Self Evaluation

MODULE B.5

STEAM TABLES

1. a) Check if the saturation temperature at 0.05 bar agrees with the stated temperature. The t_s at 0.05 bar is 32.9°C. The fluid is existing at a temperature above the saturation temperature, so the fluid is superheated steam.

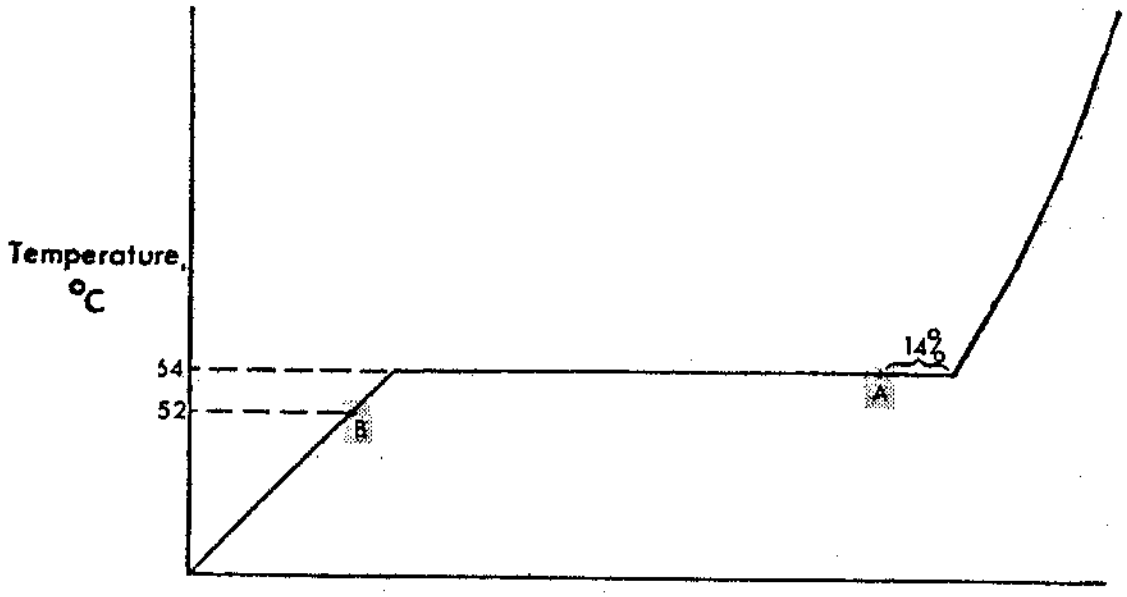
   b) Check that 3.317 bar is the saturation pressure at 137°C. It is! So the fluid is at the saturation conditions and we have to check the enthalpy. The quoted value of 2279.2 kJ/kg is more than h_f at 576.2 but less than h_g at 2729.2 so the fluid is wet steam.

   c) Check that t_s at 4.0 bar is 133.5°C. At 4.0 bar t_s = 143.6°C. The fluid is existing below the saturation temperature and is therefore subcooled liquid.

2. If the steam is 14% wet it is also 86% dry and q = 0.86.

   The steam is at the saturation temperature of 64°C. If the condensate is subcooled by 12°C the temperature of the condensate is 64 - 12 = 52°C.

   Looking at the temperature enthalpy diagram, we can see the initial and final conditions.



Enthalpy, J/kg

Fig. 5.15

At the point A, the enthalpy is found using $h = h_f + qh_{fg}$ when $t_s = 64°C$.

Using Table 1,

h_f at 64°C = 267.8 kJ/kg

h_{fg} at 64°C = 2348.8 kJ/kg.

So $h_A = 267.8 + 0.86 \times 2348.8$

$= 2287.8$ kJ/kg.

The enthalpy at the final condition of point B is h_f at 52°C which from Table 1 = 217.6 kJ/kg.

So the heat removed in the condenser is the difference between the initial and final conditions, ie, $h_A - h_B$

$= 2287.8 - 217.6$

$= 2070.2$ kJ/kg.

