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JUSTIFICATION OF THE TECHNOLOGY OF FIRE EXTINGUISHING MATERIALS BASED ON AMMONIUM PHOSPHATE

Abstract. In this paper, the justification of the technology of fire extinguishing materials based on ammonium phosphate is carried out, a justification for the production of fire extinguishing powder using MOSS technology with incoherent grinding of impurities has been developed and, accordingly, a block diagram is given. A technological scheme for the production of fire extinguishing powder materials crushed using the technology of isolated base mixtures has been developed, and information is provided on the technological calculations used in the scheme of basic and auxiliary means, as well as on the required material balance of 1 ton of fire suppressing powder according to this technology.

Keywords: ammonium phosphate, fire extinguishing materials, mechanical processing, fire extinguishing powder.

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Introduction. *The effect of mechanical grinding*. The fire extinguishing powder grinding unit used in production is divided into two types depending on the mechanism of action. One type grinds materials without air by mechanical crushing, pressure treatment, cutting. And another type takes an air-powder mixture, and then grinds the raw materials by mechanical cutting, force action and intensive cutting [1].

Classified according to the size of the grinding parts:

Grinding: 300-100 mm – large; 100-25 mm – medium; 25-1 mm – small.

Crushing: 1000-500 microns – large; 500-100 microns – medium; 100-40; microns – thin; 40 microns – very thin.

The scheme of grinding materials is shown in more detail, while the features of processing solids by grinding based on mechanical action are described.

For the production of powdered materials, ball, vibration, disintegrator and chain grinding devices are widely used in production. When obtaining fire extinguishing powder at industrial enterprises, drum ball mills are most often used, which, in turn, are characterized by a low production capacity [2].

The change in the physical and mechanical properties of finely ground materials is not only due to the shrinkage of powder fractions, since when the particle sizes change, there is a significant change in the surface crystal structures of materials. It was found that the properties of many finely ground materials depend on the dispersion method and the corresponding grinding structure.

- mills with low loading speed (ball, rod, ball, runner.);
- mills with medium loading speed (vibrating mills, magnetic, Central planetary);
- mills with high loading speed (strong-reflex, hammer-shaped, rotary, chain and disintegrator).

It is known that a mill belonging to the third group requires significantly lower electricity than mills belonging to the first and second groups, while mills belonging to the third group have very high mechanical activity.

Mechanochemical activity of impurities. At the same time, mechanochemical processes are carried out on simple installations using standard production raw materials. With the addition of impurities (liquid GCS, as well as solid), mechanochemical fire extinguishing powders are obtained.

In the process of mechanical processing, in addition to the process of changing the dispersion of solid materials, a change in mechanochemical activity is observed in mixtures, while surface crystals form in the mixture and crystals accumulate in various active states. These additives have a significant effect on the reactivity of solids. When mechanical energy is transferred to a solid, defective energies accumulate through the material, as well as other structural changes occur.

When machining solids, a number of chains of active centers are formed:

- formation of free radicals formed when covalent bonds break in macromolecules;
- free ions;
- Ion radicals when breaking various bonds;
- F-centers-electrons, reverse ionic bonds;
- F-centers-electron pairs, reverse ion bonds;
- v-centers-connections with a positive charge;
- free electrons;
- active atoms formed when the valence changes;
- formation of active centers, for example magmaplasmas.

active centers are used in mechanochemical processing in order to increase the activity of fire extinguishing agents.

Two cases of the mechanical activation method can be considered. The first is the process of mechanical action, relaxation increases, a pressure layer is formed, a chemical reaction occurs. Such processes are called mechanochemical. Secondly, the formation of a pressure layer during mechanical action will be low, the rate of chemical reaction will be high, or the time of these two reactions will be homogeneous. At the same time, the mechanical activity of the mixture increases.

