COAL ASH – A POTENTIAL SOURCE FOR OTHERS INDUSTRY

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ABSTRACT: *The coal ash represents an important industrial waste source. The most important waste produced by the energy industry is the ash resulted of coal burning into the large combustion plants. The physical and chemical properties of ash vary substantially between producers and depend on the quality and the composition of coal that are used in modern power plants, as well as on combustion conditions. The diverse chemical, mineralogical and morphological properties of ash offer an opportunity to process it and recover various fractions with particular attributes. The main constituents are* Al_2O_3, Fe_2O_3, *CaO, MgO and in smaller quantities* Na_2O *and* K_2O. *Also, the ash from burning lignite of the Oltenia mining field has an important coal char content, which could be exploited. In this work will be presented some results of specific investigations, which allow the rational regarding recovery of coal char from ash.*

KEY WORDS: thermal power plant, bottom ash, reuse, coal char.

INTRODUCTION

The fuel used in the high capacity thermo-power plants of the Oltenia Energy Complex is the lignite, extracted from the surface quarries in Gorj County. Obviously, the main purpose of the lignite burning is to produce electricity but, consecutively, derivate products occur in the process, the most important is the burning ashes known as the two main types: the fly ashes (collected from the burning gases through the electric filter systems) and the heavy ashes, named as bottom ashes, collected at the bottom of the burners and transported as hydromix or compact slurry into specially designated warehouses, named slag and ash depots.

In the case of Oltenia thermo-power plants the resulted ash quantities are important based on high relatively content of mineral substance of the burning lignite (30 - 40 % ash residue). The average characteristics of lignite from Oltenia Region are indicated in Table no.1 [1].

Table no. 1 **The average characteristics of lignite**

Parameter		Value
Adventitious moisture content		36,21 ÷ 43,21
Inherent moisture content, AR		3,18 ÷ 5,45
Total moisture content		41,35 ÷ 46,29
Ash content, AR		13,60 ÷ 25,29
Ash content, DB		25,12 ÷ 43,12
Sulfur content	Combustible, AR	1,09 ÷ 1,42
	Total	1,26 ÷ 1,72
Nitrogen content, AR		0,49 ÷ 0,65
Oxygen content, AR		7,03 ÷ 8,85
Hydrogen content, AR		1,84 ÷ 2,48
Carbon content, AR		21,98 ÷ 25,86
Lower heating value		6,92 ÷ 9,06
Volatile matter content		15,25 ÷ 21,19

By the technological process results two kind of ash: fly ash (with a diameter <0,25 mm), which is collected from flue gases through electrostatic precipitators (ESP), and from there it is mixed with water and sent to a pumping station or is collected in silo in order to delivery in cement industry; bottom ash, with a diameter 0.25 – 1 mm and more, which is collected at the furnace bottom (see Figure no. 1, 2) [2].

