



## Compressor Simulation





Example: A utility process plant is designed to supply Plant Air or PA to nearby petrochemicals. Process engineers want to develop the datasheet for the compressor needed to supply a 7-bar-compressed air. Here are the operating conditions of the PA at the compressor suction:

1. Operating pressure of 98 kPa.
2. Operating temperature of 45C.
3. Flowrate of 423 kmole/hr.

Use Aspen Hysys to calculate to the duty required with the assumption of 85% compressor efficiency.

How to simulate:

1. Add air as the component in component list.

Source Databank: HYSYS

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

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

| Simulation Name | Full Name / Synonym | Formula |
|-----------------|---------------------|---------|
| Methane         | C1                  | CH4     |
| Ethane          | C2                  | C2H6    |
| Propane         | C3                  | C3H8    |
| i-Butane        | i-C4                | C4H10   |
| n-Butane        | n-C4                | C4H10   |
| i-Pentane       | i-C5                | C5H12   |
| n-Pentane       | n-C5                | C5H12   |
| n-Hexane        | C6                  | C6H14   |
| n-Heptane       | C7                  | C7H16   |
| n-Octane        | C8                  | C8H18   |
| n-Nonane        | C9                  | C9H20   |
| n-Decane        | C10                 | C10H22  |

Component List Selection

| Component | Type           | Group |
|-----------|----------------|-------|
| Air       | Pure Component |       |

Buttons: < Add, Replace, Remove

Status: OK

2. Select PR as Fluid Package for such system.

Set Up | Binary Coeffs | StabTest | Phase Order | Tabular | Notes

Package Type: HYSYS Component List Selection: **Component List - 1 [HYSYS Databanks]** View

Property Package Selection

- BWRS
- Chao Seader
- Chien Null
- Clean Fuels Pkg
- CPA
- Esso Tabular
- Extended NRTL
- GCEOS
- General NRTL
- Glycol Package
- Grayson Streed
- JAPWS-IF97
- Kabadi-Danner
- Lee-Kesler-Plocker
- MBWR
- NBS Steam
- NRTL
- Peng-Robinson**

Options

|                          |                             |
|--------------------------|-----------------------------|
| Enthalpy                 | <b>Property Package EOS</b> |
| Density                  | Costald                     |
| Modify Tc, Pc for H2, He | Modify Tc, Pc for H2, He    |
| Viscosity Method         | HYSYS Viscosity             |
| Peng-Robinson Options    | HYSYS                       |
| EOS Solution Methods     | Cubic EOS Analytical Method |
| Phase Identification     | Default                     |
| Surface Tension Method   | HYSYS Method                |
| Thermal Conductivity     | API 12A3.2-1 Method         |

Parameters

Property Pkg: OK Edit Properties



3. Enter Simulation Environment and define a stream named Air-In with aforementioned conditions.

Material Stream: Air-In

Worksheet Attachments Dynamics

**Worksheet**

|                   |                               |         |
|-------------------|-------------------------------|---------|
| Conditions        | Stream Name                   | Air-In  |
| Properties        | Vapour / Phase Fraction       | 1.0000  |
| Composition       | Temperature [C]               | 45.00   |
| Oil & Gas Feed    | Pressure [kPa]                | 98.00   |
| Petroleum Assay   | Molar Flow [kgmole/h]         | 423.0   |
| K Value           | Mass Flow [kg/h]              | <empty> |
| User Variables    | Std Ideal Liq Vol Flow [m3/h] | <empty> |
| Notes             | Molar Enthalpy [kJ/kgmole]    | <empty> |
| Cost Parameters   | Molar Entropy [kJ/kgmole-C]   | <empty> |
| Normalized Yields | Heat Flow [kJ/h]              | <empty> |
| ▾ Emissions       | Liq Vol Flow @Std Cond [m3/h] | <empty> |
|                   | Fluid Package                 | Basis-1 |
|                   | Utility Type                  |         |

Unknown Compositions

Delete Define from Stream... View Assay ← →

Material Stream: Air-In

Worksheet Attachments Dynamics

**Worksheet**

|     | Mole Fractions | Vapour Phase |
|-----|----------------|--------------|
| Air | 1.0000         | 1.0000       |

