сельскохозяйственных угодий, проблемы с транспортировкой. Сегодня человечество уже испытывает трудности с производством достаточного количества продовольствия. А через несколько десятилетий продуктов питания понадобится в разы больше. И именно гидропоника может помочь с разрешением такой ситуации.

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ELECTROCHEMICAL METHOD FOR OBTAINING GRAPHITE POWDER AT DIRECT CURRENT IN AQUEOUS SOLUTIONS OF INORGANIC SALTS

Annotation. *The authors consider the possibility of using fine graphite powder obtained by electrosynthesis as a part of multifunctional materials and coatings of equipment for various purposes. For this purpose, a special electrochemical device with two graphite electrodes has been created. As a result of anodic oxidation, a fine graphite powder was obtained.*

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ЭЛЕКТРОХИМИЧЕСКИЙ СПОСОБ ПОЛУЧЕНИЯ ГРАФИТОВОГО ПОРОШКА НА ПОСТОЯННОМ ТОКЕ В ВОДНЫХ РАСТВОРАХ НЕОРГАНИЧЕСКИХ СОЛЕЙ

Аннотация. *Рассмотрена возможность использования в составе многофункциональных материалах и покрытий техники различного назначения тонкодисперсного графитового порошка, полученного электросинтезом. Создано*

специальное электрохимическое устройство с 2-мя графитовыми электродами. В результате анодного окисления получен тонкодисперсный графитовый порошок.

In modern technology and technological systems, the main purpose of multifunctional materials and coatings is heat protection, protection against corrosion and erosion, vibration absorption, and shielding from harmful chemicals. The secondary functions include an increase in stability, strength, rigidity and sometimes dynamics, both of individual external parts of the structure, and of the entire product as a whole [1].

An important problem in the production of multifunctional materials and coatings today is the heterogeneity of the particles of the main component. The role of the shape and size of fillers for distribution and sedimentation in a polymer composite is very important for obtaining coatings with specified quality and functional characteristics [2]. The uniform distribution of filler particles in the polymer composite is determined by their tendency to agglomeration and sedimentation.

The main method of obtaining graphite powder in modern industry is pressing up to 250 MPa of a mixture of petroleum or metallurgical coke, anthracite and pitch. Then firing is carried out at a temperature of 1200 ºC in an Acheson furnace and graphite is heated to 2600~3000 ºC. Individual particles of the original carbon materials during firing as a result of carbonization are bound into a monolithic solid. To reduce porosity, the resulting graphite is impregnated with synthetic resin or liquid pitch, and then again subjected to firing and graphitization. In the production of high-density graphite, impregnation, firing and graphitization are repeated up to five times. In the production of high-density graphite, impregnation, firing and graphitization are repeated up to five times. Further, massive pieces of graphite are crushed in a special crusher, and then one of the types of mechanical grinding: vibration grinding, fine turning, vibration abrasion and jet grinding. The result is a finely dispersed graphite powder.

In addition to the complex technological process, the disadvantage of graphite powder obtained by mechanical action (grinding) is the structural defects of the crystal lattice of the resulting particles - micropores, cracks and an increased interlayer distance.

It is known that the degree of aggregation and sedimentation of a polymer coating is always determined by the relative magnitude of the forces of attraction of the filler particles [3]. The inhomogeneity of filler particles (graphite powder obtained by mechanical grinding) leads to a significant technological disadvantage - obtaining coatings with a significantly increased density: instead of a given limit, the specific density is much higher [4]. With a strictly specified coating thickness, this leads to a larger mass of sprayed coating layers, and, consequently, an excess mass of the manufactured product.

The development of new methods and technologies for the production of finely dispersed graphite powder with high quality characteristics, the required particle size and homogeneous structure is an important modern engineering problem [5].

An alternative way to obtain a finely dispersed graphite powder used as a filler for the materials and coatings described above is direct current electrosynthesis with two inert (graphite) electrodes.

