



## STUDYING OF PHYSICAL-CHEMICAL PROPERTIES OF NITROGEN FERTILIZERS

**Umurova Elnora Nozimovna**

Undergraduate.

**Kamalova Matlyuba Bakaevna**

Candidate of technical sciences, associate professor

Bukhara Engineering

Technological Institute

| Article history:  | Abstract:   |
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| <b>Received:</b> 22 <sup>th</sup> April 2021<br><b>Accepted:</b> 11 <sup>th</sup> May 2021<br><b>Published:</b> 8 <sup>th</sup> June 2021 | Inorganic compounds, the main element of which is nitrogen, are called nitrogen fertilizers. Nitrogen enhances the growth processes of plants, but with its excess, the ripening time of the crop may be delayed. Most often, this effect is on fruit crops. Their growing season is delayed and resistance to various diseases and pests decreases. This research is aimed at improving the quality of the product, that is, its physical-chemical properties. |
| <b>Keywords:</b> Fertilizers, Ash, Manure, Soil, Harvest, Culture, Humus, Urea.   |   |

Nitrogen mineral fertilizers increase the crop-yield of agricultural crops. Since ancient times, people have used fertilizers such as manure, silt, ash, green fertilizers, and others to increase fertility. In the 17<sup>th</sup> century, the German chemist Johann Rudolf Glauber hypothesized that saltpeter is the main element in manure that increases soil fertility. At that time it was already received, but for the manufacture of gunpowder. Saltpeter really increased the yield of the soil. However, the explanation for this phenomenon came only 100 years after the discovery of nitrogen. Mineral fertilizers can have different properties and effects on crops. They contain nutrients in the form of various mineral salts. Fertilizers are divided into simple and complex. Simple or one-sided fertilizers include only one nutritional element. Complex or multilateral fertilizers simultaneously contain two or more basic elements. [1].

Mineral fertilizers are effective in their properties, easy to use and do not require large costs for transportation and storage, unlike organic fertilizers. However, many gardeners, trying to get environmentally friendly products, refuse to use mineral fertilizers, preferring only organic substance. What fertilizers to apply to the soil, mineral or organic, each farmer decides for himself. However, it should be careful when using them, because if applying any fertilizers incorrectly, it can harm the soil, crops and crops. The use of mineral fertilizers strictly in recommended doses will not lead to negative consequences. In addition, their combined application with organic fertilizers gives the most effective result. [2]

Non-concentrated nitric acid must comply with the requirements of the regulations, which is higher than the indications of OST 113-03-270-90. (table 1)

Table 1.

### Characteristics of initial raw materials, accessory and minor materials, and manufactured products

| The name of indicators   | Regulatory requirements                                  | Requirements of OST 113 - 03 - 270 - 90 premium grade |
|--|--|---|
| Appearance   | Colorless or yellow liquid without mechanical impurities |   |
| Mass fraction of nitric acid (HNO <sub>3</sub> )   | 58 ÷ 60  | no less than 57.0                                     |
| Mass fraction of nitrogen oxides (in terms of N <sub>2</sub> O <sub>4</sub> ), % no more | 0.05   | 0.07  |
| Mass fraction of the residue after calcination, % no more                                | 0.004  | 0.004   |
| Mass fraction of chlorides in terms of Cl, mg/kg 100% HNO <sub>3</sub> , no more         | 10   | not regulated   |

Non-concentrated nitric acid with a mass fraction of 60% has the following indicators (Table 2).

Table 2.

**Physical indicators of non-concentrated nitric acid with a mass fraction of 60%**

| Temperature, °C | Density kg/m <sup>3</sup> | Partial vapor pressure over aqueous solutions, Pa (mm Hg) | Dynamic viscosity Pa·s·10 <sup>-3</sup> | Specific electrical conductivity, Ohm <sup>-1</sup> ·cm <sup>-1</sup> | Specific heat, kJ/kg·K | Thermal conductivity, W/m·K |
|-----------------|---------------------------|---|---|---|------------------------|-----------------------------|
| 20              | 1366.7                    | 111,97 (0.84)   | 2.024                                   | 33.6  | 2.68                   | 0.421                       |
| 30              | 1353.3                    | 221,30 (1.66)   | 1.63                                    | 35.5  | 2.71                   | 0.424                       |
| 40              | 1339.8                    | 413,20 (3.10)   | 1.34                                    | 40.4  | 2.74                   | 0.428                       |
| 60              | 1312.4                    | 1319.70 (9.90)  | 1.00                                    | -   | 2.81                   | 0.435                       |

