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Manufacturing of Paver Bricks from Coal Ash: A proposed methodology for effective use of coal power generation waste.

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Background/Objective:

In Pakistan most of the industries where combustion occurs, generate coal by-products and waste which is mostly dumped. However, this waste material can be reused for profitable purposes. Dumping of this waste also causes damage to the environment by polluting land, air and water. Increase in the pollution makes it essential to look up on the utilization of the waste and by-products.

Coal waste such as fly ash is a major constituent of land and environmental pollution. Its utilization is important to reduce the stress on land. Fly ash majorly can be used in the manufacturing of fly ash bricks because of its cementation properties and an alternative of clay bricks which can be economically profitable. In comparison, fly ash brick are more compatible, inexpensive and of high strength.

Experimental Work:

The coal waste was collected from a chemical industry located in Karachi. The samples were submitted to laboratory for different physical and chemical analysis. Technological characterization of both samples included. proximate analysis, X-ray diffraction, visual observation and ultimate analysis. Elemental analysis of fine aggregate was carried out by Xray fluorescence for SiO₂, Al₂O₃, CaO and Fe₂O₃. The fly Ash used is characterized as class F fly Ash in accordance to ASTM. The main the characteristics of coal waste including: fly ash, bottom ash and coal sludge are mentioned table 1, 2 and 3. On the basis of above data it's been proposed that paving blocks will be produced in a drum mixer. Table 1XRF analysis of Coal waste collected from Novatex Ltd.

514	Analytes Description		Cer	il Coal	Daff	2	indge	Daff	B	r Ash	Duff.
1	Inherent Moisture	5	5.57	3.64	1.93	3.34	5.73	-2.39	0.364	1.69	-1.326
2	Total Moisture	-5	8.61	4.06	4,55	31,73	15.84	15.89	0.551	1.69	-1.139
3	Ash Contents	5	14,06	9.55	4.18	52.05	49.85	2.2	72.83	50.67	22.16
4	Volatile Matters	5	36.04	31.02	5.02	13.87	10.89	2.98	13.95	10.51	3.44
5	Fixed Carbon	5	42.11	55.08	-12.92	2.35	23.39	-21.04	12.61	37.12	-34.51
6	Sulphur	~	0.617	0.318	0.299	1.125	2.187	-1.062	0.196	0.917	-0.721
7	Higher Heating Value (GCV)	KelKg	6892	7491	-599	231	319	-88	641	701	-60
8	Lower Heating Value (Net CV)	KelKg	6072	6482	-410	176	207	-31	496	518	-22

Result and discussion:

The Fly ash collected from industry is based on black color with the physical appearance of finely granular particles. For Class F fly ash, the sum of SlO₂, Al₂O₃ and Fe₂O₃ content should be greater than 70%, whereas the CoO content should be less than or equal to 5%. With the reference of the above test results collected (almost SlO₂ 50%, Al₂O₃, 20% and Fe₂O₃ 6%) the sum of SlO₂. Al₂O₃ and Fe₂O₃ is above 70% which is around 76%, that gives the security of the strength of pavers. This composition to that of Portland cement due to which it is most suitable material for pavers/construction material. The composition of SO₃ which is around 3% shows that the paves manufactured prevent acid generation and are alkaline environment.

S	Compon	Coal	Botto	Fly ash
•	ents	Asn	m Asn	
N	The market	sludge		
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		Cit in the		
1	SiO ₂ (%)	52.73	53.11	50.25
2	Al ₂ O ₃	25.43	25.52	20.26
	(%)			
3	Fe ₂ O ₃ (%)	5.36	4.46	6.77
4	CaO (%)	3.89	3.84	5.63
5	MgO (%)	1.34	1.38	1.79
6	SO3(%)	2.14	2.20	2.43
7	Na ₂ O (%)	0.45	0.46	0.24
8	K ₂ O (%)	0.87	0.75	0.88
9	CI (%)	0.009	0.008	0.018

Ash

Sludge

22.74

32.99

25.72

0.56

36.35

66.16

4298

3.65

34.88

33.57

0.60

44.24

80.52

4213

Fly Ash

2.69

51.08

10.40

0.57

28.29

51.5

3285

Table3 Proximate analysis of Coal wa

Total Mois

(ARB%)

Ash (ARB) %

Volatile Matte

(ARB%)

Total Sulphur

(ARB%)

Loss on ignition %

Gross Calorific Value KCal/Kg

(ARB)

Table 2 Experimental Analysis of Coal Ash Sample from industry

Conclusion:

About 15 % of the coal wastage is recovered. Results obtain from different tests prove the possibility of conversion of coal waste into pavers. Paver blocks will be produced by adding 50% recycled coal waste, 20% sand, hydrated lime 10%, gypsum 5%, it will give satisfactory results in terms of mechanical properties. This practice can collaborate in clean coal production and helps in improvement in socioeconomic development of Pakistan. We believe that this methodology can be applied to minimize the environmental pollution in Pakistan and globally.

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