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Contents

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3D MODEL OF A COKE DRY COOLING PLANT

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The necessity of improving the design of coke dry cooling plants and their operation, especially in connection with the increase in the cooling chamber capacity, is shown. The long-term operation of these plants has revealed a number of problems, the main of which are:

- uneven distribution of flows of circulating gases and coke in various cross sections of the quenching chamber, which impairs heat transfer between coke and gases;
- a high value of the specific consumption of circulating gases for quenching of coke, which degrades the performance of the dry cooling plant.

The directions of research and the list of tasks for the solution of which it is necessary to create a laboratory functional model of coke dry cooling plant have been formulated, including:

- the nature of the distribution of various size fractions over the height of the quenching chamber and the influence of the conditions of coke loading in the dry quenching unit on this distribution;
- the influence of the height of the quenching zone and the design of the elements of the blowing device on the trajectory of the particles in the quenching chamber;
- the effect of coke segregation on the distribution of blast in the volume of the quenching chamber;
- the effect of the porosity of the mound on the distribution of blast in the volume of the quenching chamber;
- the effect on the distribution of blast in the quenching chamber of the design of the blasting devices;
- development of recommendations to improve the uniformity of distribution in the unit of the coke backfill and gas flow.

The creation of the model of coke dry cooling plant using 3D printing and the principles of creating model coke mixtures for research on the set point are described. Given the dimensions of a real dry cooling plant, a scale of 1:25 was adopted for the manufacture of the model. The initial data for the compilation of the mixtures were data obtained under industrial conditions on the size of dry and wet quenching of the bulk coke. Given the scale of the model, narrow classes with grain sizes of 10–6, 6–3, and 3–1 mm were used to prepare model mixtures.

Schemes and general view of the installation are given in the article.

Keywords: coke dry cooling plant, model, coke, model mixture.

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THE POSSIBILITY OF DETERMINING THE DENSITY OF CHEMICAL PRODUCTS OF COKING USING A U-SHAPED OSCILLATORY TUBE (THE VIBRATION METHOD)

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The article discusses the problem and the procedure for determining the density of liquid products of coking to meet the requirements of the legislation of Ukraine.

It is shown that one of the characteristics for attributing to the codes of the Ukrainian classification of goods of foreign economic activity (UKTVED)of heavy distillates obtained by the distillation of high-temperature coal tar (coal oil, coke-chemical fuels, etc.) is the product density at 15 °C, measured exclusively by the method EN ISO 12185 (DSTU ISO 12185: 2009). The density of the product in accordance with this DSTU is measured using a vibration densitometer.

The necessity has been proved and the results of studies to verify the possibility of determining the density of liquid chemical products of coking using the specified device have been considered. The possibility of measuring

the density of concentrated acids and alkalis has been shown. The high accuracy of measuring of the density of volatile products such as benzene, crude benzene, solvent, etc., was confirmed, for which a suction method is provided. In addition, the device can significantly reduce the duration of the density measurement at a given temperature (20 °C; 15 °C, etc.). The method also does not require a large sample volume (5 cm3 instead of 100 cm3, which are required for measurement by a hydrometer) and ensures a safe density measurement toxic and flammable liquids.

At the same time, when measuring the density of coal tar, it was difficult to inject the sample into the device (the sample is injected into the device using a syringe). It possibly related to the content of emulsified water in the coal tarwith dissolved salts of ammonium, carbon monoxide, hydrogen sulfide, and to the content of insoluble carbon substances as well as tar viscosity.

The options for improving the methods of determination have been offered. It was concluded that the device is necessary, first of all, for the operational accounting of the arrival and shipment of liquid chemical products of coking and other products, as well as for attributing the product to a non-excise (excise) code in accordance with UKTVED and complying with the excise tax code products at a temperature of 15 °C.

Keywords: density, U-shaped oscillatory tube, chemical products of coking, Ukrainian classification of goods of foreign economic activity, measurement, error.