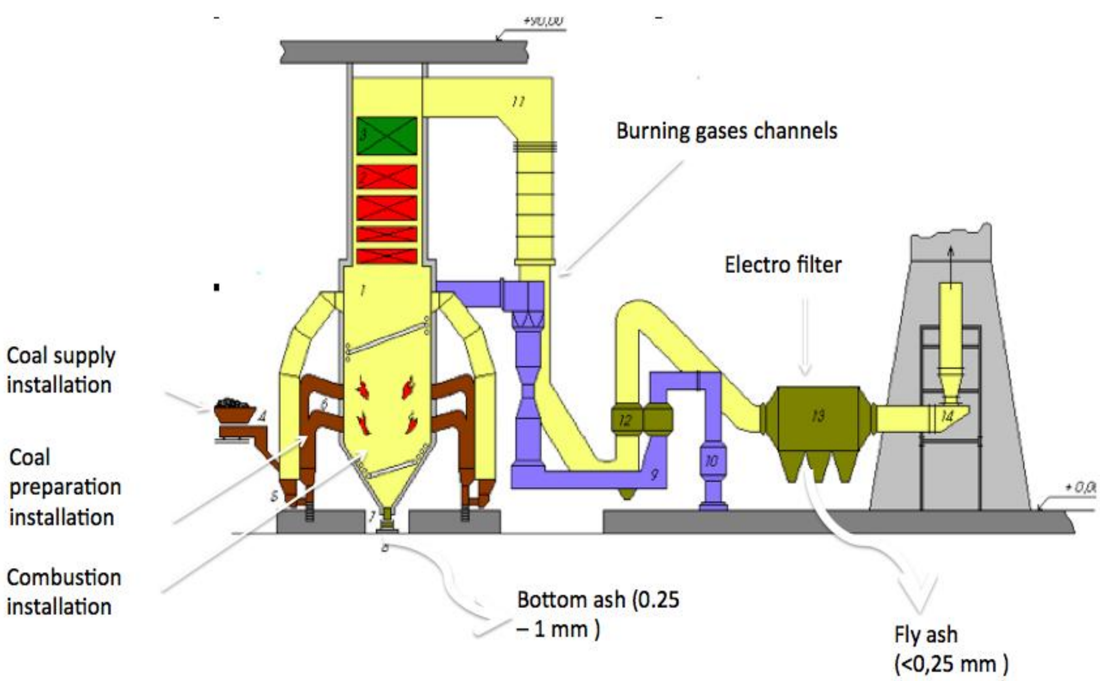


Figure no. 1 Ash generation in thermal power plant

In the case of the ash and slag resulted from the coals burning into the steam generator burners, the light ash (known as „fly ash") is exploited more then 80% on the industrial flows of Portland cement manufacturing, and the heavy ash or the burning slag (named „bottom ash") continue to represent a poor exploited industrial waste, which generates a significant ecological impact by the soil clogging effects, source of the air dust or ecosystem modifier, by the huge stored quantities which contain, each, tens of million of tones and which cover tens of hectares of natural land [3].

EXPERIMENTAL

The possibility of the exploit of this waste used as granular aggregate for making construction materials was demonstrated by the results of the researches done in LIFE ENV 729 RO Project, by using to obtain bricks, concretes, mortars and stamping tables [10-13], see Figure 3.

