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UTILIZATION OF WASTE MATERIALS OF PRIDNEPROVSKA TPP

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Purpose. Study the possibility of fly ashes full recycling of Pridneprovska Thermal Power Plant (PTPP) by their refining in industrially valuable products using gravity classification of dry ash from electrostatic precipitators and water-gravity separation of the ash from a dump.

Methodology. Classification of fly ashes using the modernized processing equipment has been carried out in the laboratory in two ways. First one is ash pneumatic separation directly from the electrostatic fields using specially selected vibrating screen. The second way is to hydro divide the original product from an ash dump using the upgraded centrifuges and hydrocyclones.

Findings. Technological solution for complex processing of fly ashes, based on the "dry" gravitational separation of ash from electrostatic precipitators and "wet" gravitational separation of ash from thermal power plants and storage dumps has been developed. It is established that the addition of active ash up to 33% on 1 m^3 of concrete allows saving up to 25% of cement and increasing strength of concrete structures up to 5%. Addition of products produced from thermal power plants waste, for production of building materials allow to reduce the share of energy consumption up to 20 – 25%, which is essential for the competitiveness of construction products. A mixture of alumina-silica products can reduce the industry clay using to 50%. Carbon products are cheap substitutes for the individual production of sorbents.

Coal combustion at thermal power stations results in accumulation of considerable amounts of ashes and slag waste. In particular, coal combustion at PTPP results in 0.5 mln tons of ash; the available ash storage facilities occupy the territory of 200 ha being constant source of contamination for soil, air and water basins.

According to [1, 2], the accumulated amounts of solid waste of thermal energy may be utilized with high economic efficiency. However, use of ash in various industries is rather limited due to inhomogeneity of its composition and high

content of unburnt coal (up to 25 %). Such material as microspheres of fly ash is rather prospective; the material is rather underdeveloped by the Ukrainian market and industry in general [3]. The microspheres are widely used abroad as thermal insulating material, sorbents, radiotransparent ceramics, fillers for composite materials, and special types of cement because of the combination of microspherical design, low density, high mechanic strength, thermal stability, and chemical inertness. Along with that, microspheres are the prospective raw material to be the basis for obtaining catalysts and adsorbents being able to function under the effect of aggressive media and high temperature.

One of the main conditions to use ashes of thermal power stations is ash production with strictly conditioned qualitative characteristics. Basic requirement providing successful use of TPP ash waste is stability of their physical and chemical parameters and content of the residual fuel.

Two-direction experiments have been carried out to classify fly ashes:

1. Pneumoseparation of fly ashes that uses ashes immediately from the electrofilters. It was performed involving the developed vibratory screen with meshes of 42 mcm and fiber thickness of 30 mcm. Main objective of pneumoseparation is the processing of ashes taken from electrofilters to obtain two industrial products – with decreased carbon content (5-8%) applied in construction industry and with the increased one (more than 10 %) used in metallurgical industry; in case of advanced processing, the product is aimed for medical field. It has been determined that the indices of fly ashes of PTPP meet GOST 25818-91 requirements, and the ash is good for processing and further use as the additives for components while building material manufacturing.

2. Hydroseparation with the use of the initial product from general system of hydroremoval. Modular experimental and laboratory plant has been developed and built to test the process of water classification of the content of ash-storage tank. Main objective of hydroclassification is processing of the ash being in storage tanks within the area of PTPP land allotments to obtain usable industrial products.

It has been determined experimentally that as a result of dry screening of the ash delivered from eletrofilters, content of carbon constituent decreases from 13-15% to 6-8% in terms of certain fractions. Considerable improvement of physical and ceramic indices of construction bricks while adding 15-20% of classified fly ashes into the composition of the initial charging material has been observed; on average, that improves mechanical strength by 30-40%.

Previously it was defined that adding of unclassified fly ashes of PTPP into concrete mixtures (370-410 kg per 1 m^3) made it possible to reduce cement consumption by 20% [4].The studies carried out in SHED “NMU” dealing with partial substitutions of high-grade cement M-400 with classified fly ashes while

producing M200 concretes have demonstrated that the saving of cement reaches up to 25% in terms of adding of 30% of ashes with the retaining of strength properties.

As a result of complex processing of Pridneprovska TPS fly ashes, 9 products characterized by different chemical and granulometric composition have been obtained; that determines various spheres of consumption and meets current requirements of State Standards of Ukraine (DSTU) and Technical Specifications (TU):

1. Magnetite and carbide of iron of 0.05-0.6 mm in size.
2. High-aluminous minerals and spheres of black and while (light-grey) colour of 0.1-0.6 mm in size.
3. Aluminous- siliceous minerals, fine spheres of black and white colour, carbon particles of 0.05-0.4 mm in size.
4. Aluminous- siliceous particles of 0.04-0.1 mm in size with increased carbon content (up to 18%).
5. Carbon particles with admixed fine silicate particles (less than 0.06 mm) and fine spheres.
6. Heavy particles of 0.02-0.08 mm in size with the prevailing iron oxides, fine aluminous materials, and fine spheres of black colour.
7. Particles of spinels, aluminous compounds, and white spheres of 0.02-0.1 mm in size.
8. Particles of low-magnetic properties and, mostly, particles with increased specific weight as well as black spheres of 0.02-0.06 mm in size.
9. Light fine particles of less than 0.04 mm in size (mostly, 5-20 mcm) with dark foliated-lamellar particles.

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Keywords: fly ashes of thermal power plants, complex recycling, industrial products

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