Class: 2nd Stage
Subject: air conditioning and refrigration
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EXP. NO. 3

Sensible Cooling

Object:

The purpose of this object is to understand how the sensible cooling can be achieved at constant moisture content and represented it on psychrometric chart.

Introduction

Sensible psychrometric process that involves the increase or decrease in the temperature of air without changing its humidity ratio

Example: passing moist air over cooling coil to conditioner the air

Sensible heat and latent heat are not special forms of energy. Rather, they describe exchanges of heat under conditions specified in terms of their effect on a material or a thermodynamic system.

The total heat in general representing summation of latent and total. When psychrometric process is done in sensible state this due to latent heat equal zero and total heat equal to sensible heat only.

The total heat of a thermodynamic process may be calculated as the product of mass (m) with its specific heat capacity (c) and the change in temperature (ΔT):

Both sensible and latent heats are observed in many processes while transporting energy in nature. Latent heat is associated with changes of state, measured at constant temperature, especially the phase changes of atmospheric water vapor, mostly vaporization and condensation, whereas sensible heat directly affects the temperature of the atmosphere.

Procedure of Sensible Cooling

Sensible cooling process is opposite to sensible heating process. In sensible cooling process the temperature of air is decreased without changing its moisture content. During this process the sensible cooling, DB and WB temperature of the air decreases while latent of air, and the DP point temperature of the air remains constant. Sensible cooling of the air is important when the air conditioner by cooling coil. In the cooling coil the air is cooling by passing it over the evaporator coil or the cooling coil that carry the low temperature refrigerant. In some cases the cooling of air is also done to suit different industrial and comfort air-conditioning applications where large air conditioning systems are used.

In general the sensible cooling process is carried out by passing the air over the cooling coil. This coil may be cooled by passing the refrigerant in evaporator pipes. The refrigerant wide used in air conditioning and refrigeration system.

Like the sensible heating, the sensible cooling process is also represented by a straight horizontal line on the psychrometric chart. The line starts from the initial DB temperature of air and ends at the final temperature extending towards the left (see the figure). The sensible cooling line is also constant DP temperature line.

The heat transfer rate during this process is given by:

$$Q_T = \dot{m_a}(h_1 - h_2)$$

$$Q_T = \dot{m_a} C_{pa}(DBT_1 - DBT_2)$$

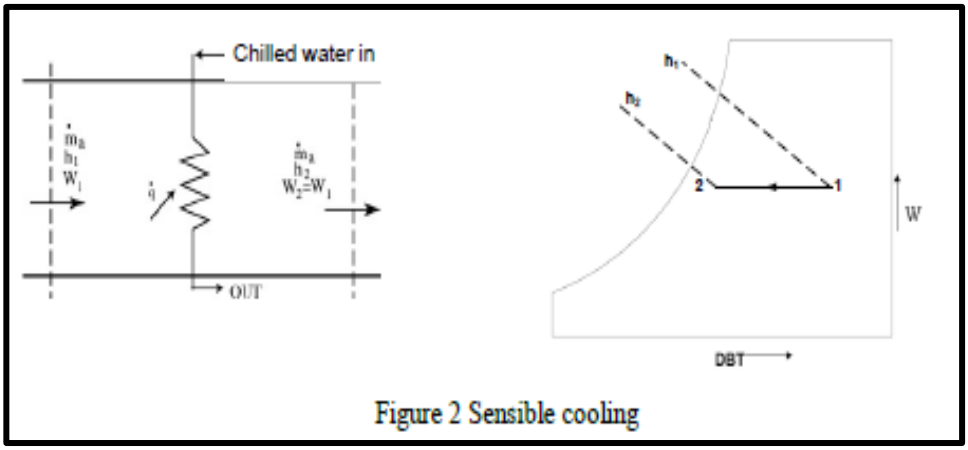


Figure 2 Sensible cooling

Calculate the cooling load when 1.5 m^3/s of moist-air, initially at a state of 21 °C DBT, 15 °C WBT and 101.325kPa barometric pressure, 1 is cooled sensibly by 5 °C using cooler coil, what is the flow rate of chilled water necessary to effect this cooling if the flow return temperature of 10°C and 15 °C satisfactory.

