

## ASH AND SLAG HANDLING

## 3.7. Analytics

## 3.7.11. Formation of competitive advantages of power enterprises by example of using ash and slag from Omsk CHPPs in the market of mineral raw materials and other natural resources

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## ABSTRACT

In the paper the factors forming competitive advantages at entering the market of ash and slag materials from Omsk CHPPs are formulated. The situational estimation of competitiveness of ash and slag materials in the local market is given. Actions for utilizing ash and slag materials within the limits of expansion of a regional raw-material base of the Omsk Region are highlighted.

Both the world and domestic statistics, and forecasts for the near future guarantee power consumption growth. In this connection, increase in fuel demand is accordingly predicted. About 38 % of electricity world-wide is generated from solid fuel, i.e. the growth of volumes of ash and slag production is predicted.

The ancient Romans used ashes for building of the such well-known ancient constructions as the Colosseum and the Pantheon, constructed in 115 BC. Nowadays many technologies of world-wide ash and slag applications are developed [1].

In our country scientists and experts have been dealing with issues relating to utilization and processing of ash and slag wastes as renewable raw materials from the underused coal natural resources several tens years. Only according to data of the Institute VTI of the Russian OJSC "United Energy System of Russia" over 400 research, design and other organizations have developed more than 300 technologies in 23 applications [2]. Unfortunately, they haven't found wide use in practice, as the economic component (till 90-ties in the conditions of the planned economy, but now – a steady economy of market relations) wasn't studied. Total amount of utilizing ash and slag materials in Russia is at the inadmissible low level and makes no more than 4 ... 5 % in comparison with their annual accumulation.

Now the developed approaches to management of industrial activity of the enterprises and use of natural resources promote increasing in volumes of rather limited natural resources, involved in economic circulation, which considerable part is consumed irrationally, that causes growth of volumes of man-made wastes and environmental pollution.

Until recently a major factor of strategic success of the enterprises was considered to be the maximum increase in volumes of basic production output. Thus, heads of the enterprises didn't pay attention to costs which were expressed in high resource capacity of the output production; considerable production volumes and disposal of production wastes polluting the environment.

In process of thermal and electric energy generation, there is a partial beneficial use of the withdrawn natural resources. Ash and slag mixes can be classified as production wastes only concerning the basic technological process. From a position of economy of nature management and estimating the efficiency of economic resource use, ashes and slags are irrationally used natural resources. Only carbon and the organic part of the withdrawn natural resources are used beneficially, and their inorganic part is simply landfilled, wasting considerable own investments of power enterprises.

First of all, the term "ash and slag wastes" is the initially wrong definition, impacting rather negatively on formation of competitive advantages of their use in the market of mineral and other natural resources. Wastes can't be goods, applied in different branches of national economy, since any production which is subject to selling according to the Russian and international legislation, should have shipping documentation, including the passport on the sold goods.

At the same time, there are certain difficulties in use of foreign models, which don't properly consider real conditions of the Russian economy development. In this connection, it's important to work out such methods, which allow to adapt adequately economic activities for dynamically changing environment to achieve competitive advantages of power enterprises, formed due to rational use of renewed resources which are ashes, ash and slag mixes and slags from TPPs.

The basic compositions of forming the competitive advantages of power enterprises due to ash and slag use, replacing natural resource materials, consist in the following:

- definition of the limiting existing and potential volumes of ash and slag market (i.e. under condition of the highest competitive advantages in the market);
- specification of the factors, forming competitive advantages, involving ash and slag in economic circulation (including market, raw, situational);
- availability of regulatory legal acts and licensing documentation;
- definition of features, forming the economic benefits resulting from ash and slag selling;
- participation in formation of the market and production development strategy of processing enterprises, which use ash and slag from TPPs as raw materials;
- working out the system approach for selling ash and slag, replacing natural resources.

Taking onto account a sufficient level of scrutiny of a technical part of the question, considered at meeting, I'd like to mention once again the important economic aspect of market relations — competitiveness of ash and slag materials in the Omsk Region, playing an important role in the regional market of natural resources, and the economic benefits resulting from the rational use of natural resources.

Reference point is the actual market demand in the assortment, reflecting level of liquidity of ash and slag materials as the goods. By this, situations when the sold goods are under low, balanced and raised demand, are considered. Market research is made on three basic directions of ash and slag use:

- use of ash and slag mixes as substitutes of nonmetallic natural materials (ground, sand, crushed stone) in industrial and civil building applications;
- use of ash and slag as raw components by manufacture of building materials and products (steel-concrete products, wall and heat insulating materials; cement and other binding materials, solutions and concrete);
- use of ash and slag as initial raw materials for extracting iron, aluminum and silicon oxides, rare-earth elements and other valuable components.

