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IMPROVEMENT POSSIBILITIES OF THE POWER PLANT ASHES OBTAINED BY DRY PROCESS FROM C.E.T. HOLBOCA JASSY

BY

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Abstract. The using of the coals for the thermal energy’s obtaining in the electro thermal power plants occupies an important percent in the global structure of the energy sources (thermal, hydraulic, atomic, wind etc.). In the end of the burning complex process and collecting of the formed products from the coal inert material an inert fine sandy material in natural conditions is resulting, forming important deposits that are occupying extended areas constituting local pollution sources. The structural and physical characterization is important and obligatory for different sources because the characteristics are depending on the utilized coal’s nature, the burning process, transport and storage. The characteristics of the ashes collected by wet process were studied for two decades, because the resulted material was different function of the utilized coal from local and import sources, especially from Ukraine.

Key words: thermal power plant; ash; coal; wet process.

1. Introduction

The coal utilized to obtain thermal energy in power plants needs a preliminary machining process such as to obtain granules with dimensions that can form suspensions in air under pressure for transport and injection in the

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furnace. In the furnaces, due to the great specific surface the burning of the coal's active percent is realized by dry process in electro-filters and by wet process that allows the hydraulic transport in sedimentation tanks and storage in opened dumps.

The ashes obtained by dry process (fly ash) are used in cements manufacturing or as admixtures for concretes. The ashes obtained by wet process that represent over 90% from the total obtained ash amount have limited utilization fields.

2. Importance of the Coals as National and World Wide Energetical Source

The continuous increase of the industry and life standards world wide and as in our country as well, imposes the increasing of the installed power of the electrical power plants (Groll, 1995).

In 2008, the energy structure at the world level had the following configuration (Fig. 1):

a) 72% produced in thermal power plants based on coal, oil and natural gases;

b) 16% hydrotechnical sources;

c) 12% produced in nuclear power plants.

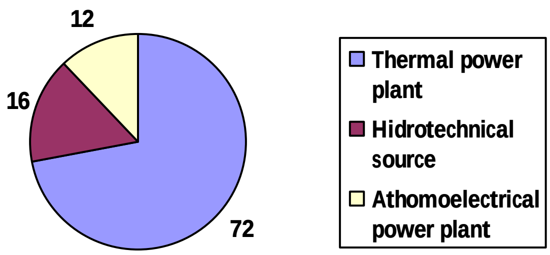

Fig. 1 – Energetical production.

From the 72% total of obtained energy in thermal power plant, 35% corresponded to the coal based sources.

In the actual and future economical conjuncture, taking into account the use of gases and oil in more efficient fields, the energetically policy of the developed and developing countries is focused on using coals, including the inferior ones and bituminous slates as combustible sources for thermal power plants.

It results that due to the great resources and to the capitalization possibilities by burning, the coals are representing at for now, as well in the future, the main energy source at international and at national level.

3. Coals Burning. Types of Ashes Function of the Coals Nature

The containing and the oxide nature varies in large limits depending on the coals genesis.

From the mineralogical results obtained by analyzing a certain number of coal ores, from different geographical areas and different geological ages, it results that the mineral substances associated to the coals are almost 95% marl nature minerals.

The marls represent minerals of bihydrated alumino–silicates type such as: potassic mica, clay minerals of illitic, caolininitic or monmorillonitic type, which are cemented, especially with calcium carbonates in association with organic substances.

A large range of subordinated minerals to coal sources exits, such as (Diaconu, 2013; Groll *et al*., 2007):

- carbonates:	- ancherite
	- calcite (trigonal)
	- aragonit (ortorombic)
	- magnezite
	- rhodocrozite
	- siderite
	- dolomite
	- stractianite
	- whiterite
- clay minerals:	- caolinic group
	- illite
	- montniorillonitic group
- feldspar group	- alkali feldspar
	- plogioclazs
- siliceous minerales	- cuartz (trigonal)
	- clorite
- serpentine	-
- sulphates	- ghypsum
	- anhydrate
	- hemihydrate
	- barite
- sulphites	- pyrite
	- marcasite
	- pirotite
	- calcopyrite
	- sphalerite
- rutil	

Excepting the above-mentioned in coals a series of elements can be found in very small amounts, which for this reason are called “trace elements”.

