CHAPTER 5
TEST CONDITIONS AND PROCEDURE

5.1 Calibration

5.1.1 Fluxmeter

The fluxmeter was calibrated in the range of interest, using the hohlraum and a microvoltmeter. The combustor end surface of the sensing plug of the fluxmeter, mounted in the instrumented tube was placed in front of the hohlraum opening. To eliminate flow of heat by conduction, physical contact between them was avoided and a clearance of 1 mm was maintained. Care was taken to ensure that the meter was located in front of the opening. The cooling water passage of the fluxmeter and the radiometer were connected in parallel to a thermostat pump by PVC tubing and Y joints. The thermostat setting was adjusted to 40°C and in this condition, the water was circulated to the fluxmeter. While the fluxmeter was placed in front of the hohlraum for calibration, the radiometer was circulated with cooling water, without disturbing the cooling system. This ensured that the same quantity of water was circulated through the fluxmeter during calibration and measurement. During calibration water was passed through the instrumented tube taking care that the tube was with full of water.

The temperature of the surface of the hohlraum was regulated by controlling the voltage across the heater.
coils by dimmerstats. Care was taken to ensure that the variation in the surface temperature was within ± 3 percent. The e.m.f. output of the thermocouples in the hohlraum with respect to an ice junction and the differential e.m.f. produced by the thermocouples fixed to the two ends of the sensing plug of the fluxmeter were measured with the microvoltmeters.

A schematic diagram of the calibration set-up is shown in Figure 5.1 and its photographic view is given in Figure 5.2. The tests were conducted both before and after the experimental runs. It was found that the deviation between them was less than 5° and the mean calibration curve shown in Figure 5.3. was used to evaluate the experimental data.

5.1.2 Radiometer

The calibration of the radiometer in the range of interest was carried out in a manner similar to that of the fluxmeter. It was placed in front of the hohlraum opening with a clearance of 1 mm between them. The thermostat setting and the cooling water system were not disturbed. The resistance of the thermistor element in the radiometer for different temperatures of the hohlraum was measured with a precision ohmmeter. The e.m.f. produced by the thermocouples fixed to the hohlraum were measured with respect to an ice junction by a microvoltmeter as before.
A - AUTO TRANSFORMER  
T.P - THERMOSTAT PUMP  
V - MICROVOLTMETER  
F - FLUXMETER  
H - HOULRAUM  
$\sim 220\, \text{V A.C. MAINS SUPPLY}$

**Figure 5.1 Calibration Set-Up for Fluxmeter**
FIGURE 5.3 CALIBRATION CURVE FOR FLUXMETER
The schematic diagram of the calibration set-up is shown in Figure 5.4. The tests were conducted both before and after the experimental runs. It was found that the deviation between them was less than 4% and the mean calibration curve shown in Figure 5.5 was used to evaluate the experimental data.

5.2 Test Procedure

The coal was crushed in the crusher and sieved in appropriate sieves to -3, -4, -5 and -6 mm sizes. 20 kilograms of -3mm coal particles were then put into the hopper of the screw feeder and were subsequently replenished by further quantities during the experiment. The cleaning door of the combustor was removed and the bed material left over after the previous run was cleaned. The instrumented tube was placed inside the bed in such a way, the two meters were at equal distance from the centre of the bed. The bed temperature probe was inserted into the bed through the static pressure probe. Ash of the same size of the previous run was put into the combustor up to a height of 25 mm. One kilograms of wood splinters roughly 50 x 25 x 6 mm size and soaked in kerosene was put over the ash. About 100 grams of cotton waste, also soaked in kerosene was spread over the wood splinters. The combustor was then ready for ignition. Then thermostat pump circulating cooling water through the fluxmeter and radiometer was started. Water from the constant head tank was allowed to flow
FIGURE 5.4 CALIBRATION SET-UP FOR RADIOMETER
FIGURE 5.5 CALIBRATION CURVE FOR RADIOMETER
through the combustor jacket. The water was also allowed to flow through the instrumented tube. The blower was then started and the globe valve in the air pipe was adjusted such that the pressure drop across the orificemeter was 1 cm of water column. The cleaning door was removed and a 25 mm ball of cotton waste soaked in kerosene was ignited and thrown into the combustor. The cleaning door was then refixed and when fire from the wood splinters in the bed was visible through the sight tube air was opened fully. After the wood had burned for five minutes, the screw feeder was switched on and coal was fed at a low rate. As the coal particles entered the bed, the fines among them were observed to escape through the chimney in an incandescent state. The bed height was noted from the fall in level of the water columns in the first few tubes, the rate of feed was increased by doubling the area of opening in the regulator. When the bed had built up to the maximum level as seen from the bed particles escaping through the overflow pipe, the rate of feeding was reduced such that the bed was just overflowing. The bed temperature was regulated to the desired value by controlling the rate of circulation of water through the combustor jacket and the instrumented tube. As the thermocouple probe was found to be damaged if it was continuously kept in the bed, it was inserted only periodically for every 5 minutes to measure the bed temperature. After 30 minutes, when all the instruments were indicating steady values of the parameters measured
by them, the appropriate measurements were taken. Then the tube was indexed to the next position and the measurements were taken after steady state was reached. This was repeated for all the locations in the tube circumference by indexing the tube in steps of 30°. The fluidizing velocity was then reduced gradually by regulating the globe valve in the air pipe and for each setting, the observations were noted after the system had attained steady state.

The tests were repeated for different particle sizes, bed temperatures and tube sizes. The mean particle size of the bed material was determined by a sieve analysis of the bed particle. Samples of the bed particle were collected after abruptly stopping the air and then allowing them to cool down. The results of the sieve analysis is given in Appendix I.