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Title: **DEVELOPMENT OF THE INSTALLATION DEVICE PRESSING THE VOLUME OF BRIQUETTED MATERIAL AND COMPUTER MODELING OF THE TECHNOLOGICAL PROCESS**

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DEVELOPMENT OF THE INSTALLATION DEVICE PRESSING THE VOLUME OF BRIQUETTED MATERIAL AND COMPUTER MODELING OF THE TECHNOLOGICAL PROCESS

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Abstract: In this work, on the basis of systems thinking, intellectual methods for studying the pressing of briquette material are developed by constructing a mathematical and computer model of the material compaction process. The apparatus of the installation for studying the process of pressing fine coal fractions was developed. The first level of the pressing process deals with the process line for preparing and compacting the material. The second level of the hierarchy includes the devices of the technological line, including the device for pressing the material.

The technique of carrying out the experiment in the apparatus of the material pressing plant is presented. On the basis of the main parameters revealed during the experiment of the process of pressing the briquette material, a mathematical model has been developed in the form of a system of equations. Using the developed mathematical model, the starting characteristic of the material compaction apparatus is studied, which characterizes the changes in the relative density of the compressed material. The change in the density of the briquette during the compaction of the material for the installation is equal to 0.25, while the density of the material increased from 600 to 724 kg / m³.

Keywords: briquette, pressing, solution, briquette strength, apparatus performance, strength, computer simulation, computer model of the compaction process.

Introduction

Currently, coal is becoming one of the main types of fuel, and therefore, the rational use of this resource is of great importance. At the same time, approximately 25% of the mined coal has a fine and dusty fraction. This type of fuel is not in demand among consumers due to its low thermal efficiency, and therefore a lot of dust and fine coal (up to 6 mm in size) accumulate in warehouses. The problem is solved in the production of briquetted coal. This technology makes it possible to produce fuel briquettes from coal dust at high pressure. Coal briquettes tolerate transportation and storage well, have a high calorific value in comparison with the starting materials (at least 6000 kcal / kg), do not emit smoke and gases, burn out completely, and obtain a given hardness and strength.

In this work, on the basis of system analysis [1,3], the technological line of the apparatus for obtaining briquettes from a mixture of coal waste has been studied. A multilevel hierarchical structure of the system analysis of the briquette material compaction apparatus has been developed. Moreover, each

level of the hierarchy encompasses elements - quasi-devices and the processes occurring in them. According to the proposed method [3,4], the input and output parameters of the pressing apparatus, consisting of a complex system, as well as the processes occurring in this system, are initially determined. Then, the system under consideration is divided into its constituent elements, the parameters for each selected element - the quasi-apparatus - are specified.

In the course of the research, we have developed an apparatus for the installation for studying the process of pressing fine coal fractions (Fig. 1).

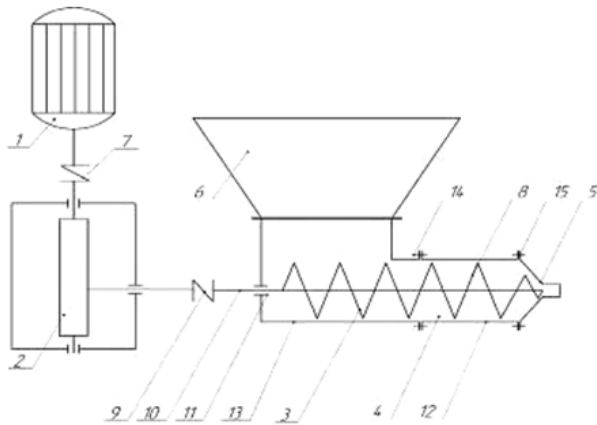


Fig. 1. The apparatus of the installation for the study of the compaction process by pressing the material

1-electric motor, 2-reducer, 3-device for receiving the product, 4-pressing part, 5-nipple, 6-hopper, 7,9-coupling, 8-auger, 10-shaft, 11-bearing, 12-clamping shell parts, 13-hopper for receiving the product, 14,15-bolt connector.

In this machine, the first level of the pressing process deals with the production line for the preparation and compaction of the material.

The second level of the hierarchy includes devices of the technological line, including the device for pressing the material, which have their own input and output technological parameters. In the next hierarchical level are the elements of the apparatus and material, and in the next hierarchical level, the elements of the material are the components.

Starting from the second level of the hierarchy, an apparatus for compaction of the material is considered, in the form of an installation for pressing fine coal fractions, where one of the abstract indicators is the coefficient of compaction of the material.