Out of these, the most frequently met in the coal mass are: germanium, vanadium, strontium, barium, scandium, cobalt, beryllium, tin, zinc, bismuth, manganese, nickel, copper, silver, chrome, molybdenum, arsenic, boron, uranium, gallium, yttrium, lanthanides.

Is assumed that in the most part these elements are found in the coal mass as organometallic complexes.

The non-coal minerals and the elements that are appearing in coal ores have two possible sources (Groll, 1995):

a) an internal source when the compounds were chemically bonded on the substances that generated coals and represent those salts initially contained initially in plants and that during the incoalation process were transformed into organometallic compounds or freestanding minerals;

b) the second source when the non-coal minerals appeared as a share and impurities in the coal mass during or after the incoalation process.

The mineral nature substances that are generating the greatest ash amount in the coal mass were formed in different ways (Groll, 1995):

i) fine particles of clay and quartz substances were transported by the waters in the accumulation period of the vegetal material that is forming the turf ores;

ii) the lentil-shape intercalations of clay substances in the coal layers were deposited by sedimentation during the accumulation period of the vegetal material or during the incoalation process;

iii) rock fragments and mineral formations appeared in the cracks of the coal layers having a secondary origin and that are representing the cracks mineralization by the infiltration waters, in a long time;

iv) accidentally admixtures of rocks fragments adjacent to the coals formed in their mass during the ores exploitation.

The mentioned minerals that are generating the ash vary depending on the ore being more quantitative than qualitative.

The ash amount is sometimes inferior in coal containing due to the levigation – carbonation phenomena that are reducing the soluble parts. The ash contain can percentage increase in the coals mass during the aging in geological time, even without foreign addition of mineral substances.

It is known that during the incoalation, the hydrogen and the oxygen are released as fluid combinations, so the volume decreases and the mineral compounds that are generating the ash are percentage increasing in the coals mass. So it can be explained that the anthracites sometimes have a more increased ash amount than the tar specific to the same geological age.

Due to the processes that are occurring in the coal structure during burning, the chemical – mineralogical composition of the coal is different than of the ash. The physical, chemical and mineralogical transformation can be studied by derivatography, difractometry and other physico – chemical modern methods.

By heating in the first stage the adsorbed phase is eliminated at a temperature between 100ºC,…,200ºC that shows the microporous character of variable dimensions. The loss of water occurs with volume decrease to limited values that can generate cracks and voids in the ash’s structure.

4. Chemical and Mechanical Characteristics of the Ashes from Thermal Power Plants

The knowledge of the ash properties from thermal power plants is important to determine their complex and efficient utilization in different fields. The interdependence between the chemical - mineralogical composition, the physical properties and the hydraulic activity of the ashes is known, as well.

The main characteristics of the ashes that are giving a clear and complete image on their utilization possibilities are presented below.

4.1. Physical and Mechanical Characteristics

Depending on the nature of the coal and on the burning conditions, the ashes from the thermal power plants can have a light grey to brown color, depending on the caption place. By coals burning slags, fine and coarse ash are resulting. The last two types are presenting as powders having the specific surfaces between 2,000,…,5,000 cm^2/g and a large range of the dimensional repartition. The exterior aspect is presenting as compact powders in natural size, as microporous spheres by optical microscopy and as vitreous or cavernous spheres by electronic microscopy (Groll, 1995; Diaconu, 2013; Groll *et al*., 2007).

The spherical shapes of the ash particles is advantageous because are improving the workability of cement based admixture mortars and concretes.

In using the ash as admixture for the clinker’s milling, the spherical shapes are standing out becoming polyhedral in shape with unfavorable effects from the point of view of mortar from the concrete mobility, plasticity and cohesion.

