

RELATIVE HEATING COSTS

A comparison of the relative cost of heating with different fuels can be made with even a fair degree of accuracy only when there is a full knowledge of the equipment which will be used with each fuel, and the efficiency with which each will be operated. When proposing to substitute one fuel for another, the yearly cost with the fuel being used can be obtained. The accuracy of the comparison will depend upon the care taken in estimating the cost of the new fuel with the equipment which will be used.

A convenient basis for comparison of various fuels is the cost per million Btu. The formula used in estimating costs for coal is:

$$X = \frac{500 \times c}{C_c \times E_c} \quad (4)$$

where

X = cost of heating with coal in dollars per million Btu.

c = cost of coal in dollars per ton.

C_c = calorific value of coal, Btu per pound.

E_c = over-all or house efficiency for coal, expressed as a decimal.

Example 4. If coal having a calorific value of 13,000 Btu per pound costs \$10.00 per ton, the cost per million Btu, assuming an efficiency of 60 per cent, will be:

$$X = \frac{500 \times 10}{13,000 \times 0.60} = \$0.64$$

The formula used in estimating costs for oil is:

$$Y = \frac{1,000,000 \times p}{C_o \times W \times E_o} \quad (5)$$

where

Y = cost of heating with oil in dollars per million Btu.

p = cost of oil in dollars per gallon.

C_o = calorific value of oil, Btu per pound.

W = weight of oil per gallon, pounds.

E_o = over-all or house efficiency for oil, expressed as a decimal.

Example 5. If oil having a calorific value of 141,000 Btu per gallon ($C_o \times W$) costs 10¢ per gallon, the cost per million Btu, assuming an efficiency of 70 per cent, will be:

$$Y = \frac{1,000,000 \times 0.10}{141,000 \times 0.70} = \$1.01$$

The formula used in estimating costs for gas is:

$$Z = \frac{1000g}{C_g \times E_g} \quad (6)$$

where

Z = cost of heating with gas in dollars per million Btu.

g = average cost of gas, including demand and commodity charges, dollars per thousand cubic feet.

C_g = calorific value of gas, Btu per cubic foot.

E_g = over-all or house efficiency for gas, expressed as a decimal.

Example 6. If manufactured gas, having a calorific value of 535 Btu per cubic foot, costs 60¢ per thousand cubic feet, the cost per million Btu, assuming an efficiency of 80 per cent, will be:

$$Z = \frac{1000 \times 0.60}{535 \times 0.80} = \$1.40$$

PROBLEMS IN PRACTICE

1 • What two factors are most essential in estimating the fuel consumption for heating a building in a normal season?

The total heat requirements of the building, and the efficiency of combustion.

2 • What will be the cost per year of heating a building with gas, assuming that the calculated hourly heat loss is 92,000 Btu based on 0 F, which includes 26,000 Btu for infiltration? The design temperatures are 0 F and 72 F. The normal heating season is 210 days, and the average outside temperature during the heating season is 36.4 F. The heating efficiency will be 75 per cent. The heating plant will be thermostatically controlled, and a temperature of 55 F will be maintained from 11 p.m. to 7 a.m. Assume that the price of gas is 7 cents per 100,000 Btu of fuel consumption, and disregard the loss of heat through open windows and doors.

The maximum hourly heat loss will be

$$92,000 - \frac{26,000}{2} = 79,000 \text{ Btu} = H.$$

$$F = \frac{79,000 \times (72 - 36.4) \times 24 \times 210}{100,000 \times 0.75 \times (72 - 0)} = 2624.9 \text{ hundred thousand Btu.}$$

The average inside temperature will be

$$\frac{(72 \times 16) + (55 \times 8)}{24} = 66.3 \text{ F.}$$

The fuel saving will be

$$\frac{100(72 - 66.3)}{72 - 36.4} = 16 \text{ per cent.}$$

Hence, the net fuel consumption will be

$$2624.9 - 0.16 \times 2624.9 = 2204.9 \text{ hundred thousand Btu.}$$

$$2204.9 \times 0.07 = \$154.34 = \text{the cost per year of heating the building.}$$

3 • What factors should be taken into consideration when determining the efficiency at which a fuel will be burned?

Manufacturers' catalogs usually give equipment efficiencies obtained under test conditions. These values do not allow for poor attendance, defects in installation, or poor draft. Such efficiencies do not consider heat radiated from the outside of the equipment, but in many cases this heat is utilized.

4 • If 20 tons of coal having a calorific value of 13,000 Btu per pound are burned in a warm air furnace and produce 286,000,000 Btu at the bonnet, what is the efficiency of the furnace?

$$\frac{\text{Number of Btu at bonnet}}{\text{Number of tons} \times \text{calorific value} \times \text{number of lb in one ton}} = \text{efficiency.}$$

$$\frac{286,000,000 \times 100}{20 \times 13,000 \times 2000} = 55 \text{ per cent.}$$

5 • In making degree-day calculations, why is the base of 65 F used for an inside temperature of 70 F?

This base was chosen because data collected from numerous installations show that heat is seldom supplied to a residence when the outdoor temperature is greater than 65 F. It was also found that the amount of fuel consumed varied in almost direct proportion with the difference between 65 F and the outside temperature.