

ASH AND SLAG HANDLING**3.7. Analytics****3.7.12. The experience of dealing with the problem of thermal power plant ash-and-slag utilization in Siberia***S.I. Kozhemyako, D.V. Bondar, V.R. Shevtsov, OJSC "Regional generation company №11"***ABSTRACT**

The paper presents factors and findings of drawing ash-and-slag materials into economic circulation in Siberia on the basis of Omsk combined heat and power plants (CHPs) of OJSC "Regional generation company №11". Utilization of thermal power plant ash-and-slag in the context of raw material supplies base expansion of the Omsk region was estimated.

Modern Russian economy is built on inadequate demands of our new time for approaches to the problem of using raw materials potential. High level of resource capacity of production and unsatisfactory environmental conditions let us say about lack of measures aimed at cost-effective use of resources. It is necessary to search and develop new and more effective methods of economic resources management.

In Russian economy the Siberian Federal District (SFD) is one of the resource-intensive macro-regions which plays one of the important roles in the business life of the country. The given region includes 12 entities of the Russian Federation:

- 4 republics (Altai, Buryatia, Tyva, Khakassia);
- 3 territories (Altai, Zabaikalye, Krasnoyarsk);
- 5 regions (Irkutsk, Kemerovo, Novosibirsk, Omsk, Tomsk).

The crucial factor defining the particular role of Siberia in the country economy is availability of natural resources. So, it is difficult to overestimate the importance of minimization of negative influence on the environment in regions. In this connection the problem of efficient use of extracted minerals and of keeping and restoring the proper natural balance takes on special significance in economics of natural resources.

The territory of the Siberian Federal District covers over 5 million sq. km:

- 34 % of the territory of Russia;
- 14,3 % of the population;
- from 60 to 85 % of energy and mineral resources (including 80 % of Russian coal deposits which explains its use as the main fuel in Siberian heat-power engineering [1]).

Under modern conditions for innovative breakthrough to happen more effective techniques of extracted natural resources utilization should be applied.

At the beginning of 2008 at the meeting of the Security Council of the Russian Federation much attention was paid to the greatest problem of increase and accumulation of waste products that are much more than the country output volume.

From the point of view of economics of natural resources ash-and-slag wastes are natural resources used

irrationally. Carbon and organic constituent of the extracted resources are utilized effectively, inorganic constituent being deposited on the ash-and-slag dump. This leads to the considerable reduction of investment resources circulation with land being in disuse.

The majority of Siberian thermal power plants operate on solid fuel such as black and brown coal of various mines with ash content from 8 to 53 % (table 1).

Taking into account natural and climatic conditions, vast territories and peculiarities of industrial organization as well as a large amount of ash-and-slag output and accumulation, a special system approach to ash-and-slag reprocessing and utilization as ash-and-slag materials with due consideration of actual logistics should be developed in SFD regions. From this it follows that such techniques should be developed to appropriately adapt economical activity to dynamically changing environment for energy company competitiveness to be reached. It can be done by efficient use of renewable sources such as ashes, ash-and-slag mixtures, thermal power plant slags.

According to its geographical position the Omsk region is situated in the West Siberian lowland and covers three climatic zones. The area of the territory is 141.1 thousand sq. km, which is equal to 0.8 % of the territory of Russia. There are steppes to the southern border with Kazakhstan. The middle part of the Omsk region is occupied by forest-steppes which give way to a woodland bordering on the Tyumen and Tomsk regions in the north and on the Novosibirsk region in the east. The climate of the Omsk region is extremely continental and the area of farming is an area of risk farming.

Large mineral deposits of zircon and ilmenite, mineral salts, sapropels, marsh marls, clays of moulding concrete stones as well as various ground waters were prospected and partially explored. In addition, the region has five raw hydrocarbon deposits (four oil deposits and one gas condensate field). Unfortunately, all the deposits mentioned above are defined as small ones (the prospected thickness is about 150 million tons). 287 peat bogs were also explored.

The major part of regional industry is concentrated in Omsk, the regional centre. It is one of the ten largest cities of the Russian Federation with the population over one million people which makes it the second city of the Siberian Federal District. Having higher education institutions, research institutes, engineering and design institutes, Omsk is considered to be one of the largest scientific and production centre of the Russian Federation which is able to solve a lot of scientific and production problems concerning recoverable resources utilization.