Generally, from the point of view of granularity the thermal power plant ashes are existing in wide limits (Groll, 1995; Diaconu, 2013; Groll *et al*., 2007). The areas are more restricted for the ashes collected in electro-filters that are satisfying the utilization as admixtures in mortars and concrete. Up to now the semi-fine and coarse ashes extracted from dump-sites are not utilized due to the more reduced hydraulic activity and variable humidity.

It was demonstrated that the capitalization possibilities of the binding potential of those ashes using patented compositions and hardening systems, that to ensure the obtaining of precast products without cement having a superior technical – economical efficiency.

The average dimensions of the particles is between 20,…,100 µm having a Gaussian distribution, the smallest fraction of less than 60 µm, presenting a major interest for the hydraulic activity. For the ashes from our country this fraction exists between 20% and 60%, conferring a medium hydraulic potential.

For the assessment of the ashes hydraulic activity is more appropriate to use the specific surface principle instead of granularity.

The ashes collected by wet process are suffering a hydrolysis and hydration process that leads to granules agglomeration, the material transforming from a dusty material to fine sand (Table 1, Fig.2).

Table 1
Input Data

Passing through the sieves (% from the mass) having the dimensios (mm)				
0.09	0.2	0.4	0.63	1
0.45	12.1	88	99.5	100

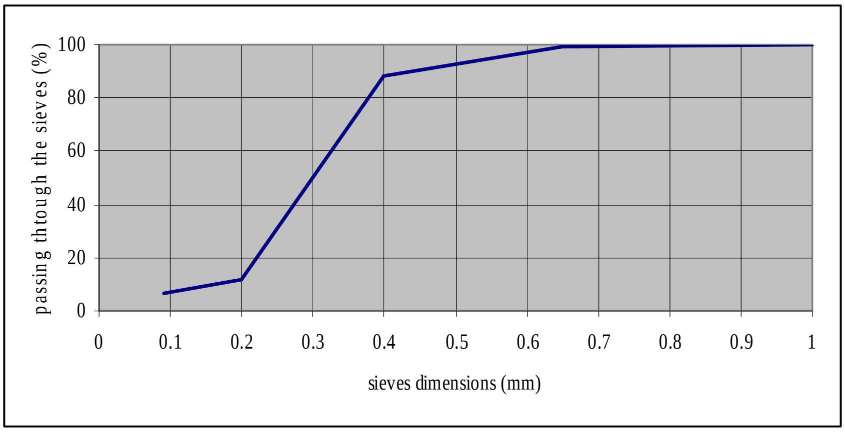

Fig. 2 – Granulosity curve.

The Blaine specific surface is between 1,800,...,5,000 cm^2/g being corelated with the volumic mass (Groll, 1995; Diaconu, 2013; Groll *et al*., 2007).

Some authors concluded that the specific surface of the ashes depends on silica and alumina content and calcination losses, as well. The ash presents a variable milling strength function of the particles dimension and structure.

Due to their abrasive nature, the ashes, after the destroying of the cavernous structure, have a low milling ability, therefore the milling time will is reduced aiming to reach a finesse to satisfy the both goals that are involving the hydraulic activity and the economical efficiency, as well.

The wear strength (Rujanu, 2009) has great values due to the crystalline and vitreous SiO_2 contain, and to the great specific surface.

The compacting ability (Rujanu, 2009) is determined by the PROCTOR method on ashes from the main thermal power plants from our contry alows to conclude the followings:

a) the ashes, having a hydrophilic character are easily retaining the water and are presenting a compacting degree with a minimal energy higher than the sands;

b) the compacting curves shape is attenuated giving to the ashes a reduced interrelation between the humidity and the maxim volumic mass (minimal bulcking).

The suction (Rujanu, 2009) ablity is determined according to the actual standard and can be defined by the capilar stress of the water from pores reducing, depending on the atmospheric presure.

The gelivity (Rujanu, 2009) behaviour esencially depends on ganulosity, the capilar and caverneous pores and the unburned substance contain, as well.

The gelivity behaviour can be appreciated by the ashes volume increasing in contact with water, classifing them as folows:

a) very susceptibility ashes;

b) less susceptibility ashes;

c) unsusceptible ashes.

