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DRYING OF COMPOSITE RAW MATERIAL BASED ON PEAT SOLID RESIDUE AFTER EXTRACTION OF HUMIC FERTILIZERS AND CORN CROP RESIDUES

Abstract: *The article presents studies of the drying kinetics of composite raw materials based on solid peat residues after extraction of the humus component and corn harvesting residues. The resulting heat of combustion of composite raw materials is 1.2-1.4 times higher than that of peat in its native state. Moreover, their fairly high calorific value allows them to be used as an alternative fuel in domestic and municipal energy.*

Keywords: *peat, corn crop residues, drying.*

Introduction

The task of human development is to preserve the environment and rational use of raw resources. Hydrocarbon fuel and gas are raw resources that are limited and to a large extent exhausted, and their use leads to pollution of the biosphere. The transition from traditional sources of energy to alternative ones is one of the opportunities to renew the raw material base and preserve the ecological situation in the world.

Sources of alternative fuel include peat, biomass, slag and waste from industry, agriculture, utilities and other enterprises.

Peat occupies a special place among natural resources classified as alternative fuels. In Ukraine, most swamps are peatlands. The latter term is often used for drained bogs, sometimes the peat bog is understood as the peat deposit of the bog, especially during its development [1].

Peat contains a large number of humic substances. Because of this, peat has significant energy and agrochemical potential and is used as a local fuel, as well as raw material for the production of greenhouse and consumer soils and organic fertilizers. Peat fuel is the cheapest and most efficient when transported over short distances. The cost of a unit of energy obtained from peat is 3 times cheaper than the cost of the same energy obtained from natural gas [1].

In the production of humic liquid or solid fertilizers, the humic component is extracted from peat. After extraction, a solid residue remains, which can be used more rationally in the future [2].

In order to use the solid peat residue left after extraction of humates as an alternative fuel, it must be dried, as it has high moisture content. But at the same time, the solid residue of peat has a high ash content of 35-45%, which can be reduced by creating a composite based on it with biomass.

The energy potential of biomass in Ukraine is about 26 million tons/year (solid biomass, liquid biofuel and biogas). The sources of solid biomass are various agricultural residues, the amount of which is about

10.8 million tons/year. The largest component of the theoretical energy potential of the country's biomass is corn crop residues after harvesting the grain and is about 4.18 million tons/year [3].

The purpose of the work is to study the drying of composite raw materials based on solid peat residues and corn crop residues.

Materials and methods

Milled peat and corn crop residues were used for the research. The study of the drying kinetics of the composite material was carried out on an experimental convective stand, which is equipped with an automatic system for collecting and processing information [4].

Results

In order to obtain high-quality material in the drying process, the 100/70°C and 100°C modes were studied. Figure 1 shows the changes in humidity and drying temperature of the mixture based on the solid residue of peat after extraction of the humic component with the crushed corn crop residues at the temperature regimes of 100°C and 100/70°C. As can be seen from Figure 1, the 1-stage drying mode of peat-corn mixture 100/70°C compared to the drying mode of 100°C indicates an increase in the duration of drying by only 9%, but the quality of the material is the same as with the mode. The duration of drying at a temperature of 100°C is 18 min to a humidity of 10%, and at 100/70°C – 42 min to a humidity of 4%, that is why there is such a difference in time.