To obtain graphite powder, a special device was created (Fig. 1), consisting of a fluoroplastic body (1), inside which there are two graphite electrodes of the GE brand (2) and (3). The working medium - electrolyte - is located between the electrodes. On the upper part of the electrodes, there are current leads (4), which are connected to a direct current source.

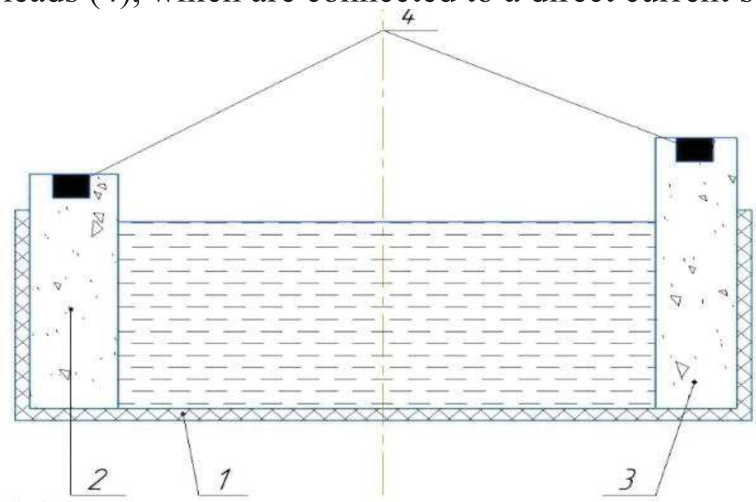

Fig. 1 - Device with two graphite electrodes

The method of obtaining a finely dispersed powder from graphite is based on the property of oxidized graphite to detach from the surface of a graphite electrode in the course of electrochemical oxidation. The electrodes are exposed to an electric current of constant magnitude after half-wave rectification with a voltage of 2~10 V, with an electric field strength of at least 240 kV/m and a current strength of 3~7 A. Between the electrodes there is a working medium - a strong electrolyte. The electrolyte is 15~25% aqueous solutions of soluble inorganic salts: sodium chloride, potassium nitrate, potassium chloride, magnesium chloride. The value of the current strength depends on the nature of the electrolyte used, on the concentration of the solution and its temperature. Electrolytes have the same temperature range of 22~25 °C.

After the end of the electrochemical process, the resulting solution was passed through a special filtering device. The basis of the filtering device is a filter consisting of several layers of filter paper. In fig. 2 shows the filter with finely dispersed graphite powder removed.

Fig. 2 - Filter with the resulting graphite particles

The study of the obtained graphite powder by electrochemical method using a digital microscope and a video measuring device of the *TESA-VISIO 300GL* laser principle of operation with the possibility of magnification up to *0.001* mm.

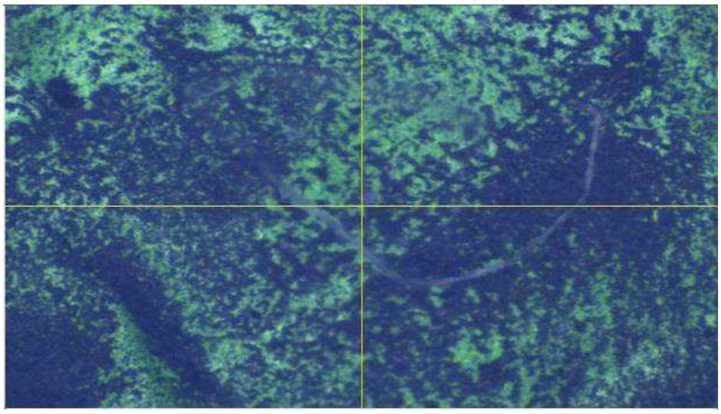

Fig. 3 - A snapshot of graphite powder, with an increase to 0.001 mm

The particles of the resulting powder have a size of 0.004~0.06 mm with a uniform homogeneous structure. Such a structure of graphite powder particles contributes to the creation of a smooth surface of the applied layers of a multifunctional coating with a given density and thickness.

