WASTE FROM HEAT ELECTRIC POWER-STATIONS WITH SOLID FUEL – ECOLOGICAL PROBLEM AND RAW MATERIAL

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ABSTRACT

In the first part of the paper an evaluation of the ecological danger from direct throwing out the cinder and fly ash (CFA) from heat electric power- station (HEPS) is presented. The possibilities of decreasing and eliminating the ill effects of the now practiced way of putting the CFA in depots are offered.

The second part concerns the possibilities for utilization of the CFA, based on the foreign and our experience. As a result of authors' research it is proved that the waste – CFA, may replace successfully the sand in underbasic concrete of temporary roads in the open mines.

A composite material and technology for cinder waste pools' covering are made on the CFA base – a radical step against dust emission and leaching heavy metals from them.

EVALUATION OF THE ECOLOGICAL DANGER FROM DIRECT THROWING OUT THE CFA FROM THE HEAT ELECTRIC POWER-STATIONS (HEPSs) OF "MARITSA IZTOK" MINES AND POSSIBILITIES FOR ITS PREVENTING.

Introduction to the problem

The production of electrical energy from lignite coal of jointstock company (JSC) "Maritsa iztok" mines, concerning to the "dirty and risked" production, is a reason for considerable ecological problems and most of them are connected with the CFA from the HEPSs. The problem concerns the quantity as well as the qualities of the cinder, fly ash and gypsum.

It becomes clear from "Energoproekt" data that the quantity of the waste is 6-7 million tones a year. The problem "quantity" finds palliative decision in mixing the waste with the overburden cover and their putting in depots on external dumps.

The "Minproekt" research [1] shows that the mixing of the waste – cinder and fly ash (C + FA) with clays of the overburden cover approves the physical and mechanical properties of the mixture as the fly ash has stabilizing effect. This technology is accepted and is being realized.

Here the question of waste's qualities (C + FA) will be concerned. As a result of research of Direction "Scientific investigations", Section "Environment preservation" for defining the physical, mechanical and chemical indicators of (C + FA) [2] a conclusion is given: "the founded harmful components (according to Bulgarian State Standard BSS 5795-81) are: the unburned particles in the cinder are 9.17% average, in the fly ash - 5.49% average and water soluble salts in the fly ash are 2.47% average. This research is not finished yet, the data for contents of heavy metals and their water soluble connections in the C + FA, whose dust emission and leaching from the waste dumps will threaten soils, waters and air near them, is not given.

In the report for evaluation of effect on the environment (EEE) for HEPS "Maritsa iztok" 2 [3] it is pointed out that " the waste pools are a potential pollutant of the environment during the exploitation as well as after stopping their using before conservation and recultivation". Further in [4], (table 5, p. 24) the contents of heavy metals in the fly ash from the waste pools and after electrical filters are presented. The presence of harmful water soluble salts, the data for heavy metals in the cinder and evaluation of the ecological danger from putting in depots the C + FA in waste pools and after dehydration in the external dump "Staroselets" are not given here.

The wide-ranged research [8] shows that the presented disseminated elements (Zn, Cu, Ga, As, Se, Mo, Cd, Sb, W or Pb) in the coal increase their contents on the external surface of the particles with decreasing their diametre and it is essential for leaching processes.

Here the main conclusion is:

Putting the cinder from the HEPSs of coal in depots and undoubtfully its removal, as a rule, is connected with harmful substances' releasing. The quantity of released harmful substances depends mainly on the form (way) of fly ash's removal. Thus, for example, if the fly ash is stored in one ordinary depot and if there is a contact with the underground waters, this leads to releasing harmful substances, which may bring to intolerable pollution of the environment"[8].

Wind and atmosphere waters contribute to spreading harms of CFA when the present technology of their putting in depots is used.

Our investigation, done in authorized laboratories, shows the following contents of heavy metals and SO4⁻ (table №1) in CFA from HEPS –2.

Seri	Lab.	Pb	Cu	Zn	Cd	Ni	Со	Bi	Ag	As	Sb	Мо	Hg	SO4-
al	Nº	mg/kg	mg/kg											
Nº														
1	13639	14	180	60	<1	80	18	<20	<1	36	<10	39	< 0.05	8765.0
2	13640	30	159	73	<1	87	26	<20	<1	86	<10	38	<0.05	16337.5

Table № 1

Continuous leaching of heavy metals by atmosphere waters brings to their gathering in soils and waters near depots for CFA.

Possibilities for decreasing or eliminating the ecological danger from direct throwing out the CFA.