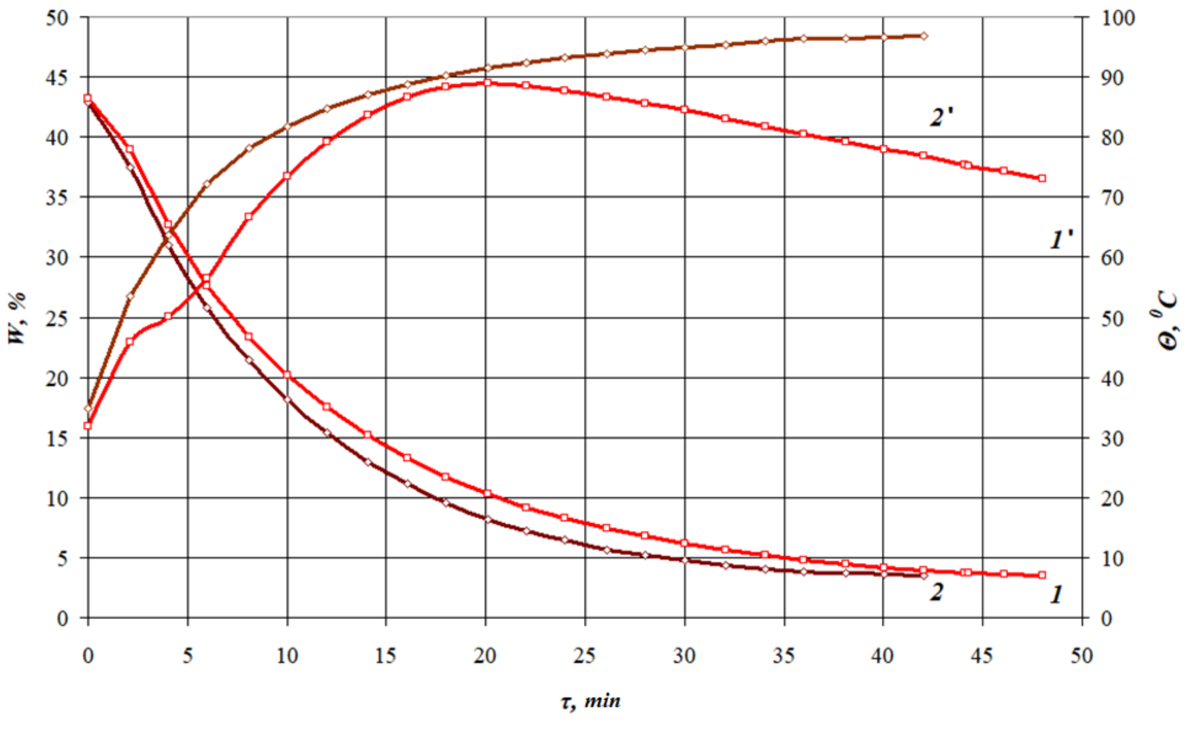

Figure 1. *Change in humidity (1, 2) and temperature in the middle of the layer (1′, 2′) of the mixture based on the solid residue of peat after extraction and the crushed corn crop residues in a ratio of 1:1. Mode parameters: V = 3 m/s, h = 10 mm, particle size ≥0.5 mm: 1, 1′ – 100/70°C; 2, 2′ – 100°C*

Figure 2 presents the curves of the drying speed of the mixture based on the solid residue of peat after the extraction of humid substances and corn crop residues crushed to 0.5 mm. As can be seen from the curves in Figure 2, the maximum drying rate of the mixture at a temperature of 100°C is 3.2%/min, and at a step mode of 100/70°C – 3.3%/min.

