$\overline{KE_2}$ = average kinetic energy *at* section 2, Btu per pound dry air.

$\overline{PE_2}$ = average potential energy *at* section 2, Btu per pound dry air.

h_1 = enthalpy *at* section 1, Btu per pound dry air.

$\overline{KE_1}$ = average kinetic energy *at* section 1, Btu per pound dry air.

$\overline{PE_1}$ = average potential energy *at* section 1, Btu per pound dry air.

${}_1l_2$ = shaft work withdrawn *between* sections 1 and 2, Btu per pound dry air.

In Equation 30 all quantities are *per pound of dry air*. If Equation 27 is used in computing average kinetic energy, the result will be in Btu per pound of dry air if v is taken as volume per pound of dry air. If Equation 28 is used, multiplication by $(1 + W)$ as in Equation 29 is required though this is a refinement seldom justified.

Properties of saturated steam are given in Table 8 and for additional definitions refer to Chapter 46.

REFERENCES

Rational Psychrometric Formulae, by W. H. Carrier (*A.S.M.E. Transactions*, Vol. 33 1911, p. 1005).

Heat and Thermodynamics, by J. K. Roberts (Chapter IV), (Blackie and Son, London, 1928).

Das i, x-Diagramm für Dampfluftgemische, by R. Mollier (ZVDI, 1929).

The Theory of the Psychrometer, by J. H. Arnold (*Physics*, Vol. 4, 1933).

Thermodynamic Properties of Moist Air, by John A. Goff (A.S.H.V.E. TRANSACTIONS, Vol. 40, 1934, p. 199).

Thermodynamic Properties of Steam, by J. H. Keenan and F. G. Keyes (John Wiley and Sons, Inc., New York, 1936).

Notes on Thermodynamics, by John A. Goff (John S. Swift Company, St. Louis, 1939).

Thermal Properties of Saturated Water and Steam, by N. S. Osborne, H. F. Stimson and D. C. Ginnings (*National Bureau of Standards*, Research Paper No. RP 1229, 1939).

Psychrometric Chart, Its Application and Theory, by William Goodman (*Heating, Piping and Air Conditioning*, June, 1939 to August, 1940).

Chapter 2

PHYSIOLOGICAL PRINCIPLES

Chemical Vitiation of Air, Physical Impurities in Air, Thermal Changes Between the Body and Its Environment, Adaptation to Hot Conditions, Adaptation to Cold Conditions, Relation of Air Conditioning Needs to Metabolism, Acclimatization, Effective Temperature Index, Physiological Objectives of Heating and Ventilation, Relation of Air and Wall Temperatures, Influence of Humidity, Influence of Air Movement, The Four Vital Factors

VENTILATION is defined in part as *the process of supplying or removing air by natural or mechanical means to or from any space.* (see Chapter 46). The word in itself implies quantity but not necessarily quality. From the standpoint of comfort and health, however, the problem is now considered to be one of securing air of the proper quality rather than of supplying a given quantity.

The term *air conditioning* in its broadest sense implies control of any or all of the physical or chemical qualities of the air. More particularly, it is often used to include the simultaneous control of temperature, humidity, movement and quality of air. The term is broad enough to embrace whatever factors may be found desirable, in a given case, for maintaining the atmosphere of occupied spaces at a condition best suited to the physiological requirements of the human body.

CHEMICAL VITIATION OF AIR

Under the artificial conditions of indoor life, the air undergoes certain physical and chemical changes which are brought about by the occupants themselves. The oxygen content is somewhat reduced, and the carbon dioxide slightly increased by the respiratory processes. Organic matter, which is usually perceived as odors, comes from the nose, mouth, skin and clothing. The temperature of the air is increased by the metabolic processes, and the humidity raised by the moisture emitted from the skin and lungs.

Contrary to old theories, the usual changes in oxygen and carbon dioxide are of no physiological concern because they are too small to produce appreciable effects even under the worst conditions of normal human occupancy. The amount of carbon dioxide in air is often used in ventilation work as an index of odors of human origin, but the information it affords rarely justifies the labor involved in making the observation[1,2].

[1] A.S.H.V.E. RESEARCH REPORT No. 959—Indices of Air Change and Air Distribution, by F. C. Houghten and J. L. Blackshaw (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 261).

[2] A.S.H.V.E. RESEARCH REPORT No. 1031—Ventilation Requirements, by C. P. Yaglou, E. C. Riley and D. J. Coggins (A.S.H.V.E. TRANSACTIONS, Vol. 42, 1936, p. 133).