Conditions and methods of research. *Mechanochemical transformation of fire extinguishing powder*. It is investigated that the addition of mixtures of transformation into the composition of powders extinguishing powder is advisable to carry out on the basis of the grinding process, under these conditions, the surface layers are formed anew [3,4]. Also, the authors of the research note that it is effective to add 0.05 and 0.8% to the powdered composition during the grinding of surfactants (surfactants) and silicon organic bonds (COB). The term "Mechanical activation" is considered to be an increase in the activity of the chemical composition and

dispersion of the fire extinguishing powder powders, as well as animprovement in the variance of the procedure.

Gamma irradiation of surface crystals of silicone mixtures is characterized. When internal rays affect a solid, active centers of various formations are formed on its surface, and the polymerization process proceeds in the presence of monomers. When processing mixtures by crushing on crushing machines, grinding is carried out in order to eliminate structural anomalies of surface crystals and increase the reactivity of solids, along with this, the polymerization process occurs in the presence of demonomers during shear. When processing mixtures by crushing on crushing machines, grinding is performed to eliminate structural defects of surface crystals and accumulation of reactivity of solids, as well as when moving solids in contact with each other, some working part when moving solids in contact with each other, some working part counteracts the force of vibrations, is also released as heat [5].

Systematically restricted surfaces can have very high temperatures and reach boiling points. At this time, the bulk of the substance remains cold. Such temperature changes occur in the area 10^{-7} – 10^{-9} m^2 is lower-10^{-4} s, so they cause chemical transformations on solid surfaces of the body. When grinding or intensive mixing of additive materials fire extinguishing powder, processes of increasing the mechanochemical activity of solid particles occur at the mill, which accelerates the polymerization process of silicon organic layers.

Studies of the processes of mechanochemical processing of research samples of fire extinguishing powder have been carried out, as well as modes and settings for processing various impurities included in the powder have been selected. In these studies, it was found that the addition of 136-41 or surfactants to the powder composition when adding liquid modified mixtures is ineffective, since the powder reacts with the liquid mixture. In addition, the ball mill uses highly modified mixtures – highly dispersed aerosil AM-1-3 00 it is difficult to add, since the processes of mechanochemical activation in mills of this type are weak, respectively, there is no mechanochemical transformation.

Results and discussion. *Production of extinguishing powder by MOSS method with separate crushing of mixtures*. The MSh-1 installation was chosen as the mill. m_1 – mass of the crushed body – 2600 kg; m_2 – mass of crushed material – 800 kg; drum diameter – 1.50 m, rotation frequency – 0.5 Hz (1c). The energy pressure for a ball mixer is determined by the formula (MSh-1):

The production unit MSH-1 was selected as a mill. m_1 - the mass of the crushed body - 2600 kg; m_2 – the mass of the crushed material - 800 kg; drum diameter – 1.50 m, rotation frequency – 0.5 Hz (1c). The power pressure for a ball mixer is specified by the formula (MSh1):

$$\mathrm{E} = \frac{m_1}{m_2} \cdot n \cdot g \cdot D = 0.024\ kW/kg \qquad (1)$$

Afterwards, when transferring the shredded material to the ball mill, 105 Jg of energy is consumed, and the shredded material is crushed for 73 minutes.

Granulated ammophos is transported in bags as white powder through a telfer with the help of a GCS supercharger and with a ball mill from the SB1 position kit. The grinding time of the mixture is 75 minutes. The crushed product flows from the ball mill into the MSh 1 hopper.

The results of the research work (Table 1) showed that the powder extinguishing agents obtained by this technology had higher indicators compared to

industrial fire extinguishing powders manufactured at domestic factories. Studies conducted have shown that powder synergy is achieved by grinding and mixing the main mixture of fire extinguishing powder to known fractions in a separate process and adding urea to the composition at a rate of 5%. It has increased significantly. This is justified by a 47% increase in the concentration of extinguishing powder when urea is added to the composition. The base mixture was ground in a separate process to obtain a high-density refractory powder product, and there was no need to add pure admixture (ground quartz, corundum, etc.) [3-5]. As a result, the probability of extinguishing the fire with the resulting powder increases.When preparing the batch, the MSH-1 mill was used (energy pressure 23.90 kW /t), while the grinding time was 75 minutes (107.6 J/g). The results of the study showed that the prepared fire extinguishing powder was 30% more effective than domestic fire extinguishing agents. The use of such technology increases the expected economic efficiency of production.