Results of ash and slag market research:

- low demand for ash and slag materials for their direct use;
- balanced demand for ash and slag mixes in the form of raw materials;
- great demand for ash and slag at their deep processing.

In the considered case natural materials competed with ash and slag materials.

Rational use of the renewed resources leads to different economic benefits:

1. Selling production wastes, suppliers of ash and slag materials receive economic benefits which include:

- benefit from ash and slag selling;
- benefit from decrease in payments for environmental contamination and withdrawal of natural resources;
- benefit from decrease in payments for production wastes disposing.

2. The customer has a benefit from using ash and slag materials as a result of the following:

- use of ash and slag materials as cheaper resources;
- improvement of quality and reliability of production;
- raised incomes due to decrease in production costs, owing to application of more effective technologies, technical and economic solutions.

3. Economic benefit from utilizing ash and slag materials on the scale of regional economy is expressed in increase in volume of the national produce, caused by the following:

- use of cheaper resources;
- improvement of quality and reliability of the manufactured production;
- reduction of costs due to decrease in payment for disposing industrial wastes;
- compensation of deficiency of natural resources;
- decrease in expenses, owing to application of effective technical and economic solutions;
- reduction of withdrawal of natural resources in the Region;
- decrease in environmental contamination and other factors.

The Omsk branch of the Open JSC "Territorial Generation Company № 11" sets a problem before the enterprises on considerable decrease in anthropogenous influence on environment in the Omsk Region, due to active using of ash and slag materials, replacing natural resources. Results of the analysis of the existing situation in the Region testify, that usage of ash and slag materials becomes complicated because of a number of reasons, resulting from the following:

- fragmentary, but not system approach to solution of ash and slag handling problem as a whole;
- insufficient development of logistics (i.e. the technology of planning, organization, control and regulation of information, financial and material streams isn't developed);
- insufficient study of the limiting existing and potential volumes of ash and slag markets;
- absence of the prepared personnel, as till recently solution on ash and slag handling problem was considered as a *not profile direction* in economic activities of power enterprises;
- absence or imperfection of regulatory legal acts (including licensing documentation, allowing to apply ash and slag materials in economic activity);
- insufficient technical and technological readiness of power enterprises for delivery of ash and slag of the current

output or from ash disposal sites as replacement of natural resources;

- insufficient readiness of enterprises-consumers for ash and slag use.

Today four combined heat power plants (CHPPs) and one boiler-house are parts of the Omsk branch of Open JSC "Territorial Generation Company № 11". All power enterprises are located in territory of Omsk. At CHPP-2 and CHPP-3 the basic fuel is natural gas. At CHPP-2 during the winter period kuznetsky coal is combusted. At the largest CHPP-4 and CHPP-5 of the Omsk branch of TGC-11, coals from ekibas-tuzsky mine field with ash content of 43 ... 53 % are combusted.

Ashes and slags are mostly conveyed as slurries and disposed at three wet ash and slag lagoons. Two ash lagoons are in immediate proximity from the unique water highway of the river Irtysh, passing through the Omsk Region. All the lagoons are classified as flat ones. During CHPPs operation about 60 million tons of ash and slag are accumulated. Almost all ash and slag disposal sites require either construction or preservation, and building of the new constructions, since they are filled at 95-97 %.

Total annual landfilling level of Omsk CHPPs makes 1,3 million t.

Obviously, the problem of landfilling of constantly increasing quantity of ash and slag, negatively influencing on environment, demands the immediate solution.

#### **On experience of the Omsk Region in solution of ash and slag handling problem.**

According to Decree № 863 of Minmontazhspetsstroy of the USSR from 16.9.1982, in 1985 a factory by capacity of 500 thousand m<sup>3</sup>/year, producing agloporyt gravel was designed and built. By the reason of financing, building of the factory was stopped in 1998.

The Governmental order №87-P of the Omsk Region dated 14.02.1996 "On use of ash and slag materials from Omsk CHPPs for road construction, industrial and civil engineering applications" was not implemented, because Omsk CHPPs had not been prepared for ash and slag shipment, the commodity market hadn't been studied and enterprises-consumers hadn't been prepared (decrease in production under conditions of transitive economy hadn't been considered).

In 2000, according to the decision of Omsk administration: "On creation of the working group on solution of a problem on using ash and slag mixes", the enterprises, applying ash and slag for the road bases (the firm "Rus" and the JSC "Building company - Management of mechanization №7") which actively and effectively used ash and slag materials in road construction works. As a result, quality of the roads constructed with use of ash and slag, has considerably improved, and customers' opinions testify that. Nowadays this experience isn't applied for various reasons.

In 1998 the collection "Rational application of ashes from CHPPs: - results of scientific and practical investigations" (under edition of E.P. Guzhulev and U.T. Usmansky) was developed. The solutions presented in the collection, on manufacture of building materials, using ash and slag, are actual until now.

