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Abstract

The objective of this thesis is to study the thermal performanse of small fire-tube packaged boilers manufactured locally, and to demonstrate how such performance data may be used to diagnose the thermal behaviour of the boilers. Overall heat balance characteristics and internal gas-to-water heat transfer effectiveness were investigated for two-pass dry-back fire-tube packaged boilers of different capacity and combustion mode.

In analysing the oveall thermal performance of boilers, the method of "Phenomenological Furnace Analysis"(Essenhigh et al.1970) was applied, giving the key parameters which constitute the basis of such analysis. The results show that the maximum thermal efficiencies are 87.0% and 87.65% at only 37.7% and 48.0% load for the 3600 kg/h and 4800 kg/h boilers respectively. Beyond these loads, the "Bottle-neck effect" occurs, suggesting that there is insufficient heat transfer area in the boilers.

The gas-to-water heat transfer rates in boilers, calculated on the basis of measured gas temperatures and velocities, indicate that the heat absorption efficiencies are generally moderate, with values ranging from 65.1% to 74.8% for chamber gas-to-water, and 63.5% to 73.7% for tube gas-to-water. The mean exhuast gas temperatures are generally higher than that estimated by empirical relations,indicating once again,the bottle-neck effect in the boiler

The two methods of analysis therefore yielded results which are in agreement, confirming that they are effective tools for thermal performanc analysis of boilers.