edit... View Properties... Basis...

OK

Delete Define from Stream... View Assay

Material Stream: 1

Worksheet Attachments Dynamics

**Worksheet**

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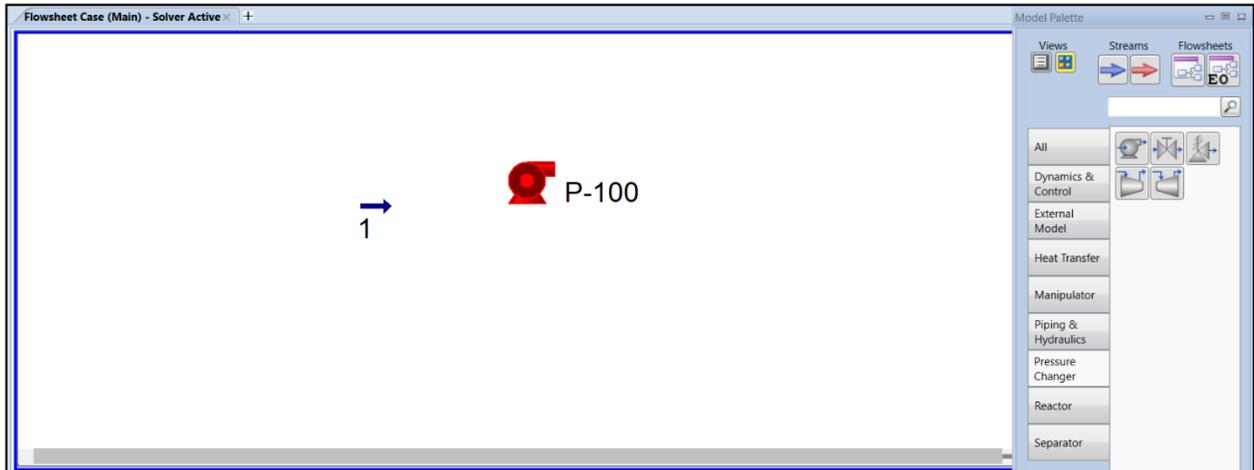
Stream Name	1	Aqueous Phase
Vapour / Phase Fraction	0.0000	1.0000
Temperature [C]	20.00	20.00
Pressure [kPa]	100.0	100.0
Molar Flow [kgmole/h]	2220	2220
Mass Flow [kg/h]	4.000e+004	4.000e+004
Std Ideal Liq Vol Flow [m3/h]	40.08	40.08
Molar Enthalpy [kJ/kgmole]	-2.854e+005	-2.854e+005
Molar Entropy [kJ/kgmole-C]	5.336	5.336
Heat Flow [kJ/h]	-6.336e+008	-6.336e+008
Liq Vol Flow @Std Cond [m3/h]	40.03	40.03
Fluid Package	Basis-1	
Utility Type		