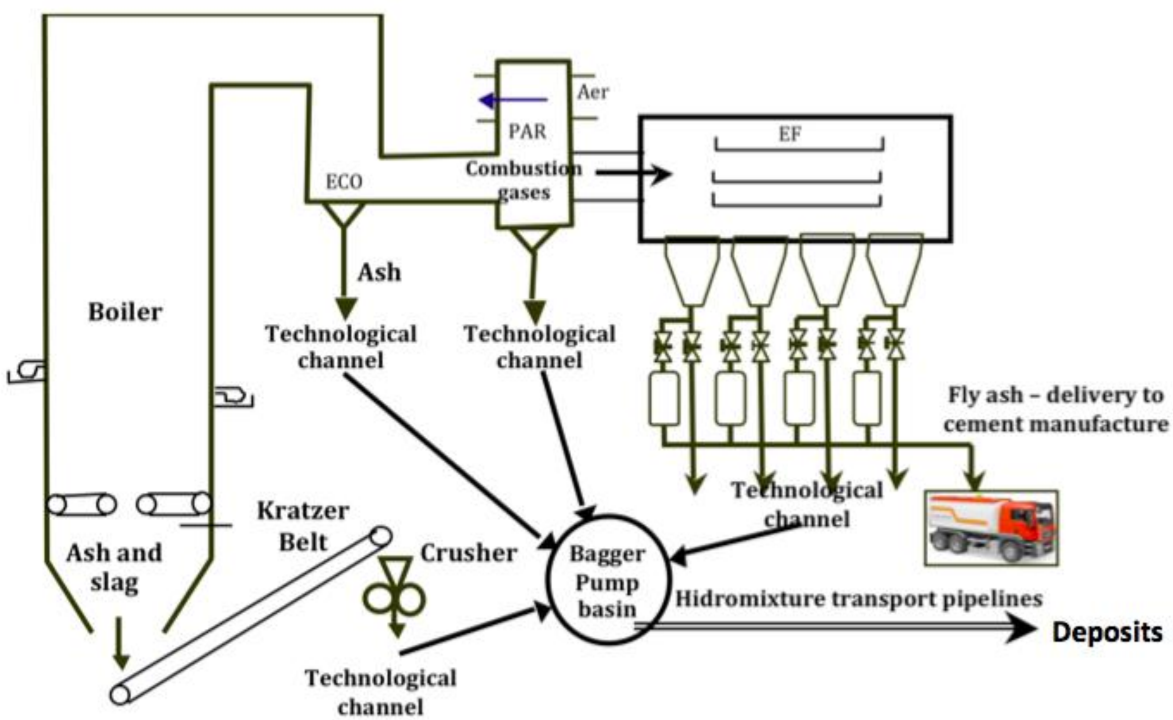


Figure no. 2 Ash and slag disposal in thermal power plant

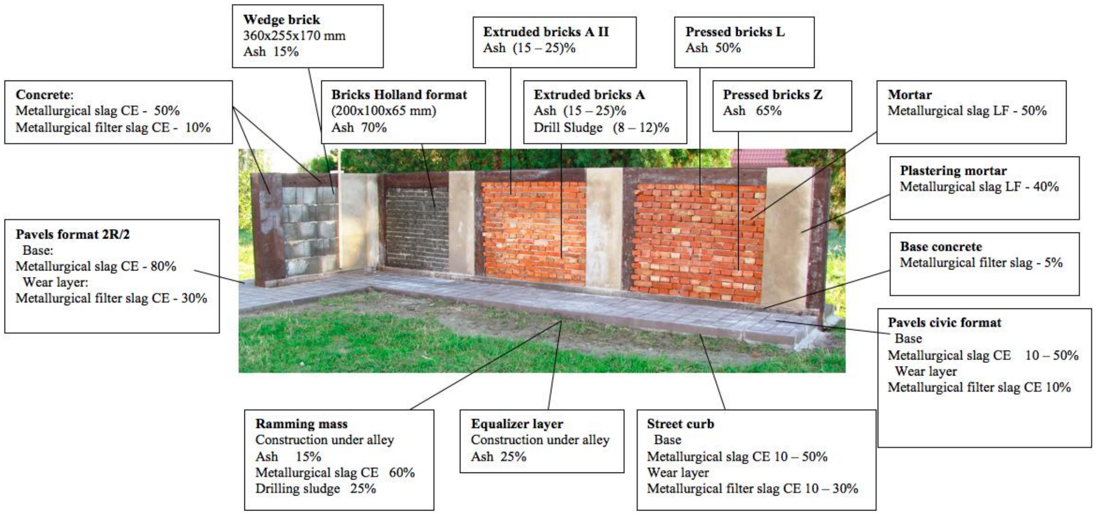


Figure no. 3. Experimental wall that containing some kind of bricks, pavers, bordures, mortar and concrete, obtained within LIFE ENV 729 RO Project

Subsequent research revealed that thermo-power ashes from the Oltenia lignite show specificity of a major variation of the characteristics, based on dimensional class of component granules, especially the share of the residue coal (unburned). Unburned carbon of the thermo-power ash is a potential precursor of the graphitized carbon, having suitable structural characteristics for using in industrial applications, as: the development of new high catalytic activity electro catalysts, higher durability, lower costs, scalability which could facilitate in great extent the improvement of the clean electric infrastructures [14]. On the other hand, in many technological applications the mineral components of the ash can provide superior efficiency, especially when they are used as granular aggregates for manufacturing construction materials based on hydraulic bindings (cold bind bricks, concrete blocks and built-ups).

Investigations were carried out on ash samples taken from Valea Ceplea ash deposit of the Turceni thermo-power plant. Sampling was done by scheme of Figure no. 4, where A, B, C, D and E area has each a surface of 2.25 ha of the deposit, representing 20% of total surface is a total of 11.25 ha. In each circular area were scored 9 equidistant points from which were drilled elementary ash samples at the depths of 5, 10, 15 and 20 m. In addition, in each area were sampled each 5 elementary samples at the surface layer of the depot (quote 0) [2, 14].