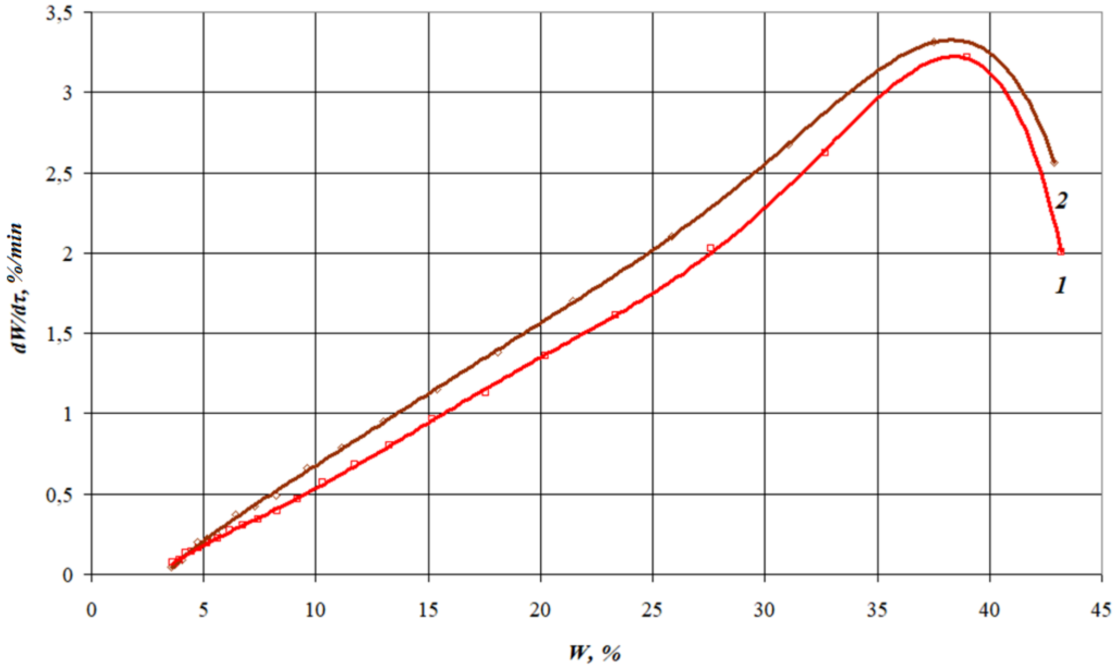

Figure 2. *Change in the speed of the mixture based on the solid residue of peat after extraction and the crushed corn crop residues in a ratio of 1:1: 1 – 100/70°C; 2 – 100°C*

A study of the specific heat of combustion of composite raw materials was carried out. The method of determining the heat of combustion corresponds to the standard method for solid fuel DSTU ISO 1928:2006 and the European standard ISO 18125:2017 "Solid biofuels – Determination of calorific value" [13, 14].

The generalized results of measurements and calculations of the properties of the studied samples in the delivery state and in the dry state are shown in Table 1.

Table 1. *Generalized results of measurements and calculations of sample properties*

Properties	**Native Irpin peat**	**Corn crop residues**	**Solid residue of peat after extraction Irpin**	**Solid residue of Irpin peat + corn crop residues 1:1**	**Chernihiv native peat**	**Solid residue of peat after extraction Chernihiv**	**Solid residue of Chernihiv peat + corn crop residues 1:1**
Humidity is finite W, %	9.7	8.5	6.2	4.9	16.1	6.6	5.3
Ash content in the delivery state, %	34.9	3.5	34.5	13.7	24.8	26.5	9.4
Dry ash content, %	27.2	3.5	36.8	14.4	24.8	28.3	10.9
Higher heat of combustion in the state of delivery, MJ/kg	12.22	20.67	14.35	16.59	13.50	14.31	16.57
Higher heat of combustion in the dry state, MJ/kg	13.53	21.36	15.30	17.46	16.09	15.33	17.50
Lower heat of combustion in the state of delivery, MJ/kg	11.26	17.78	13.42	15.23	12.33	13.27	15.32
Lower heat of combustion in the dry state, MJ/kg	12.22	17.94	13.99	16.15	14.78	14.02	16.19

As can be seen in Table 1, the content of humates in peat does not affect the heat of combustion of peat. At the same time, it becomes the same regardless of the deposit from which it was mined. As can be seen from the obtained experimental data, the heat of combustion of composite raw materials is higher than that of peat in its native state. Also, a sufficiently high heat of combustion allows them to be used as an alternative fuel in household and communal energy. Table 1 shows their characteristics in the dry state (W = 0%).

Conclusions

The study of the kinetics of the drying process of composite raw materials based on the solid residue of peat after extraction and the remains of corn crop residues made it possible to develop an effective drying regime that improves the quality of the material. The kinetics of the drying process of composite raw materials based on the solid residue of peat after extraction and the remains of corn crops were studied. An effective drying mode has been developed, which improves the quality of the material.

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