

# BALANCED NP-FERTILIZERS BASING ON AMMONIZATION OF EVAPORATED PHOSPHORIC ACID WITH UREA ADDITIVE

Turdialieva Sh.I. (Republic of Uzbekistan)

Email: Turdialieva58@scientifictext.ru

*Turdialieva Shahzoda Ismatullayevna – Assistant,  
DEPARTMENT OF CHEMICAL ENGINEERING OF INORGANIC SUBSTANCES,  
TASHKENT CHEMICAL-TECHNOLOGICAL INSTITUTE, TASHKENT, UZBEKISTAN*

**Abstract:** carried out results of studying the process of obtaining balanced NP-fertilizers ( $N:P_2O_5=1:0,5-1$ ) by adding 70% aqueous solution of urea in the pulp of monoammonium phosphate (at  $pH=5,5$ ) and diammonium phosphate (at  $pH=7,0$ ). In order to avoid ammonia loss, NP-pulps were dried at a temperature not higher than  $60^{\circ}C$  (for MAP) and  $90^{\circ}C$  (for DAP). It was shown that, depending on the concentration of evaporated off EPA (35,9-51,1%  $P_2O_5$ ), the obtained NP-fertilizers based on MAP contain from 28 to 35% N and from 17,5 to 28,5%  $P_2O_5$ , and based on DAP from 29 to 36% N and from 18 to 29,5%  $P_2O_5$ . The strength of their granules make up 3,0 MPa and more.

**Keywords:** ammophos, phosphoric acid, monoammonium phosphate, diammonium phosphate, evaporation, concentration, pulp, ammonization.

## УРАВНОВЕШЕННЫЕ NP-УДОБРЕНИЯ НА ОСНОВЕ АММОНИЗАЦИИ УПАРЕННОЙ ФОСФОРНОЙ КИСЛОТЫ С ДОБАВКОЙ КАРБАМИДА

Турдалиева Ш.И. (Республика Узбекистан)

*Турдалиева Шахзода Исматуллаевна - ассистент,  
кафедра химической технологии неорганических веществ,  
Ташкентский химико-технологический институт, г. Ташкент, Республика Узбекистан*

**Аннотация:** приведены результаты изучения процесса получения уравновешенных NP-удобрений ( $N:P_2O_5=1:0,5-1$ ) путем добавления 70%-го раствора карбамида в пульпу моноаммонийфосфата (при  $pH=5,5$ ) и диаммонийфосфата (при  $pH=7,0$ ). Во избежание потери аммиака сушку NP-пульп производили при температуре не выше  $60^{\circ}C$  (для МАФ) и  $90^{\circ}C$  (для ДАФ). Показано, что в зависимости от концентрации упаренной ЭФК (35,9-51,1%  $P_2O_5$ ) полученные NP-удобрения на основе МАФ содержат от 28 до 35% N и от 17,5 до 28,5%  $P_2O_5$ , а на основе ДАФ от 29 до 36% N и от 18 до 29,5%  $P_2O_5$ . Прочность их гранул составляет 3,0 и более МПа.

**Ключевые слова:** аммофос, фосфорная кислота, моноаммонийфосфат, диаммонийфосфат, упарка, концентрация, пульпа, аммонизация.

According to [1] from 2012 to 2018 Phosphate fertilizer production increased from 42,7 to 46,6 million tons in terms of 100%  $P_2O_5$ . Ammophos is a 100% water-soluble, highly concentrated fertilizer necessary for growing plants with a short vegetative season and on poor soils with low sorption capacity, as well as for sale abroad. However, this product is characterized by an unfavorable ratio of nutritional components ( $N:P_2O_5 = 1:4$ ). But the addition of nitrogenous fertilizers — ammonium nitrate or carbamide to ammonium phosphates — allows fertilizers with a given ratio of nitrogen and phosphorus to be obtained, and the use of high-concentration phosphoric acid reduces the energy costs of processing the neutralized mass into solid granular products. So, when combining ammonium phosphate with ammonium nitrate products are called nitroammophos, with carbamide - carbammophos. In carbammophos the content of N-26%,  $P_2O_5$  assim 26% (including  $P_2O_5$  water not less than-25%). In the latter, the nitrogen is in both the ammonia and amide forms, and a biuret may be presented as an impurity.