Temperature of crystallization – minus 21.5 °C

Boiling point – 120.06 °C at 0.1 MPa (760 mm Hg)

Nitric acid is mixed with water in any ratio with the release of a large amount of heat (493.7 kJ/kg) to obtain an infinitely dilute solution.

Non-concentrated nitric acid is used at the enterprise for the production of mineral fertilizers.

Nitrogen fertilizers are inorganic compounds, the main element of which is nitrogen. Nitrogen enhances the growth processes of plants, but with its excess, the ripening time of the crop may be delayed. Most often, this effect is on fruit crops. Their growing season is delayed and resistance to various diseases and pests decreases. Nitrogen fertilizers are best applied to sod-podsol soils, they contain 3-7% humus. Fertilizers of this type are least able to influence soils rich in organic substance. The most popular nitrogen fertilizers are ammonium nitrate and carbamide (urea). Ammonium nitrate contains 33-35% nitrogen and is easily soluble in water of any temperature. Urea has a nitrogen content of 46%. It is also easily soluble, mainly used as a top dressing. It is the most concentrated nitrogen fertilizer.

Farmers, agronomists and simple gardeners all want rapid seed growth, a strong root system, so that the plants are fully supplied with all the necessary nutrients and remain healthy. In pursuit of a simple and effective tool, they attend various exhibitions, master classes; view hundreds of web pages and videos. Why complicate things so much? It would seem water and take care. However, the fact is that right now, just taking care of the plants and watering them every day, hoping that we will be lucky and a good harvest will happen, is not enough. If in ancient times people were limited to this, now and then dancing with a tambourine in anticipation of rain, today, thanks to science, even an amateur gardener knows what determines the nature of development, the quality and quantity of the crop. Feeding on elements from the soil, the plant, as it grows, depletes and empties it. Obviously, such poor soil is unlikely to provide a plant with adequate nutrition and then it will grow weak and become a tidbit only for pests. To prevent this from happening, you need to feed and fertilize crops. There are many fertilizers on the market, and they have different functions, but many agree that it is nitrogen fertilizers for plants, like ragweed, that are the most versatile and effective. Dense roots, new shoots, leaves and flowers grow rapidly, and fruits develop - this is all the effect of nitrogen fertilizers. Why are nitrogen fertilizers so important for plants? This is because this nitrogen is involved in the synthesis of proteins and is almost a building material with which the plant gains mass. Therefore, for the harmonious and correct development of plants, the soil must contain a sufficient amount of nitrogen. If it is not enough, the leaves will first begin to suffer, then the growth process will slow down, the yield will significantly decrease, and in result, the crops may die. According to the form of nitrogen compounds, nitrogen mineral fertilizers are divided into five categories (table 3).

Table 3

**Classification of nitrogen fertilizers by the form of nitrogen compounds**

| Group            | Fertilizers       |
|------------------|-------------------|
| Nitrate          | Calcium nitrate   |
|                  | Sodium nitrate    |
| Ammonium         | Ammonium chloride |
|                  | Ammonium sulfate  |
| Ammonium nitrate | Ammonium nitrate  |
| Amide            | Urea (carbamide)  |
| Liquid ammonia   | Ammonia water     |
|                  | Anhydrous ammonia |

Nitrogen fertilizers can be liquid and solid. The liquid form is popular among agriculturalists, since its use is significantly cheaper. The most popular are liquid ammonia and aqueous ammonia. Feeding with nitrogen fertilizers in liquid form is also quite common, since the leaves are also able to absorb nutrients. For liquid dressings, urea and ammonium nitrate are used.

Nitrogen fertilizers are not recommended for use in autumn: heavy rainfall will nullify the effect, because nitrogen-based fertilizers have excellent water solubility. Nitrogen fertilization is often advised in early spring or late winter. By the time crops begin to develop, the substance has already had time to dissolve in the soil. However, one should take into account the peculiarities of the climate in the region and other factors.