Table 1. Coals utilized by the largest Siberian generation companies

Energy company	Thermal power plant	Coals utilized	Average ash content (%)
Regional generation company-11	CHP-2 Omsk	Kuznetsky	8...12
	CHP-4 Omsk	Ekibastuzsky	38...53
	CHP-5 Omsk	Ekibastuzsky	38...53
Regional generation company-12	Belovo state district power plant	Kuznetsky	8...12
	Tom'-Usinsk state district power plant	Kuznetsky	8...12
	Kemerovo state district power plant	Kuznetsky	8...12
	Kemerovo CHP	Kuznetsky	8...12
	Novo-Kemerovo CHP	Kuznetsky	8...12
	Kuznetsky CHP	Kuznetsky	8...12
	Barnaul CHP-1	Kuznetsky	8...12
	Barnaul CHP-2	Kuznetsky	8...12
Barnaul CHP-3	Kuznetsky	8...12	
Regional Generation company-13	Krasnoyarsk CHP-1	Nazarovo, Borodinsky	6...7
	Krasnoyarsk CHP-2	Borodinsky	9...11
	Krasnoyarsk CHP-3	Borodinsky	9...11
	Sosnovoborsk CHP	Borodinsky	9...11
	Kansk CHP	Borodinsky	9...11
	Minusinsk CHP	Borodinsky	9...11
	Nazarovo state district power plant	Borodinsky	9...11
Regional Generation company-14	CHP-1 Ulan-Ude	Kharanorsky	18...20
	CHP-2 Ulan-Ude	Gusinoozersky	11
	Timlyuiski CHP	Kharanorsky	18...20
Novosibirsk-energo	CHP-2	Kuznetsky	8...12
	CHP-3	Kansky, Kuznetsky	8
	CHP-4	Kuznetsky	8...12
	CHP-5	Kuznetsky	8...12
Irkutskenergo	CHP-1	Azeysky, Mugunsky, Cheremkhovsky, Pereyaslavsky	18
	CHP-5	Azeysky, Mugunsky, Cheremkhovsky, Pereyaslavsky	18
	CHP-6	Borodinsky, Pereyaslavsky	13
	CHP-7	Borodinsky	11
	CHP-9	Azeysky, Mugunsky, Borodinsky, Cheremkhovsky, Pereyaslavsky	18
	CHP-10	Azeysky, Mugunsky, Borodinsky, Cheremkhovsky, Pereyaslavsky	18
	CHP-11	Azeysky, Mugunsky, Borodinsky, Pereyaslavsky	18
	CHP-12	Cheremkhovsky	27
	CHP-16	Azeysky, Zheronsky	18
	Novo-Irkutsk CHP	Azeysky, Mugunsky, Cheremkhovsky, Pereyaslavsky	18
	Novo-Ziminskaya CHP	Azeysky, Mugunsky	18
	Ust'-Ilimsk CHP	Borodinsky, Zheronsky	18
	Bratsk thermal power plant	Borodinsky, Pereyaslavsky	13

The Omsk region has gained considerable experience of ash-and-slag utilization. Ash-and-slag mixtures of Ekibastuzsky coal from CHP-4 ash disposal area were utilized by Design, Repair and Construction Association "Omskavtodor" on the stretch of the Omsk – Krasnoyarsk road. The mixture was used as a semi-active

grain-size filler while laying a bituminous and ground pavement. Ash-and-slag mixtures as a component of an ash-lime-mineral material of the same dump were applied by JSC "Spetsstroy" to construct stabilized road bases, driveways and grounds. Construction administration 944 of "Novosibirskdorstroy" trust substituted

sand-and-cement mixture for ash-and-slag mixtures of Kuznetsky coals, CHP-2 dump, stabilized with cement, when building a roadbed under the cement-concrete pavement on the stretch of the Omsk – Muromtsevo road. Design, Repair and Construction Association “Omskavtodor” used the same ash-and-slags without any stabilization for constructing an additional roadbed layer of the Omsk – Muromtsevo road. Roadbeds made of sand with ash-and-cement binding were built. Asphalt concrete mixing plant of “Spetsstroy” trust applied ash as mineral fines while making asphalt-concrete. A lot of Omsk plants of concrete goods used ash as mineral fines for cement saving and improving its placeability. Ash-and-slag mixtures from CHP-5 dump were applied by Design, Repair and Construction Association “Omskavtodor” for roadbed building on the stretch Morozovka – Podsobnoe khozyaistvo [2].

Ash-and-slags of Omsk CHPs are used as raw materials for producing building materials and as substitutes of natural materials in industrial and civil engineering. This utilization is the essential aspect of their efficient use. Two plants manufacturing walling with ash-and-slag materials were built in Omsk (porous materials combine (PMC) and Siberian effective brick (SibEB)) but ash-and-slag utilization in construction engineering of the Omsk region has been spontaneous so far.

An Omsk CHPs ash-and-slag materials utilization analysis revealed the fact that ash-and-slag mixtures from the dumps are not in great demand at the regional raw materials market. And to meet the demand for ash of dry selection it is necessary to provide some measures aimed at re-equipment of Omsk CHPs involving considerable investments.

A low level of ash-and-slag recycling is determined by a variety of reasons:

- Omsk CHPs ash-and-slag materials competitiveness is very low;
- aspects of getting market and resource competitive advantages are not defined;
- lack of regulatory legal acts.
- Minerals suppliers are in more favorable position than those of ash-and-slag materials:
- technologies are well-proved;
- long-term relations “supplier-consumer” are established;
- constructional decisions and process technology are proved to be well developed;
- technical, technological and normative documentation is elaborated;
- legal matters are settled.

The system of manufacturing and selling ash-and-slag materials being complicated and hierarchical, ways of solving the problems designated for the Omsk branch of OJSC “Regional generation company № 11” are a detailed elaboration of each point.