It should be noted that not all phosphoric acids are suitable for obtaining high quality MAP and DAP, this depends on the composition of the starting phosphate raw material. To obtain high-quality ammonium phosphates from extraction phosphoric acid (EPA), it is necessary to carry out the process of its purification from impurities: heavy metals, arsenic, calcium, magnesium and fluorine. The main methods of purification of phosphate solutions: the method of evaporation, precipitation, purification with organic solvents, ion exchange, recrystallization.

For this production EPA composition (wt.%): 18,14  $P_2O_5$ ; 0,20 CaO; 0,28 MgO; 1,27  $SO_3$  total subjected to evaporation. Evaporation of production EPA to a given concentration of  $P_2O_5$  was carried out in a tubular quartz reactor equipped with a paddle stirrer at atmospheric pressure. The reactor was in an oil thermostat. EPA was evaporated to concentrations of 34,96; 40,18; 45,65 and 50,12%  $P_2O_5$ . Samples of EPA were kept for 24 hours to precipitate insoluble compounds. After that, the clarified part of the evaporated EPA was separated from the

precipitate by decantation. The concentration of the clarified part of EPA increased to 35,92; 40,85; 46,41 and 51,07% P<sub>2</sub>O<sub>5</sub>, respectively.

This report presents the results of a study to obtain NP-fertilizers based on ammonization of evaporated EPA with the addition of urea. To obtain samples of balanced NP-fertilizers, we clarified part of EPA ammoniated with gaseous ammonia to pH=5,5 (in the case of MAP), and in the case of obtaining DAP - to pH = 7,0. Next, a 70% solution of urea was added to the pulps at mass ratios N: P<sub>2</sub>O<sub>5</sub> = 1:(0,5-1). Such ratios are most in demand in agriculture. The temperature was maintained at 70-80°C. The time of mixing the components was 30 minutes. After the completion of the experiments, the contents of the reactor were transferred to the cups and dried. NP-pulps based on MAP were dried at 90°C, and NP-pulps based on DAP at 50°C. Granulation was carried out in the process of drying by the method of intensive stirring and pelleting. The granules were cooled and scattered. Granules with a size of 2-3mm were measured for strength. Then the products were ground and analyzed for nitrogen and phosphorus. Chemical analysis of the products was carried out according to the methods of [2]. The results are shown in tables 1 and 2.

The results show that in the resulting NP-fertilizer on the basis MAP at mass ratios N:P<sub>2</sub>O<sub>5</sub> - 1:(0,5-1) the nitrogen content changes from 34,65 to 27,72% (based on EPA with a concentration of 35,92% P<sub>2</sub>O<sub>5</sub>) and from 35,09 to 28,27% (based on EPA with a concentration of 51,07% P<sub>2</sub>O<sub>5</sub>), and the content of P<sub>2</sub>O<sub>5</sub> from 17,31 to 27,72% and from 17,55 to 28,36%, while strength is 3,21-3,48 and 3,07-3,15 MPa, respectively.

Table 1. The composition and strength of granule NP-fertilizer, obtained on the basis of evaporated and ammoniated EPA (at pH=5,5) and urea

Correlation of components N: P <sub>2</sub> O <sub>5</sub>	Contents of products, %					Strength of granules (diameter of granules 2mm)		
	N	P <sub>2</sub> O <sub>5com.</sub>	$\frac{P_2O_{5lim}}{P_2O_{5com}}$	$\frac{P_2O_{5tr B}}{P_2O_{5com}}$	$\frac{P_2O_{5wat}}{P_2O_{5com}}$	kg/granules	kg·s/sm <sup>2</sup>	MPa
Based on EPA with concentration 35,92% P <sub>2</sub> O <sub>5</sub>								
1 : 0,5	34,65	17,31	95,96	93,99	90,53	1,63	32,74	3,21
1 : 0,7	31,11	22,05	96,01	94,24	90,74	1,67	33,55	3,29
1 : 1	27,72	27,73	96,21	94,33	90,77	1,77	35,49	3,48
Based on EPA with concentration 40,85% P <sub>2</sub> O <sub>5</sub>								
1 : 0,5	34,89	17,42	96,04	94,02	90,87	1,71	34,37	3,37
1 : 0,7	31,76	22,21	96,13	94,68	90,95	1,73	34,68	3,40
1 : 1	28,01	28,02	96,57	94,72	91,43	1,79	35,80	3,51
Based on EPA with concentration 46,41% P <sub>2</sub> O <sub>5</sub>								
1 : 0,5	34,93	17,46	96,68	94,96	93,07	1,60	32,02	3,14
1 : 0,7	31,86	22,27	97,12	95,19	93,13	1,62	32,23	3,16
1 : 1	28,09	28,08	97,25	95,23	93,23	1,67	33,35	3,27
Based on EPA with concentration 51,07% P <sub>2</sub> O <sub>5</sub>								
1 : 0,5	35,09	17,55	97,15	95,21	93,11	1,56	31,31	3,07
1 : 0,7	32,04	22,42	97,32	95,27	93,22	1,59	31,82	3,12
1 : 1	28,27	28,36	97,32	95,70	93,51	1,61	32,13	3,15