Nitrogen fertilizers are an obvious solution to most problems with soil fertility and their use has a number of features and rules.

Firstly, for maximum efficiency, nitrogen fertilization must be carried out within the allotted time, in the best possible way.

Secondly, there are certain application rates for all fertilizers, including nitrogen, and they must be adhered to. Even if fertilizers are incredibly effective, this does not mean that the soil can be oversaturated with them, exceeding all permissible norms. The effect of nitrogen fertilizers when the soil is oversaturated with them can be extremely unfavorable. Following the same norms, as well as timely application, will help the soil to maintain its fertility for many, many years to come.

Thirdly, in order to do without unnecessary costs with effective fertilization of crops, it is necessary to increase the digestibility of the applied fertilizers. For these purposes, you can combine their various forms. For example, urea in the fall and ammonium nitrate in the spring. Despite the fact that nitrogen fertilization in autumn is considered irrational, urea can be considered an exception. Due to its amide form, nitrogen does not erode and is not washed out during the winter. Liming is also practiced to improve digestibility: when combined with lime, acidic soils absorb nitrogen much better.

Fourthly, it is not recommended to delay with fertilizing, especially for the soil in Uzbekistan. Nitrogen fertilization is more effective than ever for our dry soil.

Ammonium nitrate is a highly effective macrofertilizer used in the cultivation of most plant crops, since it contains at least 34.4% nitrogen as an active ingredient.

**Table 4**  
**Content of components in ammonium nitrate**

| Indicator name   | Component content in% | Determined by analysis |
|--|-----------------------|------------------------|
| Total mass fraction of nitrate and ammonium nitrogen in terms of $\text{NH}_4\text{NO}_3$ in dry substance, not less - for nitrogen in dry substance | %                     | 34.4                   |
| Mass fraction of water, no more: with the addition of calcium and magnesium nitrate  | %                     | 0,3                    |
| pH of 10% aqueous solution, not less   | %                     | 5                      |
| Granulometric composition: Mass fraction of granules: from 1 to 4 mm in size, not less   | %                     | 50                     |
| Granules ranging in size from 2 to 4 mm, no more   | %                     | 3                      |
| Granules less than 1 mm in size, no more than 6 mm   | %                     | 0                      |
| Statistical strength of granules, (N / granule), not less: with the addition of calcium and magnesium  | N/Granule             | 7                      |
| Looseness, not less  | %                     | 100                    |

Content of components (Table 4) was established by analysis, the total mass fraction of nitrate and ammonium nitrogen in terms of  $\text{NH}_4\text{NO}_3$  in dry substance, not less - for nitrogen in dry substance, 34.4%. Mass fraction of water, not more: with addition of calcium and magnesium nitrate% 0.3 pH 10% aqueous solution, not less than 5%. Granulometric composition: mass fraction of granules: from 1 to 4 mm in size, not less than granules from 2 to 4 mm, no more than granules less than 1 mm in size, no more than 6 mm. Statistical strength of granules, (N / granule), not less: with the addition of calcium and magnesium N / Granule 7. Looseness, not less than 100%. In increasing productivity, nitrogen fertilizers are very popular, and ammonium nitrate is considered universal and one of the most important fertilizers. Ammonium nitrate, the active substance of nitrate, is applied under many crops, while, according to its agrochemical data, it is suitable for all types and compositions of soils. For light soils, it is used before sowing for loosening the earth, for non-acidic soils, nitrogen fertilizer can be used at all stages, and when it comes to fields with high acidity, it is recommended to combine it with calcium carbonate. Ammonium nitrate has a major advantage over other fertilizers: a large percentage of nitrogen in nitrate form, which can be directly absorbed by plants. It is in this form that the substance is maximally absorbed and incorporated into the growth processes in crops, and the effect is quickly noticeable by an increase in leaves, stems and fruits. Mineral fertilizers are widely used not only in agriculture, but also in the chemical, mining and construction industries.

**LIST OF REFERENCES**

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2. Handbook of nitrogen worker, vol. 2. Simulin N.A., Melnikov E.Ya. Moscow: Chemistry, 1969, p. 444.