**DESIGN OF A CONDENSER**

**Introduction:**

Condenser is a device that is used to convert form vapor into liquid. Designing process of condenser includes many steps like assigning dimensions of the condenser with respect to the property of the fluid.

In manual design of a condenser, we cannot avoid the trial and error routine. A program can be easily employed as a subroutine for preliminary design purposes.

**Aim:**

To calculate shell number of tubes, film temperature, length and diameter of tubes, vapour loading, correction factor of number of tubes and heat transfer coefficient of hot and cold fluid.

**Input**:

* Hot and cold fluid inlet and outlet temperature.
* Flow rate of the fluids
* Latent heat vapourization
* Vapour pressure at shell side

**Conditions:**

* Outer diameter of the tube : ½ - ¾ inches
* Length of the tube : 3 – 5 m
* Tube side velocity: 1 - 3 m/s
* Tube pitch is 1.25 times the outer diameter of the tube

**Classes, variables and functions used:**

**Class:** Fluid

**Attributes (data members):**

* Name of fluid
* Mass flow rate
* Inlet temperature
* Outlet temperature
* Density of vapour and liquid
* Specific heat capacity
* Dynamic viscosity
* Kinematic viscosity
* Thermal heat conductivity
* Reynold’s number
* Prandtl number

**Variables:**

* Q (Rate of heat transfer)
* d (Heat transfer coefficient (dirt))
* Uc (Heat transfer coefficient (clean))
* Ao (Heat transfer area)
* Ut(tube side velocity)
* LMTD (corrected LMTD)
* Nt (Number of tubes)
* Np (Number of tube passes)
* hi
* ho
* dirt\_factor\_given
* dirt\_factor\_cal

**Functions:**

* getUd(name of hot fluid, name of cold fluid) -gets the min and max value of Ud from the table and returns the range of Ud as a tuple
* calcLMTD() -calculates LMTD

**Output:**

* Pitch : Triangular pitch
* Shell diameter
* Correction factor
* Vapour loading
* Number of tubes
* Length of tubes
* Diameter of tubes
* Tube side and shell side pressure drops

**Pseudo code:**

1. Get the name of hot fluid, mass flow rate and the inlet and outlet temperatures of the hot fluid

2. Create object for hot fluid by passing the name, mass flow rate, inlet and outlet temperatures of the hot fluid to the constructor

3. If the hot fluid is water use the getWaterProperties() method to find the properties of water

4. Else invoke the method getProperties() to get all the fluid properties

5. Get the name of cold fluid, mass flow rate and the inlet temperature of the cold fluid

6. Calculate Q and find outlet temperature of cold fluid

7. Create object for cold fluid by passing the name of the cold fluid, mass flow rate, inlet temperature and outlet temperature to the constructor

8. Call the getWaterProperties() method to find the properties of water

9. Call the function calcLMTD()

10. Call the function getUd(hfname,cfname)

11. Calculation of tube side velocity:

* Outerdia =0.01905
* length =4
* innerdia =0.0157
* Udrange= getUd (hotfluid\_name, coldfluid\_name)
* for assumedUd in range (Udrange[0], Udrange[1]+10, 10):

12.Calculate Ao

* calculate Nt
* calculate tube side flow area
* calculate tube side velocity
* #frange is user defined to have float values as parameters
* if tube side velocity in frange (1, 3, 0.1):
* break

13. Call the method findNusseltNumber(innerdia, tube side velocity )

14. Calculate hi

15. Calculate ho

16. Calculate Uc

17. Calculate dirt\_factor\_cal

18. If dirt\_factor\_cal < dirt\_factor\_given :

19. Display the message” Design can’t be done for the given duty”

20. Else invoke the method calcPressureDrop() using both the objects to calculate pressure drops for both tube side

and shell side. If pressure drops are less than 10 psi :

21. Display the output

22. Else display the message “Design can’t be done for the given duty”