

owner, and that of the outside public, the combustion must be both economical and smokeless. These two conditions are not necessarily co-existent. A furnace may be highly economical, regarding economy from all points of view, and at the same time may be periodically sending forth a quantity of unburnt carbon in the form of smoke; or a chimney may be almost smokeless and at the same time may be working in a very wasteful manner. It must not be supposed that these two conditions are necessarily opposed to one another, but in some cases they may be, and it is necessary to be careful in discriminating between smokelessness and economy.

The principal conditions which affect us are as follows: The presence of smoke in the gases escaping from a boiler flue is in most cases due to an insufficient air supply either in the neighbourhood of the fire doors and above the fuel, or at the back of the furnace near the bridge, or to partially burnt gases coming in contact with the cooling surfaces provided by the boiler plates next the water. Second, economical combustion may be interfered with to a small extent only by the amount of carbon carried away as smoke and by a deposit of carbon on the tubes and plates which interferes with the proper transmission of heat through them.

The chief source of loss of economy in the combustion of coal is due to a too liberal air supply which, besides the excess of oxygen present, contains much inert nitrogen, which takes up heat and carries it away up the chimney to waste. A too small air supply results in the formation of a quantity of CO and the carbon burnt in producing it is only partially consumed, and yields less than one-third the heat that it ought to evolve in complete combustion. Great care is therefore necessary in arranging the air supply so as to give the maximum economy in the combustion, combined with a smokeless chimney besides serving as a carrier of heat to waste the excess of air has a cooling effect on the tubes.

If it is important that the air supply should be carefully regulated as to quantity, so also the time of admission should be attended to. After firing, the maximum quantity of oxygen is required for several minutes, until the whole of the hydrocarbons have been driven off and consumed; after this time the supply should be much reduced. An excessive supply of air after the hydrocarbons have been driven off is not needed and is a source of waste. During the gasification period or that immediately after firing, air should be supplied not only underneath and over the bars, but also at or near the bridge so as to completely consume the hydrocarbon gases.

It has been said that the presence of or freedom of smoke in a boiler depends more than anything else on the quantity of air supplied to the furnace, the time at which this supply