According to the present level of the ecological science and technology the radical decisions against spread of harms, contained in the waste C + FA are two:

The first one is its putting in depots to be done in ones, which are preliminarily provided by bedded and lateral seal stopping and at the end – by covering stopping.

The second one is immobilization (inertia) at first and putting the harms from CFA in depots after that using the present technology. This decision technologically is easier for execution and demands fewer funds.

Investigations [8,9,10] are done and their results show that at mixing in advance and certain proportions of C + FA, gypsum and water from the sulphur purifying, a solid body is formed and it is called stabilizat. Salts and disseminated elements (heavy metals), included in the stabilizat, leach only in very limited scale (quantities). Contained salts' concentrations are under limited values for the responsible class of depots" [8], i.e. under top allowable concentration (TAC).

The "stabilizat", got by us, was on the base of C+FA+G+lime+water. The samples from it showed satisfactory compressive strength ($0.3 \div 1.0$ MPa), good water soluble resistance and dust emission. Leaching the heavy metals from the stabilizat has to be researched additionally as well as its formation on a base of hydraulic binders and additions.

UTILIZATION OF THE CINDER, FLY ASH AND GYPSUM – WASTE PRODUCTS FROM HEPS OF THE JOINT-STOCK COMPANY "MARITSA IZTOK" MINES

Introduction to the problem

Waste from the production of electrical energy from brown and lignite coal in form of cinder, fly ash and gypsum (C + FA + G) are a problem for all countries, engaged with such activities. As we mentioned above, big areas are necessary for its putting in depots. They are ecological danger for soils, waters and air because of their dust emission and leaching of harms, which contain heavy metals and their combinations as soluble salts and because of high content of sulphates.

Since the 80s of the last century the waste – C + FA + G has mainly treated as a raw material in order to be saved areas for its putting in depots and kept deficit materials such as sand, stone, clays, etc. Because of the heavy metals and other harms presence in the C + FA, a method for immobilization

these harms by means of suitable C + FA, gypsum and rarefied water mixing was developed.

The fields of real using the C + FA as a raw material – a component in construction materials and replacing some of them, for example the sand and stone, are systemized clearly in [8] (see table No2). Here we must add VIII.6 – the use of gypsum for creating stabilizat and immobilization the harms in the waste – C + FA before its putting in depots.

It became clear above that our practice for treating the C + FA does not correspond to that of the developed countries. Putting the C + FA in depots together with the overburden clays is a danger for the uncontrolled pollution of air, soils and waters, near and under the waste dumps with heavy metals and other harms through wind. The infiltration of atmosphere waters in the overburdens' body causes leaching of harms and from there they have their way as a polluted drainage waters to the near situated soils and underground waters. On the other hand, raw materials such as C + FA are being fully and irrevocably buried.

The data analysis of table 3 for the evaluation of effect on the environment of HEPS-2 [4] shows the presence of significant quantities of heavy metals in the cinder, thrown out to the waste pool. The following is written there: "When there are strong winds (with speed more than 5 m/s), the raising of such dust in the air is dangerous because of the presence of lead combinations, which reach the level of 25 mg/kg in the material of the waste pool.

Utilization of the cinder, fly ash and gypsum – waste products from the HEPSs

The eighth fields, shown in table Ne2 for using the cinder, fly ash and gypsum (C + FA + G) are absolutely realizable in our country. VIII.4 is being adopted in semi-industrial scale in recultivation of post-mining areas. VIII.6 and II.1 will be realizable soon. The formation of stabilizat through mixing the C + FA + G and the water from the sulphur purifying before their putting in depots together with the overburden eliminates one considerable potential danger and accumulates part of the gypsum, useless for other purposes.

One of conclusions in the report of evaluation of effect on the environment of HEPS-2 [4] is that "it is necessary to be foreseen and planned concrete investigations, connected with the possibility of waste calcium solutions from the sulphur purifying installation of the smoke gases from block 7 of HEPS-2. The possible positive results will help a traditional problem for putting the waste from the sulphur purifying installation in depots to be solved.

The received by-product from the sulphur purifying is gypsum with quantity of $300 \div 350$ thousand tones a year.