Let us consider the principle of operation of the apparatus of the installation for studying the process of pressing and compaction of a mixture of material. This experimental setup consists of an apparatus and a drive part.

The working chamber of the apparatus is made in the form of a cylinder with an annular surface. A shaft is installed inside, on which the auger is put on, with sealing dimensions of the pitch of the turns and diameters. At the end of the cylinder there is a bearing and seals for sealing the auger shaft. There is a washer on the other end of the shaft to keep the shaft centered. The initial part of the cylinder has a branch pipe for feeding raw materials coming from the tray, and at the other end of the inner part of the cylinder there is a meter thread, where a ring with a handle is installed. The ring has an external one-meter thread to provide a gap between the last turn of the auger and the horizontal cylinder.

The experiment in the installation was carried out as follows: when loading the goods, the gap between the horizontal cylinder and the auger was maximized. By twisting the cutting ring towards the augers, the gap between the auger and the conical surface is reduced until a briquette is obtained with a thickness of 3-4 mm after pressing. At the exit from the press, the density of the briquette was $724 \text{ kg} / \text{m}^3$.

At the first level of the hierarchy, a semi-industrial apparatus for compacting briquette material is considered. Continuing the previous systemic thinking [2], in this work, the apparatus for pressing briquette material itself is brought to the fore, in which its input and output parameters are determined. The main parameters of the compaction object of the briquette material are the input parameters: consumption G_{vx} of material for briquetting with a certain ratio of components, energy N , outgoing parameters: consumption G of the outgoing briquette material and its compaction. The coefficient is expressed in the unit of measurement in $\text{kg} / \text{m}^3 \text{ s}$.

In the second hierarchical stage, the working area of the apparatus is considered. In the third hierarchical stage, the main quasi-devices of the working zone of the apparatus in the form of a cylindrical conical body, a screw shaft and briquette material are specified.

In the fourth hierarchical level, the briquette material can be represented by quasi-apparatuses, these are the components of the material.

Experiments in the installation were carried out as follows: at the beginning of loading the goods, adjusting the gap between the inner surface of the cylinder and the auger, a cake petal with a thickness of 3-4 mm was obtained after pressing. After establishing stable operation of the installation, the consumption of briquette material was 160 kg / Chas. We made basic measurements of the main parameters. In a series of experiments at the exit from the press, the voidness of the briquette material decreased from 25% to an average value of 8%. At the same time, the temperature of the cylinder was within the normal range (40 - 70 0C), the cylinder was cooled by air convection.

Let us consider the construction of mathematical and computer models of the process of pressing briquette material in the apparatus of a semi-industrial installation.

Analyzing quasi-devices on the basis of systems thinking, the balance equations of the process and characteristics of the material are considered. In addition, by analyzing the design of the apparatus, mathematical and computer models of the material compaction process were built.

For the process at the hierarchical level of the briquette material, taking into account the research carried out in [2,3], a mathematical description of the influence of the supplied energy in the form of pressure exerted by the screw shaft of the apparatus on the briquette material located in the space between the tapered tube with the screw shaft is given. The supplied energy influences the compaction coefficient value which is an independent work and will be studied separately. The equation for changing the void in the composition of the volume of the briquette material is described in the form:

$$\frac{dV_1}{d\tau} = k \cdot V \cdot X_1 \quad (1)$$

This shows that the mass of the volume of the material depends on the residual concentration of leakage X_1 in the material and the coefficient k , due to the compression of the volume of the material. Taking into account this dependence (1), we represent the material balance equation for the compressible volume of material in the pressing apparatus in the following form:

$$\frac{dV}{d\tau} = (G_0 \cdot X_0 - G \cdot X - k \cdot V \cdot X) \quad (2)$$

Here, G_0 is the flow rate of the incoming material, G is the flow rate of the outgoing material, X_0 is the initial concentration of leakage in the material, X is the concentration of leakage in the outgoing material.

The volume V of the material in the working area of the apparatus can be written by the equation, as multiplying the volume of the material V_0 to the density concentration $(1-X)$ in it, in the form:

$$V = V_0 \cdot (1 - X) \quad (3)$$

Then, equation (2) transformed to characterize the concentration of leakage in the output material is as follows:

$$\frac{dX}{d\tau} = \frac{1}{m_0} (G_0 \cdot X - G \cdot X - k \cdot V \cdot X) \quad (4)$$

Let us present the equations for determining the volumetric flow rate of the outgoing pressed material G and the equation for determining the volumetric flow rate G_m of the outgoing briquette.