To achieve the goals the departments of the branch should:

- to get acquainted and follow the strategy of efficient use of natural resources extracted on the territory of the Omsk region;

- to save extracted natural resources in the days of shortage economy;
- to create an efficient trade zone for small and medium business;
- to make economic activity and manufacturing processes attractive for investment;
- to decrease man’s impact on the environment.

The departments of the Omsk branch of OJSC “Regional generation company № 11” are implementing some decisions:

1. Market study and defining prospective consumers and their needs in ash-and-slag materials amounts in assortment are conducted:

- demand analysis made according to the selection type: the ash-and-slag materials current output, hydraulic ash removal, dry selection;
- demand analysis made according to breakup of ash dry selection from electrostatic cleaners or whirlers;
- demand for dumped ash-and-slag mixtures.

2. Technical training for ash-and-slag materials issue both as ash-and-slag current output and from accumulated bulk of ash-and-slag mixtures is being provided.

3. Measures for legal reasoning of ash-and-slag mixtures utilizing according to the RF law are being taken.

4. Ash-and-slag reprocessing and utilization are being carried out successfully.

5. An organization engaging in reprocessing and utilization of ash-and-slag mixtures is being set up.

6. For raw materials sales market development:

- demand analysis at the sales market is being performed;
- major trends of reprocessing and utilization of ash-and-slag materials are indicated;
- ash-and-slag mixtures utilizing is being legally and normatively justified;
- public opinion concerning benefits of ash-and-slag mixtures utilizing is being shaped.

7. Conditions for market and resource competitive advantages for ash-and-slag mixtures are being created.

At first stage the departments of the Omsk branch of OJSC “Regional generation company № 11” made the analysis of the regional sales market.

The purpose of the analysis performed was to find prospective consumers of flue ash and ash-and-slag mixture.

The given study was undertaken from 01.08.2008 to 29.08.2008.

To get the necessary information meetings were organized, individual negotiations with heads and experts of building and building materials companies were conducted. Negotiated contracts or declarations of intention were signed.

Differentiated approach was applied while working with the prospective consumers (table 2). Consuming companies were divided into several groups according to the trends of ash-and-slag materials utilizations:

- in road building 13 enterprises were investigated;
- in the sphere of ready-mixed concrete making 13 enterprises were investigated;
- in other building materials production 5 enterprises were investigated;

- in general construction 22 enterprises were investigated;
- in intermediate reclamation and leveling operation 2 enterprises were investigated.

To make the work with the consumers more efficient information materials aimed at broadening outlook and substantiating the necessity of ash-and-slag mixtures utilization were elaborated in each business activity.

The information materials included:

- cooperative agreement;
- kinds of potential utilization of ash-and-slag mixtures;
- materials proving ash-and-slag mixtures utilization (State Standards, industry building code and requirements for CHP ash-and-slag mixtures utilization).

The results (table 2) obtained revealed that:

- 90 % of the enterprises were aware of the possibility of ash-and-slag mixtures application in production.
- 33 % of the enterprises had utilized ash-and-slag mixtures before;
- 10 % of the enterprises were currently using ash-and-slag mixtures in their production.

Investigation of 55 prospective consumers resulted in:

- 58 % answered in the affirmative and had possibilities to use the material in their production;
- 12 % of the enterprises did not exist or business activity profile did not allow them to utilize ash-and-slag materials;
- 16 % of the enterprises answered in the negative;
- 14 % of the enterprises were studying the possibility of using ash-and-slag materials in their production.

Table 2. Results of ash-and-slag materials consuming companies investigations

№	Utilization	Number of enterprises	Ash-and-slag material consumption (thousand ton/year)
Flue ash			
1	Concrete and mortars making	7	35,2
2	Building units manufacturing	6	37,3
3	Road building	1	8,0
4	Building materials manufacturing	2	208,4
Flue ash total			288,9
Ash-and-slag mixtures (dump)			
1	Reclamation of Municipal solid waste landfills	2	500,0
2	Backfilling during construction	2	9,5
3	Mineral binding materials manufacturing	4	500,0
4	Road building	1	30,2
Ash-and-slag mixtures total (dump)			1039,7
Total			1328,6

OJSC “Regional generation company № 11” is using a new approach to making a resource-saving model in its economic activity aimed at utilizing Omsk CHP ash-and-slag mixtures. This model is orientated towards the efficient use of natural, investment and labour resources. “Strategy of investment programme of Omsk CHP ash-and-slag mixtures selling, reprocessing and utilization for the period of 2008 - 2016” and the Plan for reprocessing and utilization of ash-and-slag mixtures of the Omsk branch of OJSC “Regional generation company № 11” are the basis for the departments of the Omsk branch of OJSC “Regional generation company № 11” to achieve the goals.

To reach the goals of increasing ash-and-slag circulation on generation companies it is necessary:

- to equip thermal power plants for offloading dry selected ash and dumped ash-and-slag mixtures of design volumes;

- to organize the work on shaping public opinion concerning benefits of ash-and-slag mixtures utilizing;
- to establish business units engaged in reprocessing and utilization of ash-and-slag mixtures;
- to provide regulatory background to utilize ash-and-slag materials.

REFERENCES

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