

- 6 • Use the degree-day method of computing the amount of coal required to heat an office building located in Cleveland, Ohio, assuming that the net heated space is 30,000 cu ft.

The steam consumption factor for office buildings is 0.975 pounds per M cu ft per degree-day (Table 3). Cleveland has 6154 degree-days per year (Table 1).

$$0.975 \times 6154 \times 30 = 180,000 \text{ lb of steam.}$$

From Fig. 2, this is equivalent to 13 tons of coal.

- 7 • Make a rough approximation of the gas required to heat a building located in Chicago, Ill., assuming that the calculated heating surface requirements are 1000 sq ft of hot water radiation based on design temperatures of 0 F and 70 F. Chicago has 800-Btu mixed gas, and 6315 degree-days.

Using Fig. 2, the fuel consumption for a design temperature of 0 F with 800-Btu gas is found to be 0.08 cu ft of gas per degree-day per square foot of hot water radiation.

$$0.08 \times 6315 \times 1000 = 505,200 \text{ cu ft.}$$

- 8 • A certain building has a maximum heat loss of 250,000 Btu per hour in -15 F weather. How many tons of fuel will be required to maintain a temperature of 70 F during a 260-day heating season in which the average temperature is 39 F? The heating value of the fuel is 13,200 Btu per pound and the efficiency of combustion is 60 per cent.

$$\frac{250,000 (70 - 39) 260 \times 24}{(70 + 15) 13,200 \times 0.60 \times 2000} = 35.9 \text{ tons.}$$

- 9 • Which item may be determined more closely, the heating value of a fuel or the efficiency of its combustion?

The heating values of oil, gas, and solid fuels are closely determinable, whereas the efficiency of burning depends on the particular equipment chosen and the skill used in handling it.

- 10 • In an office building, the thermostats are set to maintain 70 F from 7 a.m. to 5 p.m. and 50 F during the rest of the time. When the outside temperature is 30 F, how much saving might be expected because the temperatures are lowered? Under the above conditions the building becomes 50 F by 11 p.m. and warms up to 70 F by 8 a.m.

A temperature of 70 F is maintained during 9 hours, and one of 50 F during 8 hours; the temperature would average about 60 F during the 7 hours required for cooling down and warming up. The average is 60.4 for the 24 hours. (The average temperature calculated would have been 58.3 F, had the warming and cooling periods been neglected.)

$$\text{The saving is } \left(\frac{70 - 60.4}{70 - 50} \right) \times 100 = \frac{9.6}{40} \times 100 = 24 \text{ per cent.}$$

- 11 • How does the heat capacity of a structure influence the saving made by carrying lower temperatures during the night?

The heat storage capacity of the walls prevents rapid dropping of temperatures at night-time and delays the warming up process in the morning. In an extreme case, the building would not reach the lowered temperature by the time the higher temperature is called for in the morning. But under any conditions, the saving made by lowering the temperature can be correctly estimated by using the average temperature observed over the 24-hour period as a factor, as in Question 10.

- 12 • What are some of the miscellaneous factors that may cause actual fuel consumption to vary from the theoretical fuel requirements as calculated by the use of heat losses, temperature difference, and fuel burning efficiency?

The opening of windows; abnormally high or low inside temperatures; other sources of heat, such as machinery or lights; sun effect; and unusual winds.

Chapter 30

RADIATORS AND GRAVITY CONVECTORS

Heat Emission of Radiators and Convectors, Types of Radiators, Output of Radiators, Heating Effect, Heating Up the Radiator, Enclosed Radiators, Convectors, Selection, Code Tests, Gravity-Indirect Heating Systems

THE accepted terms for heating units are: (1) *radiators*, for direct surface heating units, either exposed, enclosed, or shielded, which emit a large percentage of their heat by radiation; and (2) *convectors*, for heating units having a large percentage of extended fin surface and which emit heat principally by convection. Convectors are dependent upon enclosures to provide the circulation by gravity of large volumes of air.

HEAT EMISSION OF RADIATORS AND CONVECTORS

All heating units emit heat by *radiation* and *convection*. The resultant heat from these processes depends upon whether or not the heating unit is exposed or enclosed and upon the contour and surface characteristics of the material in the units.

An exposed radiator emits less than half of its heat by radiation, the amount depending upon the size and number of sections. When the radiator is enclosed or shielded, radiation is further reduced. The balance of the emission is by conduction to the air in contact with the heating surface, and the resulting circulation of the air warms by convection.

A convector emits practically all of its heat by conduction to the air surrounding it and this heated air is in turn transmitted by convection to the rooms or spaces to be warmed, the heat emitted by radiation being negligible.

TYPES OF RADIATORS

Present day radiators may be classified as tubular, wall, or window types, and are generally made of cast iron. Catalogs showing the many designs and patterns available now include a junior size which is more compact than the standard unit.

Pipe Coils

Pipe coils are assemblies of standard pipe or tubing (1 in. to 2 in.) which are used as radiators. In older practice these coils were commonly used in factory buildings, but now wall type radiators are most frequently used for this service. When coils are used, the miter type assembly is to be