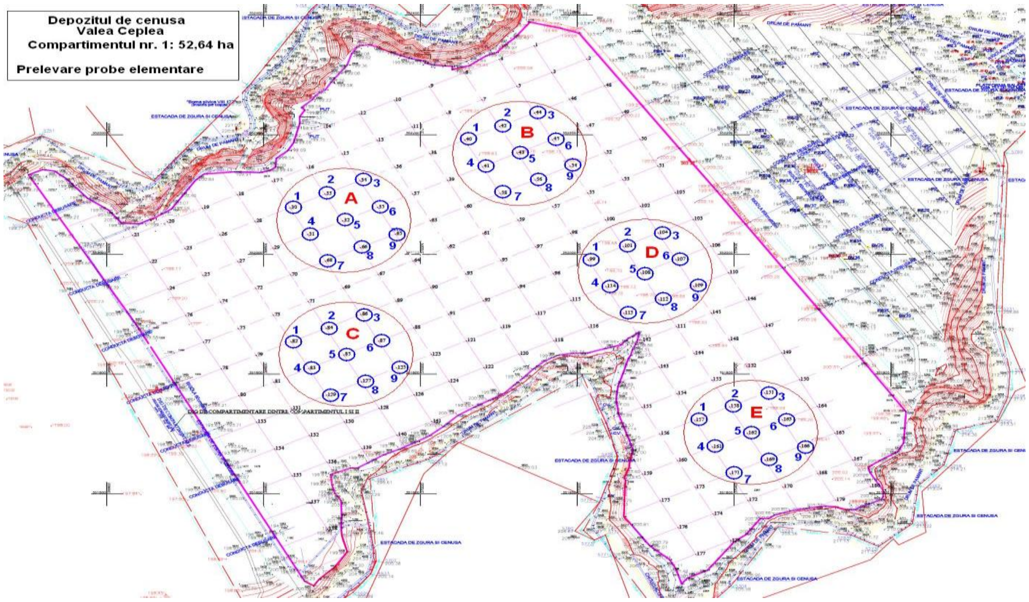
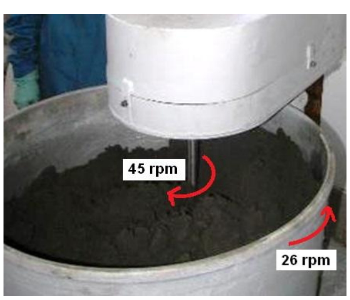


Figure no. 4. Sampling grid areas at Ceplea Valley landfill

In order to characterize in term of grain size distribution, bulk density and moisture, the ash and slag samples, the elementary samples were homogenized on areas and depth quotes, obtaining 25 cumulative average samples, each being representative for 130 thousand tones depot ash (Figure no. 5).



Nr. crt.	Average samples	Elementary cumulated samples
1	AM-0	A0-1, A0-2, A0-3, A0-4, A0-5
2	AM-5	A5-1, A5-2, A5-3, A5-4, A5-6, A5-7, A5-8, A5-9
3	AM-10	A10-1, A10-2, A10-3, A10-4, A10-6, A10-7, A10-8, A10-9
4	AM-15	A15-1, A15-2, A15-3, A15-4, A15-6, A15-7, A15-8, A15-9
5	AM-20	A20-1, A20-2, A20-3, A20-4, A20-6, A20-7, A20-8, A20-9
6	BM-0	B0-1, B0-2, B0-3, B0-4, B0-5
7	BM-5	B5-1, B5-2, B5-3, B5-4, B5-6, B5-7, B5-8, B5-9
8	BM-10	B10-1, B10-2, B10-3, B10-4, B10-6, B10-7, B10-8, B10-9
9	BM-15	B15-1, B15-2, B15-3, B15-4, B15-6, B15-7, B15-8, B15-9
10	BM-20	B20-1, B20-2, B20-3, B20-4, B20-6, B20-7, B20-8, B20-9
11	CM-0	C0-1, C0-2, C0-3, C0-4, C0-5
12	CM-5	C5-1, C5-2, C5-3, C5-4, C5-6, C5-7, C5-8, C5-9
13	CM-10	C10-1, C10-2, C10-3, C10-4, C10-6, C10-7, C10-8, C10-9
14	CM-15	C15-1, C15-2, C15-3, C15-4, C15-6, C15-7, C15-8, C15-9
15	CM-20	C20-1, C20-2, C20-3, C20-4, C20-6, C20-7, C20-8, C20-9
16	DM-0	D0-1, D0-2, D0-3, D0-4, D0-5
17	DM-5	D5-1, D5-2, D5-3, D5-4, D5-6, D5-7, D5-8, D5-9
18	DM-10	D10-1, D10-2, D10-3, D10-4, D10-6, D10-7, D10-8, D10-9
19	DM-15	D15-1, D15-2, D15-3, D15-4, D15-6, D15-7, D15-8, D15-9
20	DM-20	D20-1, D20-2, D20-3, D20-4, D20-6, D20-7, D20-8, D20-9
21	EM-0	E0-1, E0-2, E0-3, E0-4, E0-5
22	EM-5	E5-1, E5-2, E5-3, E5-4, E5-6, E5-7, E5-8, E5-9
23	EM-10	E10-1, E10-2, E10-3, E10-4, E10-6, E10-7, E10-8, E10-9
24	EM-15	E15-1, E15-2, E15-3, E15-4, E15-6, E15-7, E15-8, E15-9
25	EM-20	E20-1, E20-2, E20-3, E20-4, E20-6, E20-7, E20-8, E20-9