3. Using the temperature enthalpy diagram we can plot the initial and final conditions.

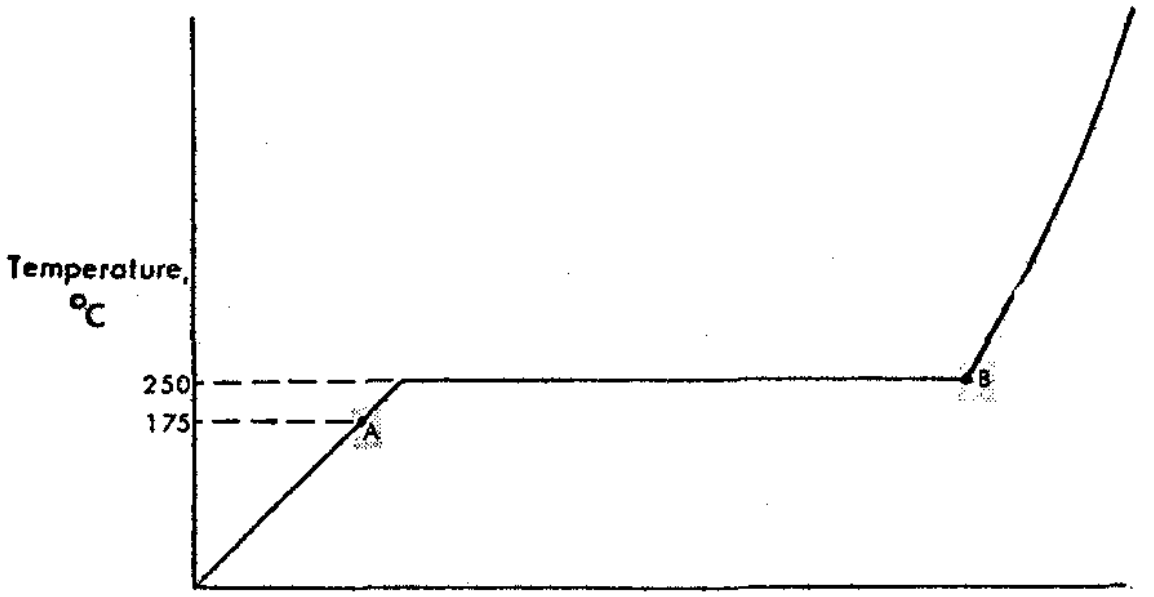


Fig. 5.16

Initial Condition A

The enthalpy at point A is h_f at 175°C which from Table 1 is 741.1 kJ/kg.

The specific volume at the initial condition is v_f at 175°C which is 1.1209 ℓ/kg.

Final Condition B

The steam is saturated at 250°C and the enthalpy may be found from Table 1 where h_g = 2800.4 kJ/kg.

The specific volume of the saturated steam at 250°C is v_g and is 50.037 ℓ/kg.

The heat added in the steam generator is the difference between the final and initial enthalpies, ie, $h_B - h_A$

= 2800.4 - 741.1

= 2059.3 kJ/kg.

The change in volume between the initial and final condition is $v_B - v_A$ = 50.037 - 1.1209, which is sensibly 49 ℓ/kg.

4. Steam hammer occurs with pressurized liquids when the line pressure falls to the saturation value. Continuous vapour production and condensation result in violent oscillations of the liquid in the pipe and can produce severe damage.

   It may be avoided by keeping the line pressure above saturation conditions whilst there is still liquid present. Valve operation should be extremely cautious.If steam hammer commences, the line flow should be reduced to raise the line pressure above the saturation valve.

5. As the system cools from 200°C to 100°C, the liquid water will contract. The volume of liquid will thus decrease.

   The decrease in liquid volume means that there will be a space created in the system. This space will be filled by vapour, which is produced using some of the heat lost by the liquid as it cools from 200°C to 100°C. So the volume of vapour increases.

   Due to the contraction of the water as its temperature decreases, the pressure of the system decreases.

* * * * *

When you have compared your test with the self evaluation sheet, take both the test and the self evaluation sheet to the Course/Shift Manager and let him discuss your test. If you are both satisfied with the results, the Manager should sign the test off in the top right hand corner.

If there are some areas that need further reinforcement that have been identified, work on these and then take the test again when you are confident.

When you have completed this module, progress to Module B.4.2 or B.3.2.