In 2002 in the OJSC "Omskenergo" a business plan for building two factories on processing of ash and slag at CHPP-4, was developed. One of them - JSC "Industrial complex of porous materials" was put into operation in February, 2008, and the factory of effective silicate brick is planned to be put into operation in the second half of the year 2008.

Since 2003 the work, directed at ecological issues, has been conducted. The result of this work "Regional norms on designing and building of highways, engineering constructions" (which require completion and coordination according to experts' conclusions) have been developed;

For the period till 2008 at the enterprises of Omsk branch of the OJSC "TGC-11" for solution of a problem on beneficial use of ash and slag from TPPs, the following actions were executed:

- in 1975 at Omsk CHPP-4 a plant of dry ash discharge by capacity of 60 000 t/y was commissioned and started to operate;

- today starting-up and adjustment works of the second stage of the new plant of dry ash discharge by capacity of 210 000 t/h come to an end at CHPP-4. Total capacity of both plants of dry ash discharge makes 270 thousand t/year, which will completely provide a demand of the industrial complex of porous materials and the factory of effective brick in ash and slag.

- in April, 2007 the agreement with JSC "Osnova-Holding" on building of the plant on dry ash discharge by capacity of 280000 t/year in territory of Omsk CHPP-5 was concluded. The plant would provide a demand in raw materials of the planned manufactures of the JSC "Osnova-Holding" – a factory of ash-ceramic brick, cement works, a factory of ash-mineral heaters.

- under conclusion is the contract with the Open JSC SIE "Osnova" on ash discharge from the disposal site of CHPP-5 in the amount of 500000 t/year with the subsequent building of a factory on manufacture of high-strength mineral bindings using ash and slag from Omsk CHPP-5.

- in the accepted decision on building of CHPP-6 already at a design stage, processing of 100 % of ash of its current output is provided.

- active co-operation with the Government of the Omsk Region and Omsk city structures on solution of the main problem - use of ash and slag at design stages of construction objects and creation of complete standard-legal base on ash and slag use, is conducted.

According to the Program of ecological policy implementation of the Open JSC RAO "UES of Russia" at support of the Government of the Omsk Region under the order №521 of the JSC "TGC-11" from 22.08.07, a Department of selling the renewable resources was created in the Omsk branch. The department functions according to the developed and confirmed long-term plan on using ash and slag materials from Omsk CHPPs for 2008-2012.

The main objective of the plan is solution of social problems on environment enhancement and improvement of environment of the person, achievement of a level of ash and slag processing in the amount of 1,3 million tons by 2012, equal to their annual current output, which includes:

- working out of the investment program on application of ash and slag from Omsk CHPPs in the national economy of the Region;

- creation of investment attractiveness of beneficial use of ash and slag in the Region;

- execution of researches, proving using ash and slag materials in different applications of the national economy, such as:

1. Road construction works;
2. Arrangement of vertical planning embankments;
3. Intermediate restoration of dumps and disposal sites.

4. Creation of the standard-legal base on using ash and slag materials in the national economy of the Omsk Region.

5. Obtaining and producing the new building materials with application of ash and slag.

Management of the OJSC "TGC-11" together with the Government of the Omsk Region (Ministry of Industrial Policy, Transport and Communication), SibADI and at the active participation of representatives of Legislative Assembly of the Omsk Region; deputies of city council and administration of Omsk; scientific, design and building organizations held scientific and practical conference on December 12, 2007. The conference subject was "Expansion of the regional raw-material base by selling ash and slag materials from CHPPs of the Open JSC "Territorial Generation Company № 11". The conference decisions were accepted and entered in the plan for 2008 – 2012.

As organizational actions for selling large-capacity volumes of ash and slag materials, the following working meetings were held in the Omsk Region at the beginning of 2008:

- Under chairmanship of the First deputy of the Minister of Industrial Policy, Transport and Communication of the Omsk Region N.Y. Lavrentev; the subject - "On use of ash and slag materials for engineering preparation at erection of the planning embankments for urban development", within the limits of execution of the governor's program;

- with proprietors of the territories, planning erection of embankments for urban development, using ash and slag materials.

Nowadays in the Omsk Region the problem on ash and slag utilization turned from especially branch to the inter-branch problem.

Enterprises of the Omsk branch of the OJSC "TGC-11" intend to concentrate their activity on three directions of ash and slag utilization, developed in Russia and world-wide:

- in direct application of ash and slag materials from disposal sites in the planning embankments, backfilling, additions; at construction of automobile roads and railways;

- in manufacturing of building materials;

- in deep processing, for the purpose of extraction of valuable raw materials for various industries.