Figure no. 5. The cumulation of elementary ash samples

RESULTS AND DISCUTIONS

Gain size distribution of the ash for the samples of area A, B, C, D and E are presented in Table no. 2, 3, 4, 5 and 6.

Table no. 2 Grain size distribution of the ash samples of the area A

Grain/mm	0 m/%	5 m/%	10 m/%	15 m/%	20 m/%
<0,1 mm	24,3	35,34	36,69	34,86	40,17
0,1-0,2 mm	25,97	21,64	24,57	26,25	27,75
0,2-0,4 mm	28,23	17,8	17,74	18,87	16,84
0,4-1 mm	17,8	15,81	13,65	13,47	10,65
1-2 mm	3,18	7,1	5,65	5,17	3,86
2-3 mm	0,39	1,56	1,28	1,12	0,63
> 3 mm	0,13	0,75	0,42	0,26	0,1

Table no. 3 Grain size distribution of the ash samples of the area B

Grain/mm	0 m/%	5 m/%	10 m/%	15 m/%	20 m/%
<0,1 mm	0	0	0	0	0
0,1-0,2 mm	0,22	0,21	0,17	0,01	0,12
0,2-0,4 mm	5,15	1,96	1,63	0,89	1,13
0,4-1 mm	23,3	9,1	8,9	7,17	8,31
1-2 mm	45,38	15,04	15,06	23,95	15,44
2-3 mm	44,12	13,01	10,59	16,09	13,39
> 3 mm	38,72	0	0	0	0

Table no. 4 Grain size distribution of the ash samples of the area C

Grain/mm	0 m/%	5 m/%	10 m/%	15 m/%	20 m/%
<0,1 mm	0	0	0	0	0
0,1-0,2 mm	0,65	0	0,15	0	0
0,2-0,4 mm	6,37	0,88	0	0,86	0,43
0,4-1 mm	21,73	7,05	5,29	6,09	6,01
1-2 mm	33,93	15,68	10,65	13	8,59
2-3 mm	0	15,78	10,55	12,18	5,87
> 3 mm	0	0	3,96	4,2	4

Table no. 5 Grain size distribution of the ash samples of the area D

Grain/mm	0 m/%	5 m/%	10 m/%	15 m/%	20 m/%
<0,1 mm	0	0,1	0	0	0
0,1-0,2 mm	0	0,11	0	0	0,86
0,2-0,4 mm	0	1,03	0,5	0,79	0,99
0,4-1 mm	3,34	7,86	5,06	5,68	6,53
1-2 mm	2,47	16,9	11,37	12,45	8,09
2-3 mm	0,91	13,83	8,75	10,66	5,77
>3mm	0	0	0	0	0

Table no. 6 Grain size distribution of the ash samples of the area E

Grain/mm	0 m/%	5 m/%	10 m/%	15 m/%	20 m/%
<0,1 mm	0	0	0	0	0
0,1-0,2 mm	0,02	0	0,12	0	0,05
0,2-0,4 mm	0,59	0,8	1,01	0,74	0,81
0,4-1 mm	5,39	9,71	7,22	7,7	5,91
1-2 mm	10,03	16,71	13,43	15,62	7,59
2-3 mm	8,03	13,65	8,57	14,01	5,07
>3mm	0	0	0	0	0

CONCLUSION

Due to its content, the thermo-power ash is an important source of raw materials for other industries, in previously published works it was clearly demonstrated the possibility of its use in making bricks, concretes, mortars and stamping tables. The significant unburned coal content from the dimensional fractions bigger than 0.5 mm also, reveal new possibilities of thermo-power ash recovery because the unburned carbon is a potential progenitor for the graphitized carbon, the graphite being a globally poor natural resource with wide application in power industry, especially to make the equipment used in technologies to producing electricity from renewable sources. The mineral residue obtained after the removing of the unburned coal also, can be used with a superior efficiency in the manufacturing technologies of the construction materials.

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