Total 1.00000

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

OK

Delete Define from Stream... View Assay ← →



Material Stream: Air-In

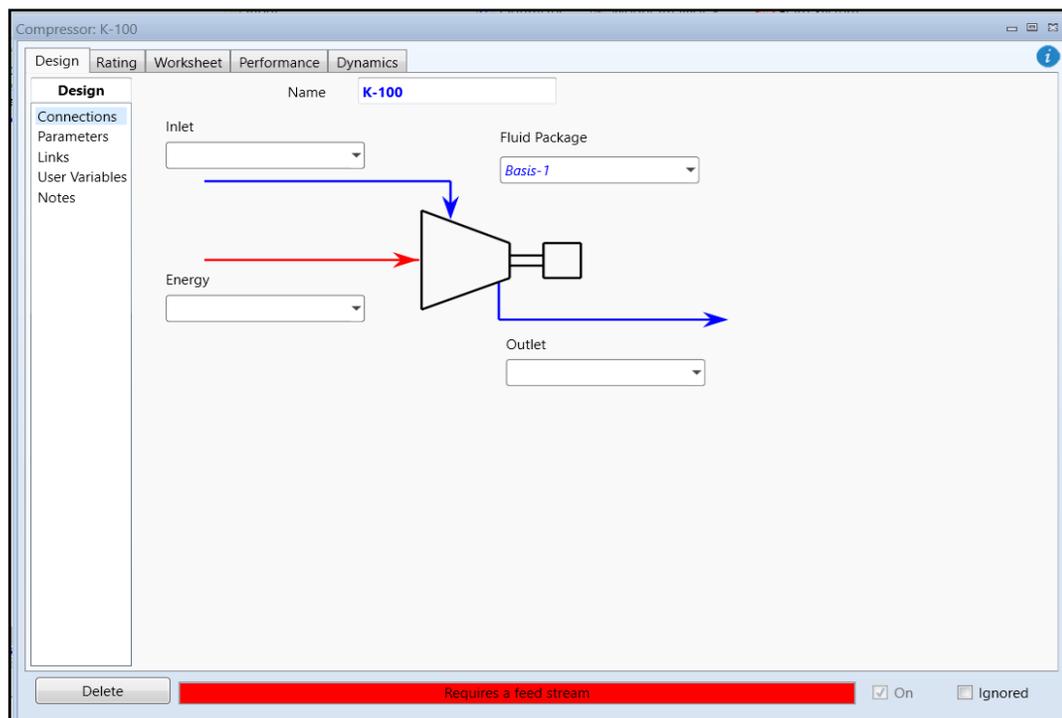
Worksheet Attachments Dynamics

| Worksheet         | Stream Name                   | Air-In     | Vapour Phase |
|-------------------|-------------------------------|------------|--------------|
| Conditions        | Vapour / Phase Fraction       | 1.0000     | 1.0000       |
| Properties        | Temperature [C]               | 45.00      | 45.00        |
| Composition       | Pressure [kPa]                | 98.00      | 98.00        |
| Oil & Gas Feed    | Molar Flow [kgmole/h]         | 423.0      | 423.0        |
| Petroleum Assay   | Mass Flow [kg/h]              | 1.225e+004 | 1.225e+004   |
| K Value           | Std Ideal Liq Vol Flow [m3/h] | 13.92      | 13.92        |
| User Variables    | Molar Enthalpy [kJ/kgmole]    | 567.7      | 567.7        |
| Notes             | Molar Entropy [kJ/kgmole-C]   | 120.3      | 120.3        |
| Cost Parameters   | Heat Flow [kJ/h]              | 2.402e+005 | 2.402e+005   |
| Normalized Yields | Liq Vol Flow @Std Cond [m3/h] | 9995       | 9995         |
| Emissions         | Fluid Package                 | Basis-1    |              |
|                   | Utility Type                  |            |              |

OK

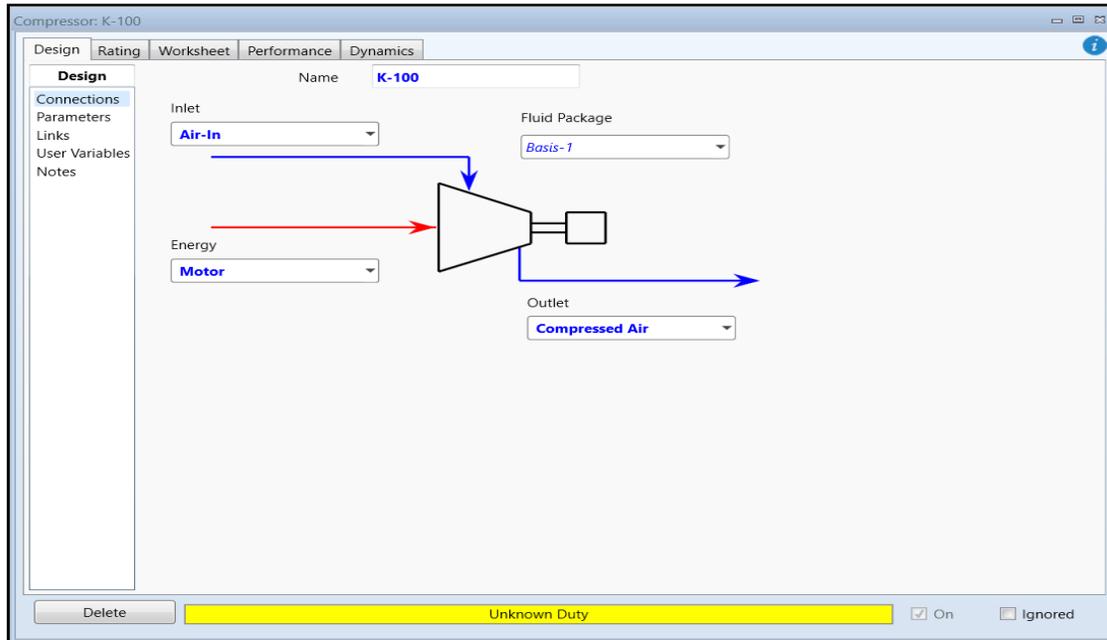
Delete Define from Stream... View Assay ← →

