small installations it is advisable to keep the furnace temperature low enough to avoid slagging the ash, with the consequent troubles of removing the slagged deposits from the hearth and walls; without the slagging the ash remains in a fluffy form and is easily removed. On the other hand, considerable ash may be carried out of the stack and create a nuisance in the district; the elimination of ash in the stack gases is one of the problems associated with the application of pulverized fuel to heating boilers. Proposals have been made to use pulverized coal for household furnaces, delivering it into bins in its prepared state. Coal in pulverized form is transported to a limited extent in Europe.

STORAGE SPACE FOR COAL

The storage space required for coal or coke is dependent upon the frequency of fuel purchases during the heating season, as well as upon the rate at which the fuel is burned.

In general, the size of the storage space can be determined on the basis of burning 3½ tons of coal or coke per heating season per 100 sq ft of attached equivalent radiation, based on a heat emission of 240 Btu per square foot.

Anthracite coal weighs approximately 52.5 lb. per cubic foot; bituminous, 45 lb. per cubic foot; and coke, 28 lb. per cubic foot.

DUSTLESS COAL

The practice of treating the more friable coals to allay the dust they create is increasing. The coal is sprayed with a solution of calcium chloride or a mixture of calcium and magnesium chlorides. Both these salts are very hygroscopic and their moisture under normal atmospheric conditions keeps the surface of the coal damp, thus reducing the dust during delivery and in the cellar, and obviating the necessity of sprinkling the coal in the bin.

The coal is sometimes treated at the mine but more usually by the local distributor just before delivery. The solution is 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.

HEATING COSTS WITH COAL

In most cases, heating costs with coal are lower than the costs with gas, oil or electricity, even though the efficiency of combustion usually is less than that with gas and oil. At prices of today the cost of coal ranges from about 40 cents to $1.20 per 1,000,000 Btu, giving proper consideration to efficiencies. For comparisons with the cost of other heat sources, see Chapters 16, 17 and 18.

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Chapter 16

LIQUID FUELS

Specifications for Liquid Fuels; Types of Oil Burners; Domestic Burners; Atomization; Air for Combustion; Ignition; Temperature Control; Protective Devices; Intermittent and High-Low-Operation; Boilers for Domestic Systems; Storage Tanks; Installation; Service; Cost of Oil Heating; Commercial Oil Burners; Fuel Storage; Oil Pumps; Boiler Settings.

OIL is used in *domestic* heating largely because it can be supplied automatically as required with practically no attention, and because there is no residue to be removed by hand. Cleanliness is also a factor, as is ability to provide an ample supply of domestic water through the summer with the same burner and boiler that heats the home.

Different factors control the selection of oil for what commonly is called *commercial* heating, involving such buildings as apartment houses, churches, office buildings, hotels, department stores, public buildings and schools. The use of oil fuel for these buildings is governed largely by the economic factor rather than by the convenience, cleanliness or comfort elements. For large commercial installations, the design should permit either liquid or solid fuel to be burned at will, depending upon relative unit costs. This makes possible the production of heat at the lowest cost, and prevents excessive cost through control of the market on one or the other fuels.

Quality and certainty of local oil supply rapidly are ceasing to be factors, owing to general acceptance of uniform oil fuel specifications, and the growing tendency for coal dealers to sell oil fuel. Few heating plants are beyond a reasonable delivery distance from a reliable source of at least three grades of oil, which simplifies the problem of selection of burner type.

SPECIFICATIONS FOR LIQUID FUELS

Uniform oil specifications were prepared in 1929 by the *American Oil Burner Association*, in cooperation with the *American Petroleum Institute*, the U. S. Bureau of Standards, the *American Society for Testing Materials* and other interested organizations. Oil fuels were classified into six groups, as indicated by Table 1. When these specifications were prepared, it was generally accepted that the first three grades were adapted to domestic use, while the last three were suitable only for commercial and industrial burners. This differentiation has not proved stable, and today domestic installations are using Nos. 4 and 5 of the so-called *heavy-oil* group. Several burners adapted to domestic use have recently been listed for automatic