Figure 4 shows the experimental results of the study of specific energy consumption from the concentration and nature of the electrolyte when using two graphite electrodes. The current density range is 1622~2265 A/m^2, for graphical display, instead of ranges of values, we will use the average values of 1944 A/m^2.

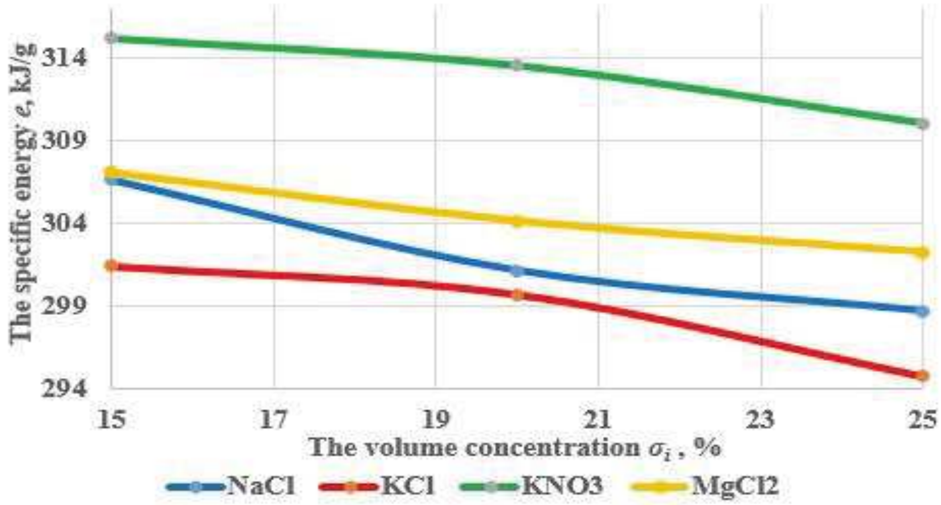

Fig. 4 - Dependence of specific energy consumption on the concentration and nature of the electrolyte

From the data obtained, it can be concluded: at the same value of constant voltage, specific energy consumption decreases with increasing concentration of electrolyte salt. The lowest specific costs of 294 kJ/g were found when using an aqueous solution of potassium chloride with a volume concentration of 25% as an electrolyte.

The resulting fine graphite powder can be used as the main component of multifunctional coatings and materials for transport, rocket and space, aviation equipment, in the production of flame retardant and thermal insulation materials for the chemical, nuclear industry, instrumentation and thermal power engineering.

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РОЛЬ ЛОКОМОТИВНОГО ДЕПО В СОЦИАЛЬНО-ПРОИЗВОДСТВЕННОЙ СИСТЕМЕ ЖЕЛЕЗНОДОРОЖНОГО ТРАНСПОРТА СТРАНЫ

Аннотация. *Рассматривается социально-экономическое значение железнодорожного комплекса Республики Беларусь и роль локомотивного хозяйства в структуре железной дороги. Приводятся основные показатели, сопровождающие производственно-хозяйственную деятельность локомотивных депо, и перспективные мероприятия, позволяющие повысить эффективность его дальнейшей производственно-хозяйственной деятельности.*

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THE ROLE OF THE LOCOMOTIVE DEPOT IN THE SOCIO-INDUSTRIAL SYSTEM OF RAILWAY TRANSPORT IN THE COUNTRY

Abstract. *The socio-economic significance of the railway complex of the Republic of Belarus and the role of the locomotive economy in the structure of the railway are considered. The main indicators accompanying the production and economic activities of locomotive depots and promising measures to improve the efficiency of its further production and economic activities are given.*

В условиях глобализации и интеграции экономик различных стран определяющую роль в функционировании экономических систем, повышении эффективности производства, обеспечении устойчивого экономического роста играют крупные хозяйственные