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Hand Firing Soft Coal

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Hand Firing Soft Coal

In order to secure efficient combustion in any boiler furnace, the furnace must be correctly designed and properly operated. A furnace designed according to correct principles is ineffective without proper operation, and no fireman can secure the best results with a furnace unsuited to the kind and quantity of fuel burned.

In this bulletin, which is intended for the use of those in charge of hand fired plants; mention only is made of some of the requirements of furnaces for burning soft coal, it being the purpose to explain those firing methods which practical experience has shown to be the most successful under average conditions in this state. While the particular methods of firing explained will not make it possible to obtain equal success in the operation of all furnaces or in the burning of all kinds of fuel, their adoption will give satisfactory results in most cases.

REGULATE DRAFT BY DAMPER IN UPTAKE.

Combustion or burning of coal is a chemical process in which the combustible combines with the oxygen of the air.

In order to have combustion it is necessary that a certain temperature known as the kindling temperature be reached and maintained. A fire is kindled to raise the temperature to this point; after the fire is started the heat produced by the combustion of the fuel maintains the temperature, and combustion continues as long as the proper amounts of fuel and air are supplied.

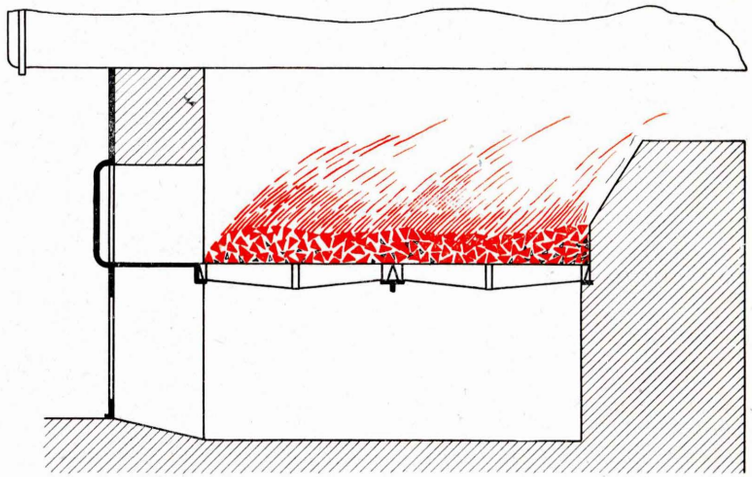
Combustion is an exact process; that is in order to burn one pound of a combustible, a certain definite quantity of oxygen is required, and a definite amount of heat is produced.

Since the oxygen required for combustion is obtained from the air, provision is made for controlling the admission of air to the fire so that the quantity can be regulated to suit the furnace conditions.

This regulation should be secured by the manipulation of the damper in the uptake or breeching, the damper being opened to increase the draft and allow larger quantities of air to enter when it is necessary to burn large amounts of fuel, and closed to cut down the draft when the demand for a heavy fire has ceased. The draft should not be regulated by opening the fire doors or by closing the ash pit doors. If the fire doors are opened the furnace is cooled off by the inrush of large quantities of excess air and heat is wasted. Closing the ash pit doors, of course, decreases the amount of air through the fire but may also cause over-heating of the grates, and fusing of the ash on the grates into clinker. Another bad effect of closing the ash pit doors to cut the draft, without closing the uptake damper, is that excess air is drawn into the furnace through cracks in the walls or other openings in the setting.

FIRE SMALL QUANTITIES AT FREQUENT INTERVALS.

When soft coal is placed on a hot fire a considerable quantity of gas commonly called volatile matter, is driven off rapidly. This process which is known as distillation takes place



Carry a Thin, Level Fire Over the Entire Grate.

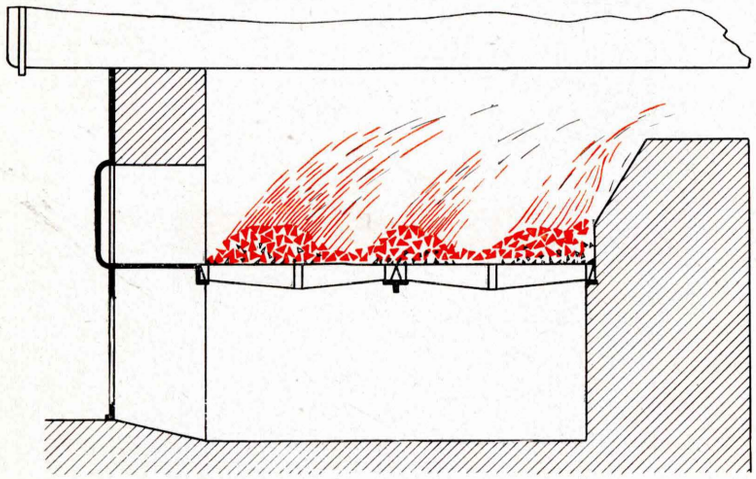
whether or not air be present. However, to secure the entire heat of the volatile matter, these gases must be completely burned before passing out of the combustion chamber. Most coals used in this state have a high percentage of volatile matter. In the case of some Iowa coals the volatile matter represents over 40 per cent of the heating value.