There is a confidence that solution of the problem on ash and slag processing in the Omsk Region will give a complex effect.

Firstly, it will be possible to solve a number of environmental problems, connected with ash disposal sites operation.

Secondly, the Omsk Region will receive hi-tech innovative manufacture, and also new workplaces.

Thirdly, dynamically developing building industry of the Region will get new resources for own growth that is especially important for successful realization of the priority national project "Affordable housing".

For revealing the reserves of increase in efficiency of using natural, personnel and investment resources, and also working out and development of industrial innovations, it is important to define all major factors, causing formation of favorable conditions for achievement of competitive advantages by the enterprises-suppliers of ash and slag from power generation on the basis of the system analysis.

A question about the reasons of strategic success of the enterprise was always in the focus of attention of researchers. In the theory of achievement of competitive advantages, there are some currents which uphold the supporters, focused both on market, and on a resource basis of economy. It is ne-

cessary to note, that opinions of supporters of various currents recently tend to harmonization.

Until recently market orientation was considered as a major factor of such success. In their works, the scientists focused on market within the limits of industrially-economic theory. They note, that enterprises reach competitive advantages in the market in the case, when they achieve such a state of affairs, when it's possible to be protected on a number of competitive factors:

1. At formation of market competitive advantages:

- in competition with the firms, working in the market;
- at a threat of occurrence of the goods - substitutes;
- at a threat of occurrence of new firms;
- in market position as the supplier;
- in market position as the consumer.

2. At formation of resource competitive advantages:

- in achievement of lower costs in comparison with competitors;
- in giving specific properties to the goods, which are met by requirement of the buyers;
- in specialization of satisfying the needs of certain buyers at minimization of production costs and selling the goods;
- as the delivered goods;
- in unostentatious service;
- in development of innovative production technologies;
- in the qualified personnel maintenance.

Estimating market factors, enterprise of the Omsk branch of the OJSC "TGC-11", entering the market of goods-substitutes, made of ash and slag from power generation, compete with the firms, working in the market as suppliers of the goods from natural materials.

To maintain a stable profitability of the enterprises, the Omsk branch of the OJSC "TGC-11" uses the system approach in arrangement of the rational use of investments and natural resources.

Selling both dry and wet ash and slag in the amount of their current output, investments in TPP reconstruction in order to create plants on materials shipment results in paying off in two or three years and start to give profit even at the minimum prices for the sold materials.

Selling ash and slag from ash lagoons isn't very much effective, but in case large-capacity volumes are sold (under preliminary estimation), it can bring rather tangible benefits.

Under the average data, consumers' costs, in particular concerning building organizations, for natural raw materials make over 50 % of the total amount of investments. Use of ash and slag allows to lower expenses for raw materials by 15 ... 30 %.

Together with this, in scales of the Omsk Region, a question of compensating the deficiency of natural building materials and raw materials is solved.

It is not necessary to dismiss an ecological effect, resulting from the decrease in a man-made impact of ash and slag lagoons on environment.

At development of technological processes on separation of ash and slag mixes on valuable components in trial volumes in the Omsk Region in case of absence of natural fossil fuel and availability of considerable resources of ash and slag from power generation, consideration of a question on building of the ore-dressing and processing enterprise would be quite possible. At this enterprise at deep processing it would be possible to extract compounds with high iron oxides content (for manufacture of cement and binders), aluminum oxides (for nonferrous metallurgy); to receive concentrates of rare and rare-earth elements, including scan-

dium; to allocate soot (for tire industry) and produce other useful components for various branches of economy.

The content of aluminum oxides in ash and slag from ekibastuzsky coals makes at the average 29 %. But the most interesting fact is that the ore-dressing and processing enterprise can use both coal ash and slag, and wastes from the petrochemical industry.

For successful large-scale selling of ash and slag, the Omsk branch of the OJSC "TGC-11" has developed and accepted a comprehensive plan of actions, which basic directions are the following:

1. Working out and realization of the complex program for:

- research of a conjuncture of the regional commodity market;
- estimation of admissible total volumes of replacement of natural resources with ash and slag within the limits of the regional commodity market;
- definition of new potential applications for ash and slag and possible volumes of their selling;
- studying and recognizing of potential customers and working out of cooperation methods;
- decrease in the total costs, connected with ash and slag accumulation;
- development of the price policy, taking into account market conditions and the economic benefits from selling and consumption of various goods;
- definition of optimum dates of project performance, proved by investments efficiency estimation.

2. Development of ash and slag processing manufactures.

3. Completion, coordination and approval of qualitative production schedules on using ash and slag in various branches of economy.

4. Development of various types and forms of co-operation with the interested organizations and business structures.

The main overall aim is mutually beneficial collaboration, selling ash and slag from power generation, which provides the interested parties with ecological and economic benefits.

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