OK

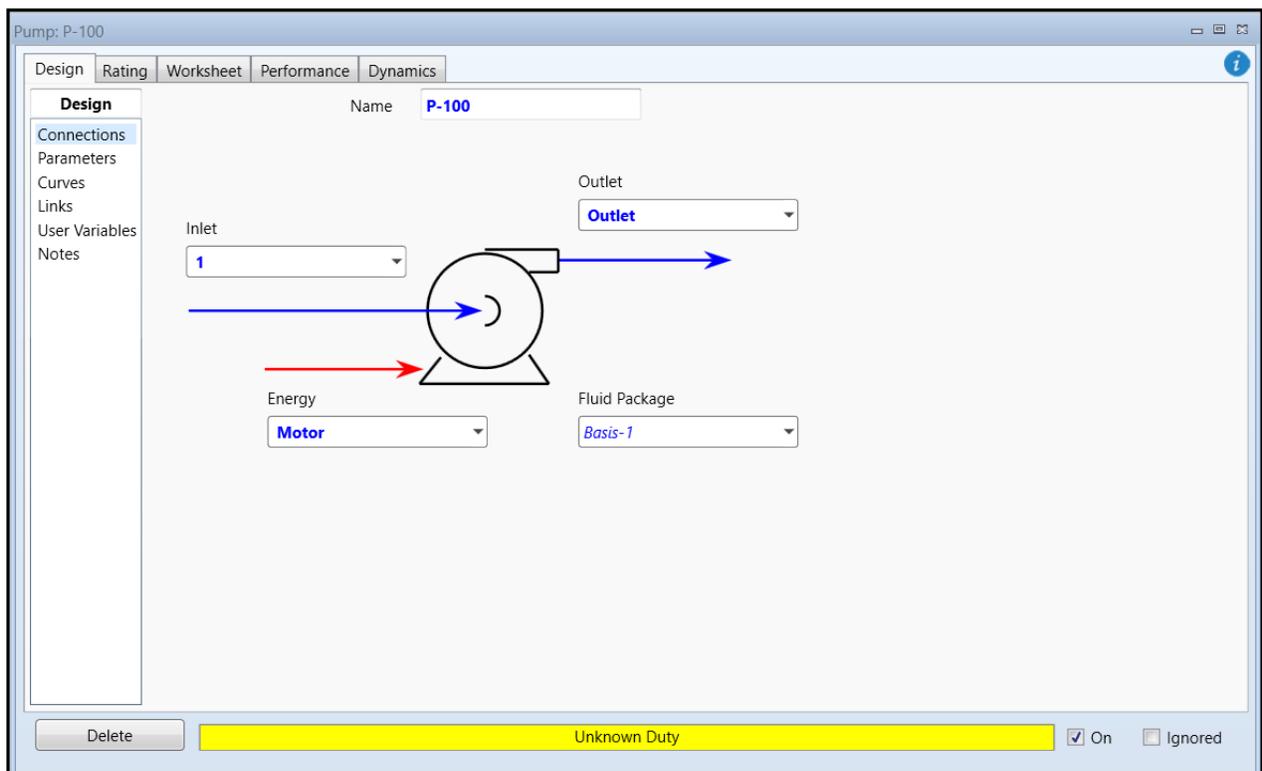
Delete Define from Stream... View Assay



4. Select Pump under Model Palette/Pressure Change and put it on the flowsheet.

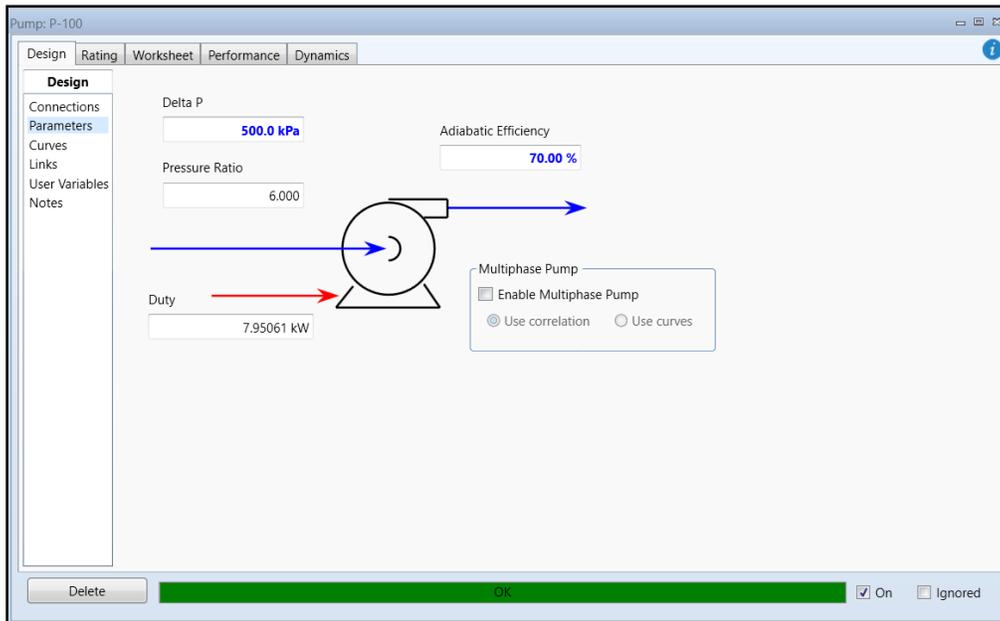


5. Double-click on the pump to see the following window, then select stream 1 as the inlet and write Outlet to create outlet stream. Finally write Motor on the energy blanket.



