ROHINI

COLLEGE OF ENGINEERING & TECHNOLOGY

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(AUTONOMOUS)

REFRIGERATION AND COLD STORAGE

UNIT III

Sensible Heat Factor

An air-conditioning process describes the change in thermodynamic properties of moist air between the initial and final stages of conditioning as well as the corresponding energy and mass transfers between the moist air and a medium, such as water, refrigerant, absorbent or adsorbent, or moist air itself. The energy balance and conservation of mass are the two principles used for the analysis and the calculation of the thermodynamic properties of the moist air. The thermal properties of air can be separated into latent and sensible heat. The sensible heat ratio (SHR) of an air-conditioning process is defined as the ratio of the change in absolute value of sensible heat to the change in absolute value of total heat, both in Btu/hr:

$$SHF = \frac{SH}{SH + LH} = \frac{SH}{TH}$$

SHF = sensible heat factor

SH = sensible heat

LH = latent heat

TH = total heat

For any air-conditioning process, the sensible heat change

$$SH = 60 * Vs * \rho * c\,(T_2 - T_1) = 60 * m * c * (T_2 - T_1)$$

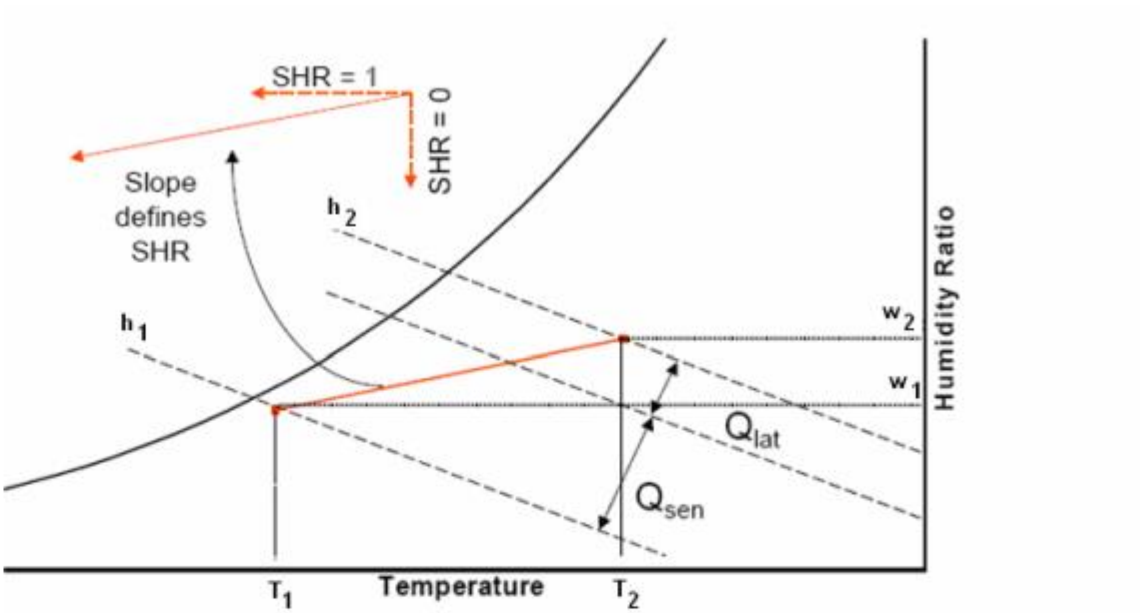
Where

- Vs= volume flow rate of supply air, cfm
- ρs = density of supply air, lb/ft^3
- T_2, T_1 = moist air temperature at final and initial states of an air-conditioning process, °F and
- The mass flow rate of supply air is m = Vs * ρ

The latent heat change is

$$LH = 60 * Vs * \rho * (w_2 - w_1) * h_{fg} = 1060 * 60 * Vs * \rho * (w_2 - w_1)$$

Where w2, w1 = humidity ratio at final and initial states of an air-conditioning process, lb/lb. In Equation above, hfg ~ 1060 Btu/lb represents the latent heat of vaporization or condensation of water at an estimated temperature of 58°F, where vaporization or condensation occurs in an air-handling unit or packaged unit. The ratio of space sensible cooling to total cooling is useful for plotting the slope of the path that supply air travels after introduction into the space. The relationships among the psychrometric states, capacities, and sensible heat ratio are shown graphically in figure below. For a given pair of entering and leaving air states, the figure shows that sensible, latent, and total capacities are proportional to the differences in temperature, humidity ratio, and enthalpy, respectively. The SHR is defined by the slope of the line connecting the two points.



Room Sensible Heat Factor (RSHF)

The room sensible heat factor (RSHF) represents the psychrometric process of the supply air within the conditioned space. Room Sensible Heat Factor is the ratio of room sensible and room latent heat.