#### 4. Select compressor icon from Model Palette/Pressure Change

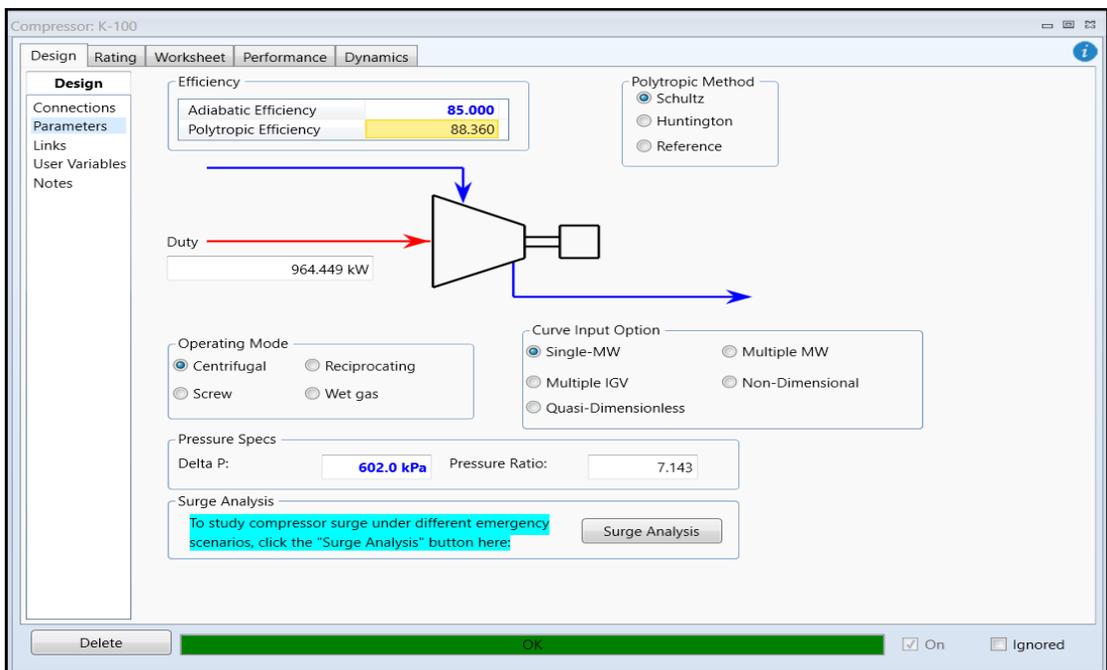




5. Select Air-In as the inlet stream and define Compressed Air as the outlet stream. Also, define an energy source named Motor.



6. Go to Parameter sheet, change the efficiency to 85% and set delta P to 602 kPa.





Based on the result, the calculated duty is 964.44 kW. Also, it is worthy checking the Worksheet tab and observe the dramatic increase in outlet temperature from 45C to 322C.

Compressor: K-100

Design Rating **Worksheet** Performance Dynamics

**Worksheet**

|                             | Air-In     | Compressed Air | Motor      |
|-----------------------------|------------|----------------|------------|
| Name                        |            |                |            |
| Vapour                      | 1.0000     | 1.0000         | <empty>    |
| Temperature [C]             | 45.00      | 322.3          | <empty>    |
| Pressure [kPa]              | 98.00      | 700.0          | <empty>    |
| Molar Flow [kgmole/h]       | 423.0      | 423.0          | <empty>    |
| Mass Flow [kg/h]            | 1.225e+004 | 1.225e+004     | <empty>    |
| LiqVol Flow [m3/h]          | 13.92      | 13.92          | <empty>    |
| Molar Enthalpy [kJ/kgmole]  | 567.7      | 8776           | <empty>    |
| Molar Entropy [kJ/kgmole-C] | 120.3      | 122.5          | <empty>    |
| Heat Flow [kJ/h]            | 2.402e+005 | 3.712e+006     | 3.472e+006 |

Delete OK  On

Compressor: K-100

Design Rating Worksheet **Performance** Dynamics

**Performance**

| Results                       |            |
|-------------------------------|------------|
| Adiabatic Head [m]            | 2.457e+004 |
| Polytropic Head [m]           | 2.555e+004 |
| Adiabatic Fluid Head [kJ/kg]  | 241.0      |
| Polytropic Fluid Head [kJ/kg] | 250.5      |
| Adiabatic Efficiency          | 85.000     |
| Polytropic Efficiency         | 88.360     |
| Power Consumed [kW]           | 964.4      |
| Polytropic Head Factor        | 1.0018     |
| Polytropic Exponent           | 1.4707     |
| Isentropic Exponent           | 1.3970     |
| Speed [rpm]                   | <empty>    |

Delete OK  On  Ign