Water and liquids permeability

The coarse ashes have a high permeability coeficient (3,...,7 × 10 cm/s), so are utilized as drainage materials, while the fine particles are presenting a low permeability characterized by a coeficient of 0.04,...,1 × 10 cm/s. This characteristic is important at using of the fine ashes as admixtures in concretes having a double hydraulic and as micro aggregate effect (Rujanu, 2009).

The magnetic susceptibility (Rujanu, 2009) is determined by the presence of the Fe_3O si Fe_2O_3 with a iron and paramagnetic character.

The magnetic susceptibility represents the basics for iron concentrates for siderurgy.

4.2. Elementary Chemical Composition

By coals burning, in the ash, a series of chemical elements is concentrating, that are entering in different complex combinations or oxides mixtures.

For ashes from pit coal the compositions present an insignificant difference of the oxides contain excepting the CaO that can be found in greater amounts in the lignite ashes.

It can be observed that besides the main components SiO_2, Fe_2O_3, CaO and SO_3, the ashes contain also secondary compounds (see Table 2) (Groll, 1995).

Table 2
Chemical Composition

Component	CaO	SiO_2	MgO	Fe_2O_3	Al_2O_3	S	SO_3	Combustible	Rezidual HCl	Calcination losses
Dump ash	2,92	36,92	0,18	4,98	37,15	1,44	1,45	9,89	87,18	9,93
Flying ash	5,60	50,05	2,20	7,58	32,42	1,47	3,76	2,29	89,72	1,34

4. Utilization Fields in Construction (Groll, 1995)

Field	Utilization
Construction materials industry	- Cement admixture - Celular concretes structure obtained by foaming with gas generators - Agloporite (granular products for concretes and and thermal isulations) - Degresants for ceramics industry
Civil Engineering	- Active admixtures for mortars and concretes - Impermeabilization admixture for mortars - Admixtures for concretes exploited in chemical aggressive terains - Clays stabilizators - Masonry blocks (in combination with other materials - sawdust, slaggs)
Construction of terestral comunication ways	- Self compacting layer - Soil stabilizators in combination with calcium donator materials - Filer replacing for asphaltic mixtures

5. Conclusions

1. The dumps of the thermal power plants ash collected by wet process takes out from the agricultural circuit an important surface, constituting in the same time an important pollution source of the air, soil and water.

2. By caption and hydraulic transport the thermal power plant ash is losing an important percent from its hydraulic character.

3. The using of the ashes collected by wet process in different fields is relative reduced, the storage dumps occupying important areas.

4. Any research that leads to the utilization of the ashes collected by wet process is welcomed.

5. The residual hydraulic character from the ash granule can be used by the acid character admixture that to destroy the superficial layer formed during the hydraulic transport.

6. This paper provides to some beneficiaries the structural and physico – chemical characteristics for their using.

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POSIBILITĂŢI DE UTILIZARE A CENUŞILOR DE TERMOCENTRALĂ RECOLTATE PE CALE UMEDĂ DE LA C.E.T. HOLBOCA IAŞI

(Rezumat)

Folosirea cărbunilor pentru obţinerea energiei termice în electro-termocentrale ocupă un procent importatnt în structura globală a surselor de energie (termică, hidraulică, atomică, eoliană etc.). La sfârşitul lanţului de ardere şi recoltare a produselor formate din materialul inert din cărbune rezultă un material nisipos fin inert în condiţii naturale formând depozite importante care ocupă suprafeţe mari constituind surse de poluare locale. Caracterizarea structurală şi fizică este importantă şi obligatorie pentru diferite surse întrucât aceste caracteristici depind de natura cărbunelui utilizat, de

procesul de ardere, recoltare, transport şi depozitare. S-au studiat pe parcursul a două decenii carateristicile cenuşilor recoltate pe cale umedă, întrucât materialul rezultat a fost diferit funcție de cărbunele utilizat din surse indigene dar şi din import, în special din Ucraina.