where

U_t = heat transfer expressed in Btu per hour per square foot per degree difference in temperature between steam and air, for transverse flow.

At a velocity of 400 fpm, $U_t = 5.8$; at a velocity of 800 fpm, $U_t = 9.3$.

Referring to Fig. 3, showing the rate of heat transmission by evaporation for different air velocities, it will be noted that for transverse flow there are 560 Btu per hour per square foot transferred per inch difference of vapor pressure at a velocity of 400 fpm, and 910 Btu per hour per square foot per inch difference in vapor pressure at a velocity of 800 fpm. One inch of vapor pressure difference corresponds approximately to 95 deg difference between the wet- and dry-bulb temperature. Dividing by 95,

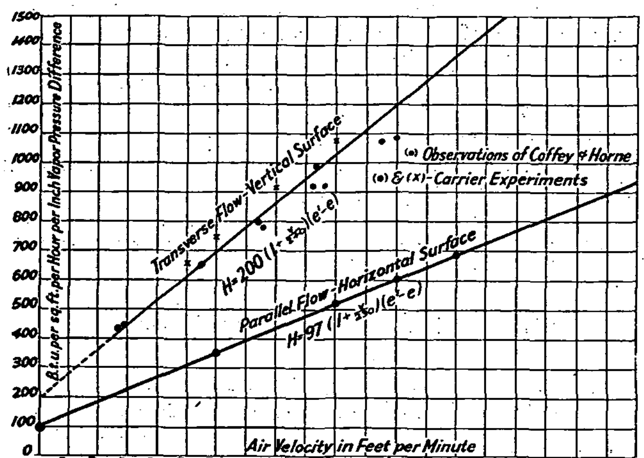

FIG. 3. HEAT TRANSMITTED BY EVAPORATION

the value of 5.9 Btu per square foot per degree difference in temperature is obtained for a velocity of 400 fpm, and 9.55 Btu per square foot for a velocity of 800 fpm.

It will be noted that for these two cases the heat transfer by evaporation per degree difference in temperature corresponds almost exactly with the heat transfer by convection coils. The similarity may be noted by comparing the formula for heat transfer in parallel flow, where

$$U_p = \frac{1}{0.026 + \frac{161}{v}} \tag{20}$$

with the heat transfer by evaporation with parallel flow. The relationship will be seen to be very close in both cases and would indicate that the heat transfer by evaporation is actually brought about by a process of convection.

The difference in form of the two formulae may be due in part to errors in observation at the higher and lower velocities.

In cooling air and condensing out the moisture therefrom the heat transfer is considerably more rapid than when the air is dry and no moisture is condensed. In general the rate of heat transmission on the air side is increased an amount which is proportionate to the latent heat removed as compared with the sensible heat removed. That is, if the latent heat removed was 50 per cent of the sensible heat removed, then the conductivity of the surface in contact with the air would be increased approximately 50 per cent.

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PROBLEMS IN PRACTICE

1 ● Given air at 70 F dry-bulb and 50 per cent relative humidity with a barometric pressure of 29.00 in. Hg, find the weight of vapor per pound of dry air.

Weight of saturated vapor per pound of dry air = W_t = 0.01578 lb (Table 5). Saturation pressure of the vapor at 70 F = e_t = 0.7386 in. Hg.

From Equation 7,

$$W = \frac{0.01578 \times 0.5\ (29.00 - 0.7386)}{29.00 - (0.5)\ (0.7386)}$$

W = 0.00779 lb of vapor per pound of dry air at 70 F dry-bulb and 50 per cent relative humidity.

Approximate Method:

0.01578 × 0.5 = 0.00789 lb of vapor per pound of dry air at 70 F dry-bulb and 50 per cent relative humidity.

2 ● Given air with a dry-bulb temperature of 80 F, relative humidity of 55 per cent, and a barometric pressure of 29.92 in. Hg, calculate the weight of a cubic foot of the mixture.

Weight of saturated vapor per cubic foot = 0.001580 lb (Table 5).