NITROGEN-SULPHURIC FERTILIZERS BASED ON AMMONIUM NITRATE MELT AND PHOSPHOGYPSUM

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Abstract: *to obtain samples of nitrogen-sulphuric fertilizers weight ratio of AN: PG was varied from 100 : 0.5 to 100 : 20. It was shown that crystallization temperature is reduced from 165 to 152 ^oC. In fact, the water soluble forms of calcium are increased from 0.06 to 2.86% due to interaction of ammonium nitrate and dehydrate of calcium sulphate resulting calcium nitrate and ammonium nitrate. When studying ratios of AN:PG = 100 : (0.5÷20) strength of granule is increased from 4.09 to 7.67 MPa while the packing of the product is rose from initial 5.62 kg/cm^2 to 1.83 kg/cm^2 that is 3.1 fold.*
Keywords: *ammonium nitrate, phosphogypsum, crystallization temperature, nitrogen-sulphuric fertilizer, composition, strength, packing and conversion.*

АЗОТСЕРОСОДЕРЖАЩИЕ УДОБРЕНИЯ НА ОСНОВЕ АММИАЧНОЙ СЕЛИТРЫ И ФОСФОГИПСА

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Аннотация: *для получения образцов азотносерных удобрений массовое соотношение АС: ФГ варьировалось от 100 : 0.5 до 100 : 20. Показано, что температура кристаллизации плава селитры понижается с 165 до 152^o С. В продуктах увеличение водорастворимой формы кальция с 0.06 до 2.86% свидетельствует о прохождении реакции взаимодействия нитрата аммония с дигидратом сульфата кальция с образованием нитрата кальция и сульфата аммония. При изучаемых соотношениях АС : ФГ = 100 : (0.5÷20) прочность гранул продукта повышается от 4.09 до 7.67 МПа. При этом слёживаемость продукта снижается с исходного 5.62 кг/см^2 до 1.83 кг/см^2 в продукте, почти в 3.1 раза.*
Ключевые слова: *нитрат аммония, фосфогипс, температура кристаллизации, азотносерное удобрение, состав, прочность и слёживаемость гранул, конверсия.*

Ammonium nitrate (AN) is multipurpose and agrichemical valuable nitrogen fertilizer. Moreover, it is used widely as an additional fertilizing for all agricultural crop and for all type of soils. However, this type of fertilizer has grave lacks namely packing during the storage and high explosion hazard. Therefore, the present study is devoted for remedial this action.

In order to remove saltpetre's packing there are added such as sulphate, sulphate-phosphate, phosphate-sulfate-borate additives, caustic magnesite and so on in AN. In that case, the best effect is reached with using of magnesite [1]. At Present magnesite is used for two plant of Uzbekistan such as JSC "Maxam-Chirchik" and "Ferganaazot". At JSC "Navoiazot" magnesite is used, but in form of natural mineral, brusite $Mg(OH)_2$. The preparation of nonpacking and thermostable AN with usage of phosphogypsum as an addition is actual with point of view for processing the latter. Today, at JSC "Ammofos-Maxam" there was piled about 80 billion tonnes phosphogypsum.

At the present research we have studied composition and property of AN with additive of the phosphogypsum waste from JSC "Ammofos-Maxam" and product of ammonium nitrate conversion.

The experiments were carried out as follows: NA was melted in metallic reactor placed on the electric stove. Next during the mixing powdered PG was introduced in the melt in such amount that weight ratio of the AN melt was equal to 100 : (0.5÷20). Gypsum-nitrate melt was held in 2-3 min at 170^{o}C then it was poured into the granulator which is metallic vessel with perforate bottom, whose diameter of holes was 1.2 mm. By pump from top of vessel pressure was created and melt sprayed from height 35 m on the polyethylene film lying on the

ground. Hence, obtained granules were sieved on graininess. According to State standard 21560.2-82 particles with size of 2-3 mm are conducted measuring on granule strength. Then the products were grained and analysed by according to the procedure in [2].

