

Table 9 also gives the calorific values of the more common types of manufactured gas. Most states have legislation which controls the distribution of gas and fixes a minimum limit to its heat content. The gross or higher calorific value usually ranges between 520 and 545 Btu per cubic foot, with an average of 535. A given heat value may be maintained and yet leave considerable latitude in the composition of the gas so that as distributed the composition is not necessarily the same in different districts, nor at successive times in the same district. However, in any community the variations in gas composition are held within suitable limits so that the performance of approved gas appliances will not be adversely affected.

COMBUSTION OF GAS

The majority of gas burners utilized in central domestic heating plants are of the Bunsen type and operate with a non-luminous flame. In this type of burner part of the air required for combustion is mixed with the gas as primary air, the air and gas mixture being fed to the burner ports. Additional secondary air is introduced around the flame by draft inspiration. In the luminous flame burner, which is sometimes used, all of the air for combustion is brought in contact with the flame as secondary air. This secondary air should be brought into intimate contact with the gas.

Some makes of burners use radiants or refractories to convert some of the energy in the gas to radiant heat. The radiants also serve as baffles in directing the flow of the products of combustion.

The quantity of air given in Table 9 is that required for theoretical combustion, but with a properly designed and installed burner the excess air can be kept low. In order to insure freedom from carbon monoxide under conditions which may obtain in installations, it is customary to design gas burning appliances for a supply of 30 to 35 per cent of excess air. In individual installations in which flue gas analyses are made, the excess air is sometimes reduced to approximately 20 per cent. The division of the air into primary and secondary is a matter of burner design, the pressure of gas available, and the type of flame desired.

The air gas ratio has a decided effect upon flame propagation. It is necessary that the gas will flow out of the burner ports fast enough so that the flame cannot travel back into the burner head, i.e. *flash back*, but the velocity must not be so high that it blows the flame away from the port.

The maximum and minimum flow speeds from burner ports which may be permitted are known to be very close together when air-gas mixtures in theoretical proportions are being supplied to the burner. As the air-gas ratio is lowered, and the mixture becomes more *gas rich*, the limiting speeds become farther apart, until with 100 per cent gas, in an all-yellow flame, flash back cannot occur and a much higher velocity is needed to blow off the flames.

SOOT

The deposit of soot on the flue surfaces of a boiler or heater acts as an insulating layer over the surface and reduces the heat transmission to the water or air. The *Bureau of Mines Report of Investigations No. 3272*⁴ shows that the loss of seasonal efficiency is not so great as has been believed and usually is not over 6 per cent because the greater part of the heat is transmitted through the combustion chamber surfaces. The *Bureau of Standards Report BMS 54*⁵ points out that, although the

decrease in efficiency of an oil fired boiler due to soot deposits is relatively small the attendant increase in stack temperature may be considerable.

The soot accumulation clogs the flues, reduces the draft, and may prevent proper combustion.

CONDENSATION AND CORROSION

Sulphur dioxide or trioxide formed by the combustion of fuels is the corroding element in flue gases and becomes active whenever moisture is available for the formation of sulphurous or sulphuric acid. It is therefore necessary to maintain a flue gas temperature above 175 F in all parts of appliances, and consequently it is not practicable to recover the latent heat in flue gases. Since some unpreventable condensation occurs during the warming-up period, it is important to design appliances so that all surfaces reach quickly a temperature above the dew-point of the flue gases or have corrosion-resistant properties enabling them to withstand the corrosive effect.

DUSTLESS TREATMENT OF COAL

The practice of treating the more friable coals to allay the dust they create is increasing. The coal is sprayed with various petroleum products, a solution of calcium chloride or a mixture of calcium and magnesium chlorides.

The coal is usually treated at the mine, but sometimes by the local distributor just before delivery. The salt solutions are sprayed under high pressure, using from 2 to 4 gal or from 5 to 10 lb of the salt per ton of coal, depending on its friability and size. Oil for the dustless treatment of coal is also applied under high pressure, in concentrations of 1 to 8 qt per ton of coal, depending upon the characteristics of the coal and oil.

Dustless treatments which are of such a corrosive nature that they may damage coal handling or burning equipment should not be used.

REFERENCES

- ¹—Hand Firing Soft Coal Under Power Plant Boilers (*U. S. Bureau of Mines Technical Paper No. 80*).
- ²—Five Hundred Tests of Various Coals in Househeating Boilers (*U. S. Bureau of Mines Bulletin No. 276*).
- ³—Quality of Anthracite as Prepared at Breakers, 1935 (*U. S. Bureau of Mines Report of Investigations, R. I. 3283*).
- ⁴—Effect of Soot on Heat Transmission in Boilers (*U. S. Bureau of Mines Report of Investigation No. 3272*).
- ⁵—Effect of Soot on the Rating of an Oil-Fired Heating Boiler (*National Bureau of Standards Report BMS 54*).

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- Classification and Selection of Illinois Coals, by G. H. Cady (*Illinois State Geological Survey Bulletin No. 62*).