**Introduction to Engineering Calculations**

Before starting with material balance calculations, you need to recall some of the fundamental information on:

-Units and dimensions

-Unit conversions

-Validation of results

-Numerical calculations

-Interpolation

-Molar/mass composition

-Process variables such as temperature and pressure

Solve the following questions to recall your previous knowledge

1. The Prandtl number, NPr, is a dimensionless group important in heat transfer calculations. It is defined as *Cpμ / k*, where *Cp* is the heat capacity of a fluid, *μ* is the fluid viscosity, and k is the thermal conductivity. For a particular fluid, *Cp* =0.583 J/(g°C), k=0 286 W/(m°C), and *μ=*1936 lbm/(ft.h). Estimate the value of NPr without using a calculator (remember, it is dimensionless), showing your calculations; then determine it with a calculator.
2. A hygrometer which measures the amount of moisture in a gas stream, is to be calibrated using the apparatus shown here:

Steam and dry air are fed at known flow rates and mixed to form a gas stream with a known water content, and the hygrometer reading is recorded; the flow rate of either the water or the air is changed to produce a stream with a different water content and the new reading is recorded, and so on. The following data are taken:

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a)Draw a calibration curve and determine an equation for y(R).

b)Suppose a sample of a stack gas is inserted in the sample chamber of the hygrometer and a reading of R=43 is obtained. If the mass flow rate of the stack gas is 1200 kg/h, what is the mass flow rate of water vapor in the gas?

1. The relationship between the pressure P and volume V of the air in a cylinder during the upstroke of a piston in an air compressor can be expressed as

PVk = C

where k and C are constants. During a compression test, the following data are taken:



Determine the values of k and C that best fit the data. (Give both numerical values and units.)

1. Derive the following equations for average molecular weight.

 

Reference: Richard M. Felder, Ronald W. Rousseau, Elementary Principles of Chemical Processes, 3rdEdition.