TABLE №2.			
FIELDS OF USI	NG THE CINDE	ERS FROM	THE HEPS

Fields of	Purpose of using
USING L Production	1 Addition to concrete for its production (sign for
of cement	cinder testing)
and concrete	2 Raw material and initial supply of energy
	during cement production.
	3. Raw material for artificial cinder applomerate
	which substitutes the additions to concrete -
	stone and felt.
	4.Raw material for binder solutions.
II.Small	1.Raw material for small blocks used in
blocks for	construction (for example, light concrete small
construction	blocks and bricks in mixture with limestone and
	sand).
III.Highway	1.Filler in bituminous covering and bearing
and road	courses
construction	2.A component part in hydraulic connected
	bearing courses (HGT).
	3.Hydraulic binder cinder for reinforcement of
	soils as bearing, cold-preventing course in the
	upper and down structure.
	4.Raw material for artificial cinder aggiomerates
IV/ Building	(granules) which substitute stone and reft.
IV.Duiluiliy	nrohlem slimes (for example CaSO ₂ /CaSO ₄
exploitation of	slimes from purifying (clarifying) and
denots	excavating)
dopoto	2 Material for compaction of depots' bottoms
	(bottom isolation).
	3.Material for covering and recultivation of
	depots (for example, depots for solid waste of
	life and mining halds).
	4.Material for embankments and roads on
	depots.
	5.Material for putting out mining fires in the
	halds.
	6.Material for binding the dust in the mining
)/l enderer:	Naios.
V.Landscape	1.A component part of the filling in landscape
Ioming	building cound isolating shafts (ombankmonts)
VIIIndergrou	1 Raw material for solution respectively
nd	hardener for filling
construction	2 Using material for embankments
VII.Raw	1.Raw material for metals extraction (for
materials	example, Al. Fe).
providing	
VIII.Others	1.Using cenospheres for special construction
	materials.
	2.Filler for covering isolated bituminous layers.
	3.Isolating material in metallurgic industry.
	4.Way for improving soils' qualities.
	5.Raw material for special glass (porous foamy
	glass).
	6.Receiving a stabilizat during putting C + FA in
	depots in the waste dumps with immobilization
	ot heavy metals and other harms.

In conclusion to the report for evaluation of effect on the environment for the project "Completion of block №8 and building sulphur purifying installation" [5] three possibilities for using the gypsum in sulphur purifying are considered:

• Production of gypsum with commercial qualities for using by final consumers;

- Putting in depots in the waste pool;
- Using gypsum for filling waste pits.

In that case a spreading the spectrum for using the waste gypsum according to the practice of developed countries, namely **production of light blocks** for construction on C, FA, G base plus certain additions is offered. It will take considerable part of the waste and save putting valuable raw materials (clay and sand) in present production of blocks and bricks. The necessary investigations for realizing that production are:

• Making and check the execution of prescriptions for production of construction elements;

• Defining the physical, mechanical and chemical properties of these elements, namely: volume weight, strength indicators, water absorption, resistance to cold, resistance to heat, thermal isolation qualities and other requirements to them according to our standards;

- Making a production technology;
- Evaluation free on production workshop.

The fields III.3. and IV.6. are very perspective too (see table N $^{\circ}$ 2).

The underbasic bearing courses in temporary roads of open mines is building now from gravel stone and constant ones – from concrete. In these two cases CFA may substitute the sand. The investigations carried out by the University of Mining and Geology and the University of Architecture, Civil Engineering and Geodesy, Sofia, show that CFA-concrete's compressive strength and elasticity modulus meet the requirements for underbasic bearing course. Its thickness is 15÷20 cm and it can bear loading of machines running on mines' roads.

0.8 m³ CFA with a value $8\div10$ times lower than that of the sand are used into 1 m² CFA-concrete at an average instead of sand.

The problem of waste pools covering near the HEPSs against dust emission of CFA, thrown out in them, is **unsolved**. The efforts in this direction had as a result creating a composite material on CFA base plus binders which together with our suitable technology [6] can temporarily seal the waste pools' surface and solve simply and cheaply the problem with dust, spreading from their surface in dry periods of the year. The strength and water resistance of the sealing course prevent dust emission and strong infiltration of surface waters in the waste pools' body. These qualities correspond to the technology of scraping up the dried sections.

CONCLUSIONS

Big fly ash and sulphur contents of East-Maritsa lignite coal determines considerable qualities of waste + CFAG during their burning-up. The situation is similar for the other HEPSs in Bulgaria. The lack of sufficient capacity of the waste pools sets the acute problem of areas, taken by them, and protection of the environment.

The Republic of Bulgaria "produces" 3% of the waste world volume [7].

The actuality of investigations for solving the ecological problems connected with the waste from the HEPS as well as their utilization in Bulgaria is undoubted.

Widening the fields of applying the CFAG by means of creating execution of prescriptions and technologies for certain cases is obligation of our scientific specialists on the base of foreign experience and own investigations.

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