Since distillation takes place in the first few minutes after firing, and the rate of flow of air through the fuel bed is practically constant, extra air must be admitted above the fire during this time, in order to secure complete combustion. It is usually found necessary to admit this extra amount of air required, either through the damper openings in the fire doors or by leaving the fire doors open slightly for a few minutes immediately after firing.

As the amount of gas given off depends entirely upon the amount of fresh fuel, small amounts should be fired at frequent intervals to maintain as nearly as possible the proper proportions between fuel and air supply. The fire door dampers should be opened, or the doors cracked slightly for 2 or 3 minutes after firing. The fire doors should be closed as soon as the gas is burned or the furnace will be cooled off and heat wasted.

CARRY A THIN, LEVEL FIRE OVER THE ENTIRE GRATE.

A fuel bed of uniform thickness should be carried over the entire grate, so that combustion takes place at the same rate



Fire Fresh Coal on the Thin Spots.

in all parts of the furnace. If the bed is not of uniform thickness too much air may flow through the thinner spots, while too little may flow through the thicker parts due to their greater resistance.

The thickness of the fuel bed should vary according to the draft, but in all cases should be thin enough to allow sufficient air for complete combustion to flow through it. Just how thick a fuel bed should be cannot be said offhand, as the thickness which should be maintained in any particular plant depends upon the kind and size of fuel and the draft. With coals commonly used in Iowa, fuel beds should be from 4 to 6 inches thick to give the best results in most plants. Fuel beds less than 4 inches thick have a tendency to allow air to pass

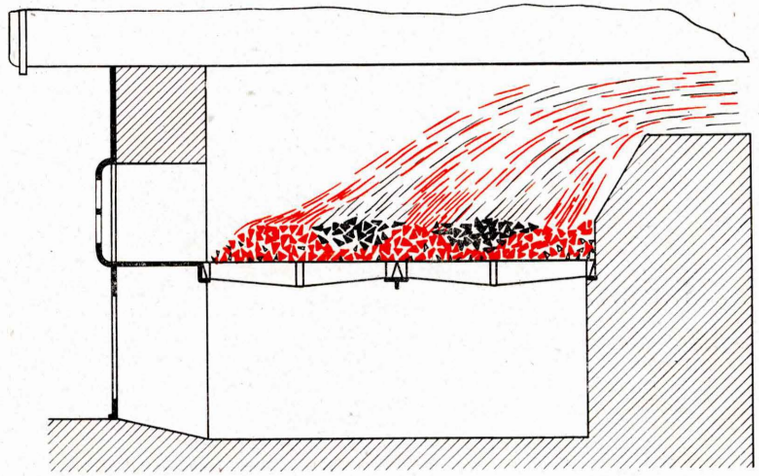
through without giving up its oxygen on account of the small holes that are usually found in them.

FILL UP THE BRIGHT OR THIN SPOTS.

As the fuel does not burn at the same rate over the entire grate, thin spots will develop in any fuel bed. This difference in rate of combustion may be due to clinker, caking of the coal, or difference in the sizes of coal.

The fireman should place the fresh coal on these thin or bright spots rather than cover the entire fuel bed. By doing so he will be able to keep the fuel bed level with little raking or poking.

With short intervals between firings there is small chance



Open Fire Door Slightly for Two or Three Minutes Immediately After Firing.

of the thin spots burning out entirely, and thus letting large amounts of cold air into the furnace through holes in the fuel bed.

Uneven burning due to difference in sizes of coal can be largely overcome by breaking all lumps to fist size. Caking is usually caused by firing too much coal at a time, especially if the coal contains much slack. Of course, if high or thick spots in the fire are caused by clinker it will be necessary to clean the fire to get the fuel bed to burn uniformly, as no air can get through the clinker.