The equation for the volume of dry material is presented in the form:

$$V_c = V_0 \cdot (1 - X_0) \quad (5)$$

Considering that the mass flow rate of dry material at the beginning and end of the

apparatus will be the same, an equation can be written in the form:

$$G_0 \cdot (1 - X_0) = G \cdot (1 - X) \quad (6)$$

In this case, the equation for the volumetric flow rate of the material at the outlet from the apparatus is:

$$G = G_0 \frac{1-X_0}{1-X} \quad (7)$$

In this case, the equation of the volumetric flow rate of the material at the beginning of the process is determined as follows:

$$G_0 = G \frac{1-X}{1-X_0} \quad (8)$$

Taking into account equations (5-8), we rewrite equation (4) in the form:

$$\frac{dX}{d\tau} = \frac{1}{m_0} \left(G_0 \left(X_0 - \frac{(1-X_0)}{1-X} X \right) - k \cdot V \cdot X \right) \quad (9)$$

As a result, a mathematical model of the briquette material pressing process was obtained in the form of a system of equations:

$$\begin{cases} \frac{dX}{d\tau} = \frac{1}{m_0} (G_0(X_0 - X) - k \cdot V \cdot X) \\ G = G_0 \frac{1-X_0}{1-X} \\ G_m = G_0 \frac{X_0-X}{1-X} \\ k = f(N, d, l, S, G_m, G_{cm} \dots) \end{cases} \quad (13)$$

We have compiled computer equations using the MATLAB application program, in particular, for the material balance equation for the material pressing process, it is presented in the following form:

$$\frac{(u(4) \cdot (u(5) - ((1-u(5))/(1-u(1)) \cdot u(1))) - u(3) \cdot V \cdot u(1)) / u(2)}{\quad} \quad (14)$$

The computer model of the entire material pressing process, obtained on the

basis of the mathematical model (13), has the following form:

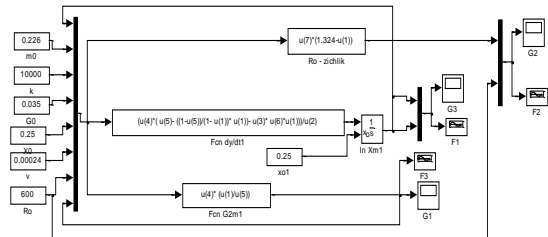


Fig. 2. Computer model of the compaction process of briquette

material in the apparatus

In fig. 2 shows a computer model of the compaction process of briquette material in the pressing apparatus. The computer model consists of several blocks, on the left side are shown blocks for the introduction of the main input parameters.

The mixture of the volume of the briquette material had a mass of 0.226 kg, the material consumption was in the range of 100 - 160 kg / h. If we translate it into a second expression, we get 0.0035 kg / seconds. The mixture of material and an average looseness of 0.25 or 25 percent of the material mass is at the input summarization block. This also includes the values of the calculated indicators returning from the block of integration of the density of the output material and the flow rate of the output material, All these 6-parameters are included in the calculation block under the integral expression presented by the equation, the integration calculates the concentration of leakage in the outgoing material, Above is the block for determining the density of the output pressed material, below there is a block for determining the volumetric flow rate of the outgoing pressed material and, even lower, a block for calculating the volumetric flow rate of the outgoing squeezing air. The signals from these blocks enter the signal generalization block and they, as output parameters, are fixed in the blocks of indicating and recording elements. These blocks are A3 and f1, respectively.

The computer model works as follows. Input parameters are entered into the computer through input parameter blocks. Including, in the input parameters is the coefficient of pressing of the material characterizing the degree of decrease in the density of the material. On a computer model, this is the equation expressed by multiplying the compaction ratio by the concentration of leakage in the output material. Given the values of the compression ratio of the material mixture, it is possible to analyze the changes in the outlet concentration of its looseness using the method of directed random search. Varying the value of the compaction ratio, we compare the values of the outgoing leakage concentration on a computer model with the result of an experiment obtained in a pilot plant.

The results of computational experiments on a computer model are shown in the following figures.

