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## Study of physical and mechanical ash properties of Krasnokamensk power station

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The thermal power stations operating on peat, slate or coal produce about 70 million tons of cindery waste every year. Currently, this waste hasn't been fully utilized and storage of such waste disposal areas requires more than 150 million of RUB per year. Moreover, it requires agriculturally used areas approximately 300–1500 hectares near each big thermal power plant [1].

The study purpose is a complex research of physical and mechanical properties of Krasnokamensk ash for further utilization.

The object of research is ashes of the Krasnokamensk district power station. Ahes are taken from the dump which is directly adjacent to output pipes through, where ashes are taken out by water in the form of a pulp from boiler installations of the station. The chemical composition of the studied material determined by the method of the chemical analysis is given in Table 1.

Losses, when calcinating, are caused by availability of coke and particles of coal that are not burned down. These particles of coal in the presence of moisture are known to be easily oxidized and increased, thus increasing in volume up to 15% and even more. In addition, the high content of these particles leads to fast self-destruction of the product.

**Table 1.** Chemical composition of Krasnokamensk ashes (%)

| Name or code name | Oxide content, % | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SiO_2$ | $TiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | MnO | $Na_2O$ | $K_2O$ | $P_2O_5$ | $SO_3$ | Impurities |
| Ash | 63.1 | 1.17 | 13.22 | 7.99 | 8.67 | 0.88 | 0.09 | 0.54 | 2.47 | 0.37 | 0.6 | 10.7 |

**Table 2.** Physical and mechanical properties of Krasnokamensk power plant ash

| Size grade, mm | Pycnometric density, g/sm$^3$ | Packed density, kg/m$^3$ | Aggregative density, g/sm$^3$ |
|---|---|---|---|
| 0.315 | 1.983 | 500 | 1.813 |
| 0.25 | 2.028 | 588 | 1.955 |
| 0.125 | 2.135 | 823 | 2.47 |
| 0.08 | 2.452 | 911 | 2.26 |
| 0.063 | 2.745 | 970 | 2.65 |
| 0.04 | 3.2 | 1058 | 3.2 |
| > 0.04 | 3.493 | 1117 | 3.493 |

The physical and mechanical characteristics of ashes are determined by standard techniques and presented in Table 2.

Table 2 shows that particle size decrease leads to aggregative density increasing. The reason of such effect is different chemical composition of cindery waste, i.e. quantitative content of magnetic components and particles of coal, which are not burned down. Increasing of aggregative density of fine fraction is caused by vibration in magnetic components. It is known, that the higher content of magnetic components the higher the value of aggregative density [2].

he important characteristic of disperse materials is their granulometric structure, which depends on such factors as operating conditions of a boiler installation, furnace construction, coal feed and coal pulverization system [1]. In this work screen analysis is applied for granulometric structure determination. The results are given in Figure 1.

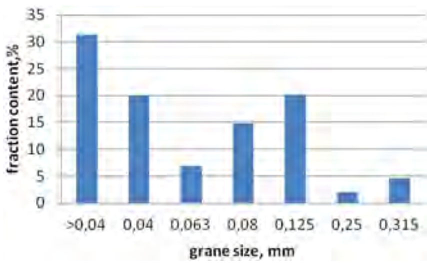


**Fig. 1.** *Granulometric structure of Krasnokamensk power plant ash*

The obtained data show, that the investigated ash is fine material, and the increasing of aggregative density of fine fractions should be considered during treatment method choosing and extraction of separate components from cindery waste mixture. According to the data of Krasnokamensk power plant, ash can be reffered to a latent active group, therefore the main fields of application are highway engineering and production of biding materials solidifying in the presence of activators at high temperatures. Chemical composition of cindery waste shows that the major part of ash consists of aluminium, silica, potassium and ferrum oxides. The content of ferrum oxides makes ash valuable raw material for ferrous and nonferrous industries and for an agricultural sector, where it used as an inorganic fertilizer.

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# Mathematical model developing of heat exchanger block in low temperature separation scheme


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At the present time one of the most urgent and perspective problem in industry is gas fuel production. It is associated with number of factors, and the main one is gradual depletion of world oil reserves. According to the British Petroleum data at the year 2013 end Russia is known to be the second world leader on natural gas deposit (16,8 %). High-quality gas treating is to be a complex and demanding challenge, which includes using of modern technologies and equipment, that meet the requirements and standards of gas quality.

As a rule, gas produced from wells contains dropping liquid, consequently, gas has to be drained preliminary. Essential technology for gas dehydration is a low temperature separation technology. Purpose of this technology involves the droplets capture by reducing the gas temperature to approximately –30 °C. Reduction of temperature is achieved through the effects of isenthalpic (using ejector units or choke valves) and isentropic (using turbo-expanders) gas expansion. Also it is possible to apply recuperative heat exchangers.

This work is devoted to the mathematical model developing for calculation of heat exchanger block in a low temperature separation scheme.

Technological scheme provides cooling of raw gas fluid before the sec-