Table 1

Results of regulatory documentation for fire extinguishing powder

Fire extinguishing powder	Name of the indicator research result						
	specific gravity of powder, kg / m^3		Ability to absorb moisture	The ability of water not to absorb, min	Humidity, weight %	Relative shallowness, cm^2 / g	Tendency to transformations,%
	sealed	not sealed					
GOST R 53280.4-2022 conditions of the standard	At least 700	At least 1000	No more than 3%	No more than 120 min	No more than 0,35	-	No more than 2
Production of fire powder in the RF	760	1100	1.70	220	0.23	3125	0.5
Powder fire extinguishing agents processed on the basis of MAF	870	1220	1.48	455	0.12	4085	0
Powder fire extinguishing agents treated on the basis of ammophos	855	1135	1.63	385	0.18	4000	0

Conclusion. In the final part, the mechanisms of action of the powder composition for extinguishing fires based on ammonium phosphate are considered in more detail. The basic fire extinguishing powder characteristics and data on fire extinguishing effectiveness, flowability and moisture absorption capacity are described in detail in Parts I and II.

Regarding analytical review materials, it has been shown that it is desirable to use fine powders to extinguish fires, however, without transport, they can also be ignited by air flow. By comparing the mechanisms of action of fire extinguishing compounds and fire extinguishing powders, it becomes clear that they are often similar to each other. A technology for producing a hydrophobic fire extinguishing

powder based on ammonium phosphate has been developed. The following stages are included in the technological processes: drying of the main mixture, mechanical activation, mechanochemical transformation, grouping (re-grinding process), packaging of finished products.

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АММОНИЙ ФОСФАТЫ НЕГІЗІНДЕ ӨРТ СӨНДІРУ МАТЕРИАЛДАРЫН АЛУ ТЕХНОЛОГИЯСЫНЫҢ НЕГІЗДЕМЕСІ

Аңдатпа. Жұмыста аммоний фосфат негізінде отты өшіру материалдарының технологиясын негіздеуі жүргізілді, қоспаларды бөлек майдалау арқылы өртті сөндіру ұнтағын алу өндірісінің негіздемесі жасалынды және сәйкесінше блок-сызбасы келтірілді. Негізгі қоспалары бөлек технология бойынша майдаланатын ӨСҰ материалдарын алу өндірісінің технологиялық сызбасы жасалынды, және сызбада қолданылатын негізгі және қосалқы жабдықтардың, сондай-ақ, аталған технология бойынша ӨСҰ 1 т қажетті материалдық балансына қатысты технологиялық есептеулер жөнінде мәліметтер берілді.

Тірек сөздер: аммоний фосфаты, өрт сөндіру материалдары, өңдеу, өрт сөндіру ұнтағы.

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ОБОСНОВАНИЕ ТЕХНОЛОГИИ ПОЛУЧЕНИЯ ОГНЕТУШАЩИХ МАТЕРИАЛОВ НА ОСНОВЕ ФОСФАТА АММОНИЯ

Аннотация. В работе проведено обоснование технологии огнетушащих материалов на основе фосфата аммония, разработано обоснование производства получения порошка пожаротушения путем раздельного измельчения смесей и, соответственно, приведена блок-схема. Разработана технологическая схема производства получения материалов огнетушащего порошка (ОТП), измельчаемых по технологии с раздельными основными добавками, и представлены сведения по технологическим расчетам применяемого в схеме основного и вспомогательного оборудования, а также в отношении необходимого материального баланса ОТП 1 т по данной технологии.

Ключевые слова: фосфат аммония, огнетушащие материалы, механическая обработка, огнетушащий порошок.