$$RSHF = \frac{RSH}{RSH + RLH} = \frac{RSH}{RTH}$$

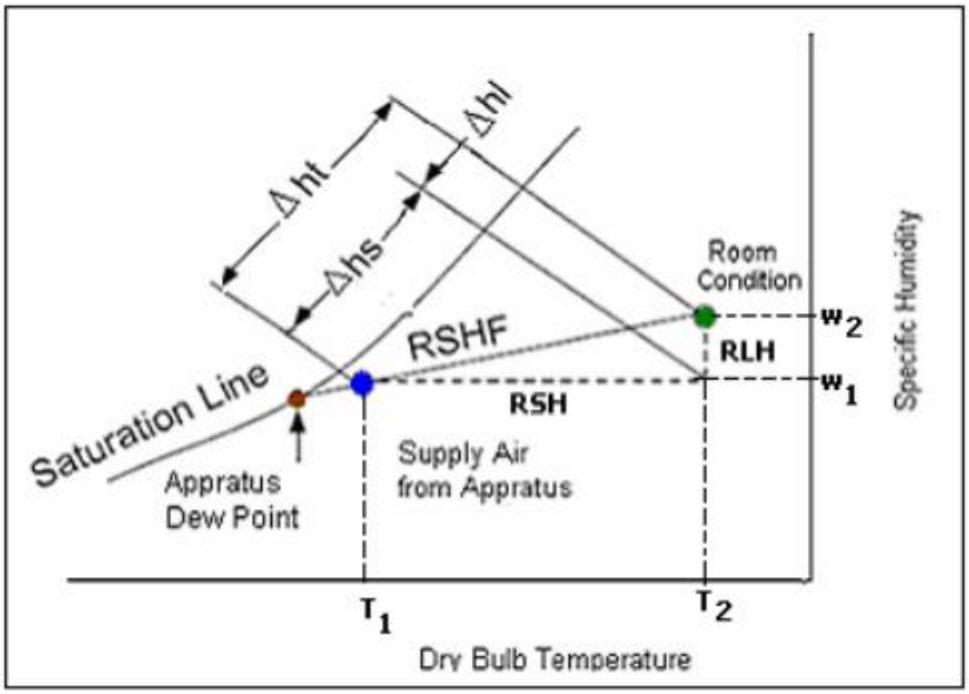
RSHF = room sensible heat factor

RSH = room sensible heat

RLH = room latent heat

RTH = room total heat

The supply air to a conditioned space must have the capacity to offset simultaneously both the room sensible and room latent heat loads. The process is plotted on the standard psychrometric chart as below.



The slope of the RSHF line illustrates the ratio of sensible to latent loads within the space. RSH is projected on the enthalpy lines to estimate the Δhs (sensible load) and RLH is projected on the enthalpy lines to estimate the Δhl (latent load). Room total load (RTH) is the enthalpy difference between the room design condition and the supply air condition. Thus, if adequate air is supplied to offset these room loads, the room requirements will be satisfied, provided both the dry- and wet-bulb temperatures of the supply air fall on this line. The figure above also shows a third point, defined as the apparatus dew point (ADP). The ADP represents an effective coil surface condition and the apparatus dew point temperature can loosely be thought of as the coil temperature. The ADP is determined by extending the straight line between the entering and leaving air states until it reaches the saturation curve.

Grand Sensible Heat Factor (GSHF)

Grand Sensible Heat Factor is the ratio of the total sensible heat to the grand total heat load that the conditioning apparatus must handle, including the outdoor air heat loads. This ratio is expressed as:

$$GSHF = \frac{TSH}{TLH + TSH} = \frac{TSH}{GTH}$$

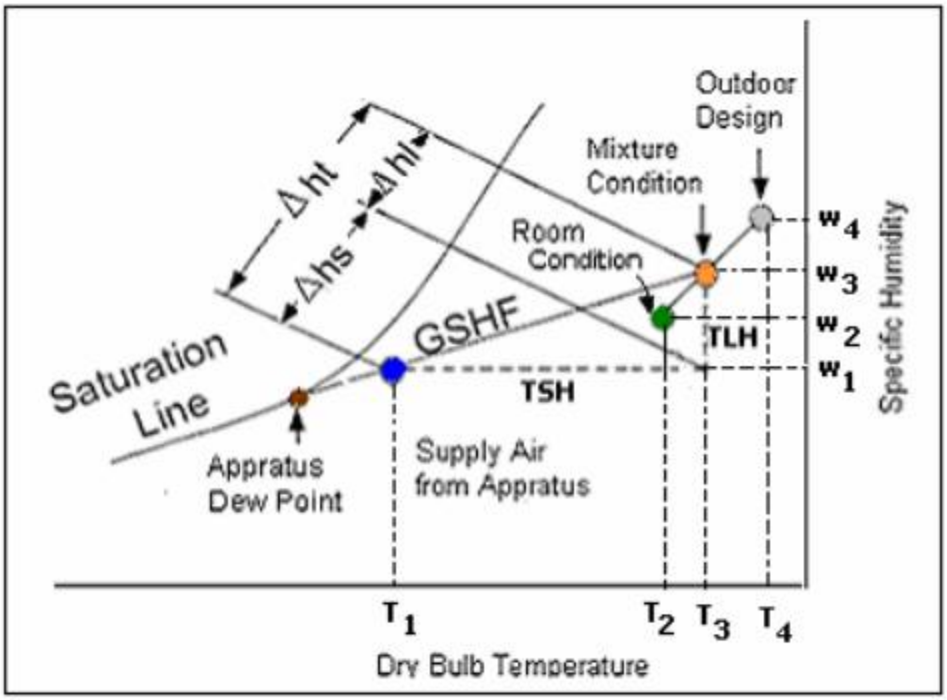
GSHF = grand sensible heat factor

TSH = total sensible heat

TLH = total latent heat

GTH = grand total heat

The air which is passing through the AHU coil increases or decreases the temperature and/or the moisture content. The amount of rise or fall is determined by the total sensible and latent heat load that the conditioning apparatus must handle. The condition of the air entering the apparatus (mixture condition of outdoor and returning room air) and the condition of the air leaving the apparatus is plotted on the psychrometric chart as shown below.



GSHF Line is plotted between mixture conditions to supply air leaving condition from apparatus. The slope of the GSHF line represents the ratio of sensible and latent heat that the apparatus must handle. GSH is projected on the enthalpy lines to estimate the Δhs (grand sensible load) and RLH is projected on the enthalpy lines to estimate the Δhl (grand latent load). Grand total load (GTH) is the enthalpy difference between the mixed air condition and the supply air condition.