The Advantage of Using Low Un-Burnt Carbon Coal Ash for Producing Coal Ash Bricks and an Assessment of the Physical Characteristics of such Bricks Produced from the Coal Ash of the NTPC Singrauli Station - A Case Study

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Summary

It is evident that with boom in the industrial growth, the need for power has increased manifold. With about 1,000,000 MW installed capacity, nearly 73% of India's total installed power generation capacity is thermal, of which about 90% is coal-based generation, with nuclear, diesel, wind, gas, and solar making up the rest. It is important to mention that National Thermal Power Corporation Limited, a premier power utility of India (NTPC), has an installed capacity of 19,435 MW. For thermal power generation in India, 75 million tonnes of fly ash and bottom ash are produced every year and this tends to degrade the scarce land and environment. Only about 10-12 % of ash is utilized. Efforts are being made to find the solution in large-scale utilization. One of the avenues is the manufacture of coal ash based bricks, preferably with low un-burnt carbon.

The present paper assesses the physical characteristics of the bricks produced from the fly ash and lagoon ash having low un-burnt carbon. The physical properties such as (I) Compressive strength, (ii) Water absorption, (iii) Apparent Porosity, (iv) Flexural strength, (v) Abrasion resistance, (vi) Linear dry shrinkage, (vii) Tensile strength, (viii) Weathering Characteristics, (ix) Thermal Conductivity Characteristics, (x) Acoustic Characteristics, and (xi) Thermo-gravimetric and Differential thermal analysis of brick samples.

It is pertinent to note that the un-burnt carbon in the fly ash and lagoon ash is quite low as compared to the fly ash of power stations in US. The un-burnt carbon in ESP fly ash is 0.6% and in lagoon ash the un-burnt carbon was only 1.7%. The data indicated that the wet compressive strength was more than 100 kg/cm^2 for the bricks that were autoclaved for 6 hours at 14 kg/cm^2 steam pressure. The water absorption values ranged from 21.3% to 20.6%. The apparent porosity of bricks varied between 28.8% to 33.9% and 24.8% to 31.0% in case of lagoon ash and ESP fly ash. The values of flexural strength varied from 8.1 kg/cm^2 to 18.1 kg/cm^2 for different autoclaving pressures such as 7, 10, 14 kg/cm^2 for ESP fly ash bricks and lagoon ash bricks, and the values of linear drying shrinkage varied from 0.021% to 0.038% for the same conditions. Similarly the values of tensile strength were 0.20 N/mm to 0.25 N/mm. The fly ash and lagoon

ash bricks were subjected to 50 cycles of watering and drying, and the values of compressive strength of these bricks decreased from 80 kg/cm^2 to 64 kg/cm^2 and 152 kg/cm^2 to 130 kg/cm^2 for the abovementioned bricks, respectively. It is interesting to note that the there was a weight loss in the fly ash and lagoon ash bricks to the extent of 51.9% and 58.6% when subjected for abrasion test. The thermal conductivity values for the fly ash and lagoon ash bricks varied from 0.465 kcal/h/ºC/m to 0.600 kcal/h/ºC/m and the noise reduction coefficient was found to be 0.19 and 0.18, respectively, when subjected to different processing conditions. The TGA analysis indicated there was a weight loss of 6.0% to 8.0 % at 900ºC in these fly ash bricks, indicating the present of chemically bound water in the C-S-H gels thus formed during the autoclaving process. This loss of water took place below 600 ºC confirming that the loss was not due to decomposition of un-burnt carbon. The same was confirmed by the differential thermal analysis investigations of the fly ash and lagoon ash bricks.