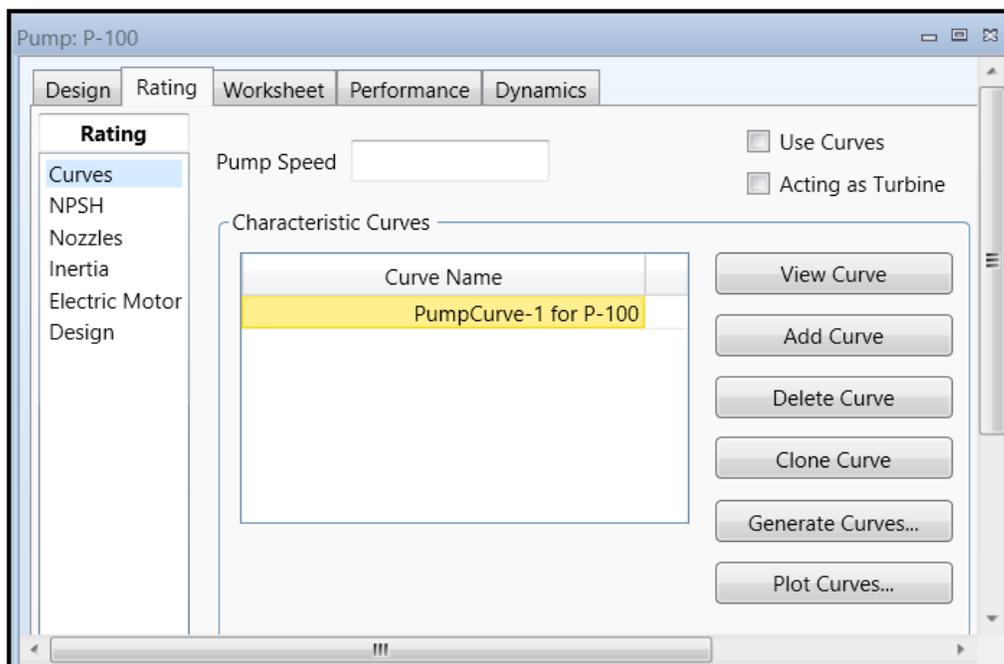


6. On the Parameter tab, enter 5 bar as the pressure difference and 70% as the pump efficiency as stated in the example.



7. Based on above results, the duty required is 7.95.

8. At this stage, the characteristic curve is used. To proceed with this stage, all data in Parameters sheet is erased. Instead click Rating tab and under Curve sheet, add the curve.





PumpCurve-1 for Pump: P-100

Curve Selections

Name: **PumpCurve-1** Flow Units: **m3/h**

Speed:  Head Units: **m**

Flow	Head	% Efficiency
10.00	60.00	70.00
20.00	57.50	70.00
30.00	55.00	70.00
40.00	53.00	70.00
50.00	50.00	70.00
60.00	47.00	70.00
70.00	42.50	70.00
80.00	37.00	70.00
<empty>	<empty>	<empty>

Erase Selected      Erase All

9. Now activate "Use Curve"

Pump: P-100

Design   Rating   Worksheet   Performance   Dynamics

**Rating**

- Curves
- NPSH
- Nozzles
- Inertia
- Electric Motor
- Design

Pump Speed

Use Curves

Acting as Turbine

Characteristic Curves

Curve Name
PumpCurve-1 for P-100

View Curve

Add Curve

Delete Curve

Clone Curve

Generate Curves...

Plot Curves...



10. Based on the result, the electricity required is 8.24 kW.

The screenshot shows a software window titled "Pump: P-100" with several tabs: Design, Rating, Worksheet, Performance, and Dynamics. The "Design" tab is active, and a sidebar on the left lists options: Design, Connections, Parameters (selected), Curves, Links, User Variables, and Notes. The main area displays the following parameters:

- Delta P: 518.6 kPa
- Adiabatic Efficiency: 70.00 %
- Pressure Ratio: 6.186
- Duty: 8.24648 kW

A central diagram shows a pump with a blue arrow entering from the left and another blue arrow exiting to the right. A red arrow points to the "Duty" parameter. Below the diagram is a "Multiphase Pump" section with the following options:

- Enable Multiphase Pump
- Use correlation
- Use curves

At the bottom of the window, there is a "Delete" button, a green "OK" button, and checkboxes for "On" (checked) and "Ignored".