Table 2. The composition and strength of granule NP-fertilizer, obtained on the basis of one stripped off and ammoniated EPA (at pH = 7,0) and urea

Correlation of components N: P <sub>2</sub> O <sub>5</sub>	Contents of products, %					Strength of granules (diameter of granules 2mm)		
	N	P <sub>2</sub> O <sub>5com.</sub>	$\frac{P_2O_{5lim}}{P_2O_{5com}}$	$\frac{P_2O_{5tr B}}{P_2O_{5com}}$	$\frac{P_2O_{5wat}}{P_2O_{5com}}$	kg/granule	kg·s/sm <sup>2</sup>	MPa
Based on EPA with concentration 35,92% P <sub>2</sub> O <sub>5</sub>								
1 : 0,5	35,75	17,89	96,42	94,13	92,57	1,58	31,72	3,11
1 : 0,7	32,85	22,09	96,46	94,48	94,07	1,60	31,92	3,13
1 : 1	29,21	29,23	96,51	94,53	94,12	1,72	34,47	3,38
Based on EPA with concentration 40,85% P <sub>2</sub> O <sub>5</sub>								
1 : 0,5	35,81	17,90	96,54	94,19	92,91	1,66	33,15	3,25
1 : 0,7	32,88	23,05	96,57	94,75	94,19	1,68	33,66	3,30
1 : 1	29,25	29,26	96,62	94,77	94,22	1,74	34,88	3,42

Basedon EPA with concentration 46,41% P <sub>2</sub> O <sub>5</sub>								
1 : 0,5	35,98	17,98	97,11	95,16	93,16	1,61	32,23	3,16
1 : 0,7	32,97	23,14	97,19	95,25	94,25	1,62	32,33	3,17
1 : 1	29,51	29,50	97,28	95,29	94,31	1,64	32,84	3,22
Basedon EPA with concentration 51,07% P <sub>2</sub> O <sub>5</sub>								
1 : 0,5	35,99	18,00	97,28	96,00	93,89	1,44	28,96	2,84
1 : 0,7	33,01	23,15	97,36	96,19	95,08	1,37	27,38	2,86
1 : 1	29,53	29,52	97,36	96,21	95,12	1,50	29,98	2,94

A similar picture is observed in DAP-based NP-fertilizers, where the nitrogen content varies between 35,75-29,21% and 35,99-29,53%; P<sub>2</sub>O<sub>5</sub> 17,89-29,23% and 18,00-29,52%, and the strength of the granules is 3,11-3,38 and 2,84-2,94 MPa, respectively, for EPA with concentrations of 35,92 and 51,07 % P<sub>2</sub>O<sub>5</sub>. According to their physico-chemical characteristics, granulated products meet the requirements of GOST on carboammophos. All this suggests that it is possible to obtain high-nutrient carbammophos on the basis of local source raw materials.

#### *References / Список литературы*

1. Fertilizer Statistics 2013-2014. The Fertilizer Association of India, New Delhi, 2014. III-14 and III-15.
2. Methods of analysis of phosphate raw materials, phosphoric and complex fertilizers, fodder phosphates / M.M. Vinnik, L.N. Erbanova, P.M. Zaitsev, etc. M.: Chemistry, 1975. 218 p.