Procedure for Material Balance Calculations

1. Draw a flow chart of the process, and fill in all given variables
2. Choose an amount or flow rate of one of the process streams as a basis for the calculations
3. Convert known stream volumes or volumetric flow rates to mass or molar quantities, using tabulated densities or gas laws
4. Label unknown stream variables on the flow chart
5. If you are given mixed mass or mole units for a stream, convert all quantities to one basis or the other
6. If any information if given in the problem statement that has not been used in labeling the flow chart, translate it into equations in the variables defined in step 4.
7. Write material balance equations in an order such that those that involve the fewest unknowns are written first. The maximum number of independent equations that can be derived by writing balances on a nonreactive systems equals the number of chemical species in the input and output streams.
8. Solve the equations derived in steps 6 and 7 for the unknown quantities to be determined. When the value of an unknown has been calculated, write it on the flow chart immediately.
9. If a stream quantity or flow rate Qg was given in the problem statement and another value Qc was either taken as the basis or calculated for this stream, scale the balanced process by the ratio Qg/Qc to obtain the final result

Adapted from R.M. Felder and R.W. Rousseau, *Elementary Principles of Chemical Processes*, Wiley: New York, 1978.

Example Problem

A mixture containing 45% benzene (B) and 55% toluene (T) by mass is fed to a distillation column. An overhead stream of 95 wt% B is produced, and 8% of the benzene fed to the column leaves in the bottom stream. The feed rate is 2000 kg/hr. Determine the overhead flow rate and the mass flow rate of benzene and toluene in the bottom stream.