$Q_{1-3} = m_a (h_1 – h_3)$

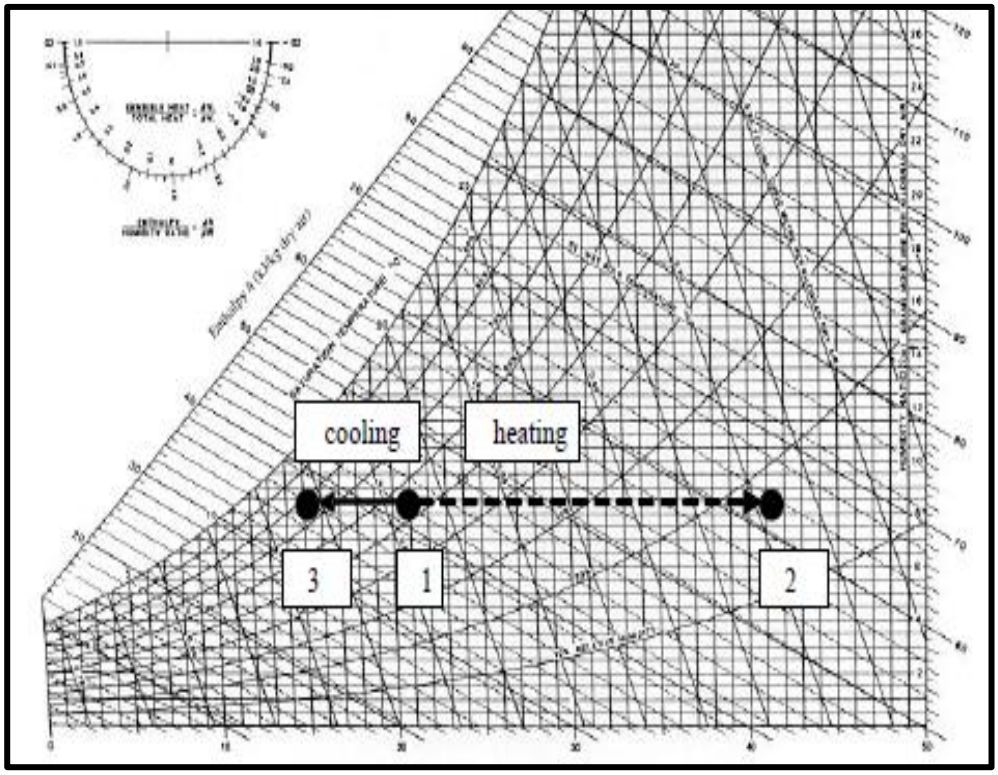
h_3= 36.77 kJ/kg

$Q_{1-3} = 1.777 (41.88 - 36.77) = 9.1kW$

Heat lost from air = heat gain by water

$9.1 = m_w \times 4.186 \times (15-10)$

$m_w = 0.434\ kg_w/s$



$Q = ma\ (h1 - h2)$

$m_a = \rho_a - V_a \qquad (Kg/s\ )$

V_a Volume flow rate of air m / s va.A

V_a air velocity m/s (using pitot tube to measure)

$h1$ enthalpy of entering air kj/kg (from psychrometeric chart)

$h1$ enthalpy of exit air kj/kg (from psychrometeric chart)

To locate h1 and h2 dry bulb and wet bulb temperature should be measured for both entering and leaving air .

Points	DBT °C	WBT °C	m^3/Pkg	h kg/kjL	Head mm
1					
2					
1					
2					
1					
2					

Discussin:

1- Discuss Result ?

2- Define sensible heating