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WASTE AND EMISSIONS OF UKRAINIAN POWER PLANTS WORKING ON SOLID FUELS

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The share of thermal power plants in the energy complex of Ukraine is about 67%. During the operation of solid-fuel thermal power plants, huge quantities of ash-slag waste (ash dump) and dust emissions are generated. At work of the Ukrainian solid-fuel power plants on 1 kW of the installed capacity is formed on average 500 kg/year ZSHO. When Ukrainian solid fuel TPPs operate, an average of 500 kg/year of ash dump is generated per 1 kW of installed capacity. The total output of ash dump reached 14 million tons per year and, due to deterioration in fuel quality, tends to increase. This creates technological and environmental problems as a result of increased both production costs and the cost of environmental measures.

A necessary requirement for the creation of an environmentally friendly thermal power plant on solid fuel is, in particular, the disposal of ash dump. Solid fuel ash is a complex multicomponent mineralogical system. The results of studies confirmed the high content of Hg, As, Cr, Ni, Pb, Sr, Zn, V, Sc, Cd, Co, S in the soils of coal mines areas, processing plants and thermal power plants of Ukraine .

When burning coal mines in Northern Donbass, most of the mineral matter turns into ash and less into slag. The ash of the main types of coal is ≈ 98% composed of free and chemically bound oxides of Na, K, Si, Al, Ti, Ca, Mg, Fe, S. Depending on the coal deposit, the ashes contain compounds of most heavy, rare and rare earth metals, a number of toxic metalloids and radioactive elements. The slag component contains quartz contaminated with inadequate organic fuel (the bulk), feldspar (up to 10%), magnetite (10%), carbonates, glass and mica (up to 5%).

The petrographic and mineralogical composition of coal ash from a number of coal basins has been determined. When disposing and storing ash dumps and their use in construction and agriculture, their possible danger should be taken into account using the following indicators: radiative, migration, sanitary, translocation and toxicological.

Before using ash and slag waste in road construction or for recultivation of disturbed lands, they must be cleared of arsenic salts in order to prevent compounds of this toxic element from entering the groundwater.

The examples of pollution scales in all spheres of the environment by the activities of the largest coal-fired power plants in Ukraine, Tripoli and Zmiiv, have been given.

The sites of soil pollution in the areas of placement of large solid fuel TPPs of Ukraine have been determined. The basic physicochemical properties of the ash and slag waste generated during the combustion of a number of Ukrainian coals have been studied. The territories of technogenic deposits of valuable components in the ash of coal in Northern Donbass have been established.

The results of the study of the chemical composition of the coal of Northern Donbas and the territories of the deposition of the ashes of this coal allowed to create the maps of technogenic deposits of valuable components.

Keywords: solid fuel thermal power plants, coal, ash and slag, chemical and mineralogical composition, heavy, rare, rare earth metals, waste utilization, environmental protection.

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GRAPHENE STRUCTURES FROM COAL AND COKE. REPORT 2.

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The article shows the prospects of research in the production of graphene structures. It is noted that the high cost of graphene stimulates the development of new methods for its production and the expansion of the raw material base for its production. A brief overview has been provided of the methods of obtaining graphene, a new allotropic modification of carbon, which is a two-dimensional source material for carbon structures of all other dimensions: fullerene (0D), nanotubes (1D) and 3D graphite. It is shown that methods of obtaining graphene can be divided into two groups: the mechanical separation (splitting off) of graphite layers and synthesis.

The first group includes such methods as micromechanical stratification of graphite, rare-phase stratification of graphite and oxidation of graphite. Such methods for producing graphene uses sound energy or shear forces to peel graphene layers from graphite and then disperse the layers in large quantities of organic solvent. Without enough solvent, the graphene layers reattach to graphite. At present, at least one ton of organic solvent is required to produce one kilogram of graphene.

The second group of methods includes such methods as the synthesis of graphene by the method of chemical vapor deposition, graphene production in an electric arc, thermal decomposition of silicon carbide, epitaxial growth on the metal surface. They allow the formation of high quality graphene, but are quite durable and expensive.

It is shown that methods of obtaining graphene from coal, coke and other carbonaceous raw materials of a turbostructure structure can be attributed to a separate (third) group of methods for obtaining graphene structures. Their essence lies in the fact that amorphous bridges are split chemically between the crystalline packets, followed by the destruction of crystallites in the crystalline packets and the formation of a graphene layers.

Keywords: graphene, production methods, graphite, coal, coke.

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