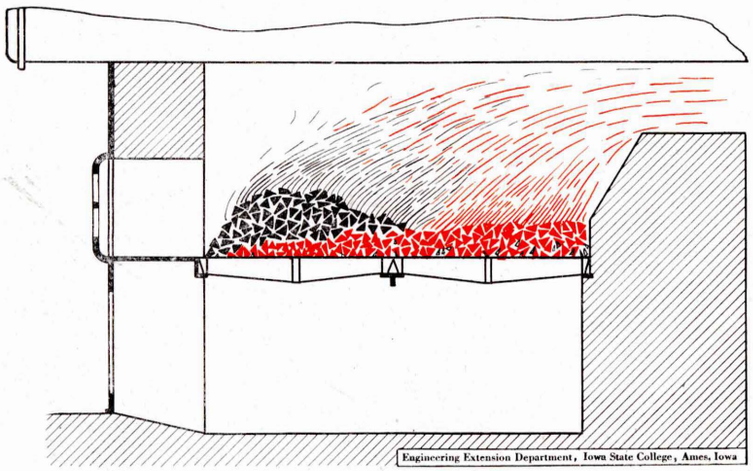
CAUSES OF CLINKER.

As clinker is caused by melting of ash any coal will form clinker if the ash is heated to the melting temperature.

The most common causes of clinker are thick fires, stirring the fire, firing coal containing much slack, closed ash pit doors and fire in the ash pit. Clinker forms in a thick fuel bed because the smaller supply of air through the grate permits the ash to become heated to the melting point. By stirring the fire, ash is lifted into the hotter parts of the fire and fused to clinker. Coal containing much slack may cake or form a crust over the fire, thus stopping the flow of air through the fire in the same way as a fuel bed which is too thick. Closed ash pit doors and fire in the ash pit cause over heating of the grates and the ash above them.

CLEANING FIRES.

On account of the fact that clinker and coarse ash will not



Use Coking Method for Firing Large Charges.

pass through the grates, it is necessary to clean the fires from time to time.

In the side method of cleaning fires, one side of the fire is cleaned at a time. The good coal is moved to one side of the grate, with the hoe or slice bar and the exposed clinker and ash removed. After one side of the grate has been cleaned, the good coal is all moved to that side and the rest of the grate cleaned. The burning fuel is then spread over the entire grate.

In the front to rear method of cleaning the burning coal is pushed back to the bridge wall and the coarse ash and clinker removed, after which the coal is spread over the grate.

USE COKING METHOD FOR FIRING LARGE CHARGES.

In many plants, especially small ones the fireman has other duties, in addition to firing, so that large charges must be fired at rather long intervals. When such is the case, the coking method of firing should be used.

In the coking method, the fresh coal is fired at the front of the grate, after most of the live coal has been pushed back. A considerable area of live coal is left uncovered at the back of the furnace, so that the volatile matter from the fresh charge, is burned in passing over this hot coal. The fire door should be cracked to admit the air required for combustion of the volatile matter. When the coal is coked it should be spread evenly over the entire fuel bed, and the fire door and fire door damper closed. Care should be used in spreading, not to stir up the fire.

SMOKE PREVENTION.

Smoke is caused by the presence of very fine particles of unburned carbon in the gases which pass out of the fire box. These particles are so fine that they are carried along by the slightest current and are able to float in the air for some time, finally being deposited as soot.

Practically all smoke is produced during the time that distillation is taking place, that is after firing fresh fuel. The products of perfect combustion being invisible gases, smoke appears only when combustion is incomplete, due to lack of air, imperfect mixing of air and gases, or cooling of the mixture before combustion takes place. Under these conditions, some of the carbon in the volatile matter is unconsumed and passes out as smoke.

It is often stated that black smoke issuing from a chimney for any considerable length of time is an indication that the full heating value of the fuel is not being utilized on account of furnaces improperly designed for the kind and quality of fuel being burned, or improper methods of firing or both. While this statement is absolutely true, the fact that a chimney is not smoking must not be taken as an indication of high furnace efficiency. As a matter of fact, this smokeless condition may be due to the dilution of the smoke by the admission of large quantities of excess air to the furnace. Every pound of air admitted to the furnace is excess of the amount actually required for combustion, simply decreases the efficiency of the furnace by absorbing heat and carrying it up the stack. Smoke prevention or rather dilution by this means is expensive.

The matter of furnace design is very important in burning coal having a large percentage of volatile matter. The combustion chamber must be designed to provide for the thorough mixing of air with the gases before they pass out of the chamber. In order to maintain a high temperature, the gases must not be allowed to come into contact with the comparatively cool boiler shell or tubes until combustion is complete, otherwise they may be cooled below the ignition temperature and pass out unburned.

These requirements are usually taken care of by having a combustion chamber of considerable length provided with a suitable fire brick arch or by covering part of the cooling surfaces (tubes and shell) with fire clay blocks. Many of the arches used serve two purposes—in helping to mix the gases and keeping them from being cooled.

The most common fault in the design of hand fired furnaces using Iowa coal is that the combustion chamber is too small. This is probably due in large measure to the installation of equipment designed for burning eastern coals, many of which are low in volatile matter, while Iowa coals often contain above 40 per cent volatile matter.