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A Preliminary Study of Stratification in the Furnace Tube of a Shell-Type Boiler Fired by a Chain-Grate Stoker

by M. V. Murray

SUMMARY

Experimental work is described in which gas samples have been taken in the furnace tube of an Economic boiler in an attempt to find out the degree of stratification of the gas streams. It is concluded that stratification does exist, and that it hampers the completion of the combustion reactions, because the combustible gases remain at the top of the tube whilst the air which has leaked through the back of the grate remains at the bottom of the tube. It is suggested that suitable baffles might speed up the release of heat.

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(1) Introduction

The gas composition in the furnace tube of a shell-type boiler gives an indication of the progress of the gaseous combustion reactions. A complete gas analysis at any point will show the proportion of heat which has been released and the amount which remains to be released.

Heat is transferred in the furnace tube mainly by radiation; it is obviously desirable that the heat should be released as early as possible, to attain the highest temperatures and so make the most effective use of the heating surface available. In the normal boiler designs, even the Economic or the Lancashire-type boiler with an Economiser, it is impracticable to provide sufficient convective heating surface to compensate for late heat release and consequent ineffective use of the furnace tube. A knowledge of the gas composition may indicate how best the combustion reactions can be speeded up.

In a gas producer or a combustion pot it is possible to gasify all the coal while supplying less air than is theoretically required for the complete oxidation of the carbon to carbon dioxide. With good mixing of the partially burnt gases with air it should be possible to achieve complete combustion with little excess air. In boiler operation, however, it is rarely possible to complete the combustion of coal on a grate without supplying at least 25% more air than should be required;