

then to attempt to burn the fuel at a high rate while warming up. A uniform low fire will minimize the clinker formation and keep the clinker in an easily broken up condition so that it readily can be shaken through the grate.

Forced draft and small mesh grates are frequently used for burning buckwheat anthracite. For best results and a higher degree of convenience, domestic stokers are used.

No. 2 buckwheat anthracite, or rice size, is used only in domestic stokers. No. 3 buckwheat anthracite, or barley, has no application in domestic heating.

The *Anthracite Institute* Standards of sizing are shown in Table 6 taken from *Anthracite Industries Manual*, Report No. 2403.

### FIRING METHODS FOR BITUMINOUS COAL

Bituminous coal should never be fired over the entire fuel bed at one time. A portion of the glowing fuel should always be left exposed to ignite the gases leaving the fresh charge.

Air should be admitted over the fire through a special secondary air device, or through a slide in the fire-door or by opening the fire-door slightly. If the quantity of air admitted is too great the gases will be cooled below the ignition temperature and will fail to burn. The fireman can judge the quantity of air to admit by noting when the air supplied is just sufficient to make the gases burn rapidly and smokelessly above the fuel bed.

The red fuel in the firebox, before firing, excepting only a shallow layer of coke on the grate, should be pushed to one side or forward or backward to form a hollow in which to throw the fresh fuel. Some manufacturers recommend that all red fuel be pushed to the rear of the firebox and that the fresh fuel be fired directly on the grate and allowed to ignite from the top. The object of this is to reduce the early rapid distillation of gases and to reduce the quantity of secondary air required for smokeless combustion.

It is well to have the bright fuel in the firebox so placed that the gases from the freshly fired fuel, mixed with the air over the fuel bed, pass over the bed of bright fuel on the way to the flues. The bed of bright fuel then supplies the heat to raise the mixture of air and gas to the ignition temperature, thereby causing the gaseous matter to burn and preventing the formation of smoke.

The importance of firing bituminous coal in small quantities at short intervals is discussed in the *U. S. Bureau of Mines Technical Paper*, No. 80. Better combustion is obtained by this method in that the fuel supply is maintained more nearly proportional to the air supply.

This is demonstrated in Fig. 5 where diagram A shows the air supply and the distillation of the volatile combustible when the firings are 5 min apart; and diagram B indicates the same relationships when the firings are 15 min apart. In both cases the amount of coal fired per hour and the weight of volatile combustible distilled from the coal are the same. This weight of volatile combustible is represented by the shaded area under the saw-tooth curve. The horizontal dotted lines represent the constant air

supply sufficient to burn the volatile matter represented by the shaded areas under each line. The shaded areas above each horizontal line represent for each air supply the loss from incomplete combustion of the volatile matter. The clear area under each horizontal line represents the loss from excessive air. As the air supply increases the loss from incomplete combustion decreases but the loss from excessive air becomes larger. The sum of the two losses is the least when the air supply is introduced as noted by the average line. It is evident that the sum of the losses for the average air supply is much larger in diagram B than in A which would indicate that small and frequent firings are better than large firings at long intervals.

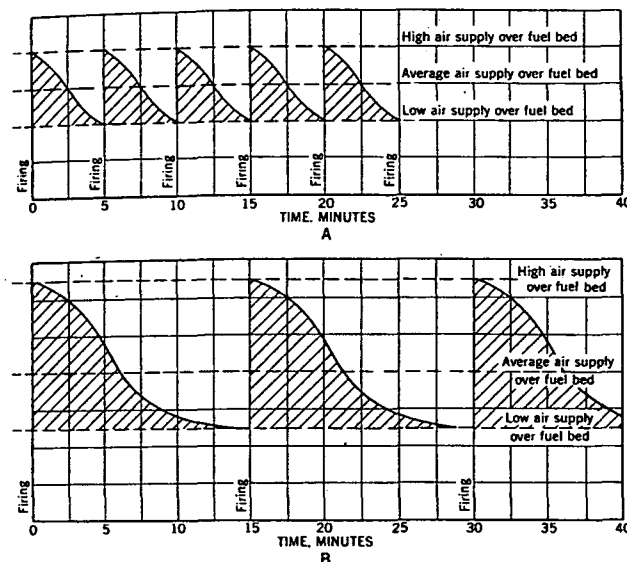


FIG. 5. RELATION OF RATE OF DISTILLATION OF VOLATILE MATTER AND NECESSARY AIR SUPPLY

If the coal is of the caking kind the fresh charge will fuse into one solid mass which can be broken up with the stoking bar and leveled from 20 min to one hour after firing, depending on the temperature of the firebox. Care should be exercised when stoking not to bring the bar up to the surface of the fuel as this will tend to bring ash into the high temperature zone at the top of the fire, where it will melt and form clinker. The stoking bar should be kept as near the grate as possible and should be raised only enough to break up the fuel. With fuels requiring stoking it may not be necessary to shake the grates, as the ash is usually dislodged during stoking.

It is acknowledged that it may be difficult to apply the outlined methods to domestic heating boilers of small size, especially when frequent attendance is impractical. The adherence to these methods insofar as practical, however, will result in better combustion.