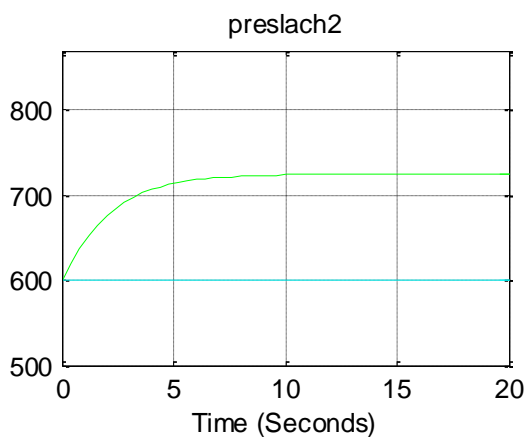


Fig. 3. Change in the density of the briquette according to the start-up time of the pressing apparatus, with a pressing ratio equal to $10,000 \text{ kg} / \text{m}^3 \text{ s}$.

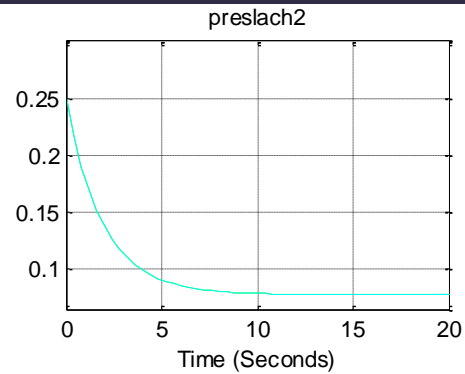


Fig. 4. Change in the relative decrease in the looseness of the material by pressing time at a pressing ratio equal to $10000 \text{ kg} / \text{m}^3 \text{ s}$.

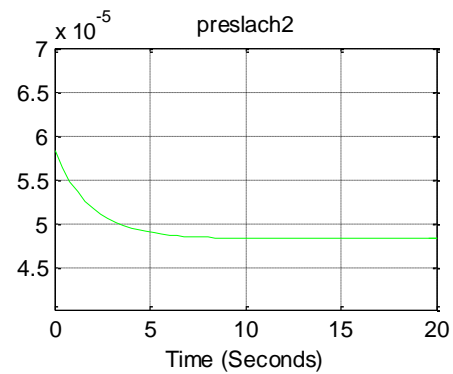


Fig. 5. Change in the decrease in volumetric flow rate, starting output of briquette material, in terms of pressing time at a pressing ratio of $10,000 \text{ kg} / \text{m}^3 \text{ s}$.

Figure 3 shows the change in the starting characteristic of the pressing device, which characterizes the changes in the density of the briquette according to the start-up time of the pressing device, with a pressing ratio equal to $7100 \text{ kg} / \text{m}^3 \text{ s}$. In fig. 4 shows the relative decrease in the leakage of the outgoing material over the pressing time. Fig. 5 shows the change in the volumetric flow rate of the outgoing material. As can be seen from Fig. 5 with a coefficient of extraction k equal to $10,000 \text{ kg} / \text{m}^3 \text{ s}$, the flow rate of the outgoing material from the initial value of $5.88 \times 10^{-5} \text{ m}^3 / \text{s}$, decreases to $4.88 \times 10^{-5} \text{ m}^3 / \text{s}$. The volumetric consumption of material gradually decreases and stops. The results of experiments on a

computer model of the object of pressing show that the change in all parameters of the material has a stable mode for the system under study.

Conclusion

Thus, the apparatus for pressing the material of a semi-industrial installation is analyzed by systems thinking. The computer model of the process of pressing the volume of the material made it possible to analyze the starting characteristics of the pressing apparatus, changes in the density of the output material up to 0.08, and the volumetric flow rate of the material. The calculations carried out on the basis of a computer model, as well as their comparison with the results of experiments on a semi-industrial installation, showed the value of the density extraction coefficient for an industrial installation for pressing the volume of material equal to 0.06. In this case, the material consumption decreases from 0.0035 kg / s to 0.00136 kg / s. The flow rate of the obtained density is 0.00214 kg / s.

Literature:

1. Decree of the President of the Republic of Uzbekistan dated October 8, 2019, PF-5847. Tashkent 2019.

2. *Горячев А.Р.* Проектирование и реализация методики преподавания дисциплины «Общевойсковые уставы» на военных кафедрах при гражданских вузах // Вестник Казанского технологического университета. – Казань.: Казанский технологический университет, 2011. – С. 223-226.

3. *Калмыков В.Е.* Повышение качества методического мастерства преподавателей военно-специальных дисциплин: дис. ... канд. пед. наук / Калмыков В.Е. – М.: Военный университет, 2017. – С. 230.

4. *Киселёв А.В.* Социально-педагогические условия формирования методической компетентности у начинающих преподавателей высших учебных заведений ФСБ России

пограничного профиля: дис. ... канд. пед. наук / Киселёв А.В. – М., 2010. – С. 185.