In addition, it was exanimated that in what rate conversion of ammonium nitrate was conducted. The fact of the matter is that during the mixing melt of NA with PG depending on weight ratio of AN:PG in a varying degree the exchange decomposition reaction is taken place below:

$2NH_4NO_3 + CaSO_4 \cdot 2H_2O \leftrightarrow Ca(NO_3)_2 + (NH_4)_2SO_4 + 2H_2O$

Definition of conversion level of NH_4NO_3 was carried out by the procedure [3].

As the results present that addition of PG in NA melt reduces considerably crystallization temperature of the melt. When studying ratios of AN : PG = 100 : (0.5÷20) the crystallization temperature of the saltpetre's melt dropped from 165 ^oC (initial NH_4NO_3) to 152 ^oC, that is introduction of phosphogypsum into the melt of NH_4NO_3 leads to reduce its melt temperature at 13°C. Decrease of crystallization heat of AN in presence of PG can be explained that insoluble ingredients are crystallization center, which ease solidification process of the melt.

It was established with increase in amount of phosphogypsum from 0.5 to 20 g in towards to 100 g of NH_4NO_3 leads to reduce nitrogen in the product from 34.81 to 29.04%, while the content of sulphur grows from 0.10 to 3.62%, as well as CaO_{total} from 0.17 to 6.23%. It is necessary to note that sulphur is in the composition of proteins and amino acids during the formation of the crop. According to physiological role in plant's nutrition sulphur should be put at the third position after nitrogen and phosphorus. By the way, calcium on significance for plant's nutrition holds at the fifth position after nitrogen, phosphorus, potassium and sulphur. Even if, it is introduced in the soil as an acceptable form for plants it will give significantly crop addition. Thus, it can be said that the composition of AN is enriched additionally by two macroelements such as sulphur and calcium. The growth of water soluble form of calcium in the samples of nitrogen-sulphuric fertilizers from 0.06 to 2.86% gives evidence on transmission mentioned above to the reaction between the NH_4NO_3 and $CaSO_4 \cdot 2H_2O$ with generation of $Ca(NO_3)_2$ and $(NH_4)_2SO_4$.

With increasing mass fraction of phosphogypsum in the melt of NH_4NO_3 from 100 : 0.5 to 100 : 20 the strength of granule grows from 4.09 to 7.67 MPa.

In fact, that such strength of the granules can reduce porosity and inner specific surface of AN. So, reducing permeation of diesel fuel into the inside of granule it is said about decrease of detonating ability of AN.

The packing is one of the main figures of fertilizers 'commodity. There are presented the rate of packing of granular fertilizers depending upon weight ratio of AN:PG. in order to obtain the granule of nonpacking AN (no less than 34% of N) which possesse sufficient strength (4.09-4.56 MPa) while weight ratio of AN:PG should be met 100 : (0.5÷2.5). In that case, the packing of AN is 2.62-2.68 kg/cm^2 that exceeds 1.74-1.78 times in comparison with packing of standard AN with additive of 0.28% of MgO (4.67 kg/cm^2).

However, for samples made from when AN : PG = 100 : (5÷20) this value is in a range 1.83-2.26 kg/cm^2. To compare packing of the pure granular of NA without additives constitutes 5.62 kg/cm^2.

As seen from mentioned above that phosphogypsum leads to converse NH_4NO_3 while with increasing amount of additives this indicator grows monotonous. If the conversion rate of AN constitutes 0.21% when AN:PG = 100 : 0.5, that 100 : 3 will be 1.34%, 100 : 5 – 2.46%, 100 : 10 – 4.95%, and 100 : 20 – 13.19%.

To sum up, that mixing melt of ammonium nitrate with powdered phosphogypsum subsequent prilling of gypsum-nitrate melt in the tower allows obtaining qualitative nitrogen-sulfuric fertilizers with improved physicochemical and low detonating properties.

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