WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 6, June, 2022

OBTAINING HIGH CONCENTRATIONS OF PHOSPHATE FERTILIZERS

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Annotation
The relevance of this article is about Phosphate fertilizers which speaks about Finding the best P source, how commercial phosphate fertilizer is manufactured, Method for obtaining nitrogen-phosphorus fertilizer. Especially about the invention relates to the production of nitrogen-phosphorus mineral fertilizers.

Keywords: Phosphorus fertilizers, Process, Common fertilizer sources, Method for obtaining nitrogen-phosphorus fertilizer.

Introduction

Phosphorus fertilizers -are Phosphate fertilizers are obtained by extraction from phosphate rock, which contains two principal phosphorus-containing minerals, fluorapatite $Ca_5(PO_4)_3F$ (CFA) and hydroxyapatite $Ca_5(PO_4)_3OH$. These minerals are converted into water-soluble phosphate salts by treatment with sulfuric (H_2SO_4) or phosphoric acids (H_3PO_4). The large production of sulfuric acid is primarily motivated by this application. In the nitro phosphate process or Odda process (invented in 1927), phosphate rock with up to a 20% phosphorus (P) content is dissolved with nitric acid (HNO_3) to produce a mixture of phosphoric acid (H_3PO_4) and calcium nitrate ($Ca(NO_3)_2$). This mixture can be combined with a potassium fertilizer to produce a compound fertilizer with the three macronutrients N, P and K in easily dissolved form.
When producers pay special attention to managing phosphorus (P), it can lead to profitable crop production. The best way to use fertilizers to meet P requirements changes with crop, soil properties and environmental conditions.

Finding the best P source

Inorganic commercial P fertilizers have evolved over the last several decades into a refined, predictable product. Plus, there are the organic P sources closely associated with livestock operations or with proximity to major metropolitan areas.
There should be no difference in P fertilizer sources, as long as nutrient analysis differences are taken into account. While there are certain situations where one

product performs better, phosphorus fertilizer recommendations are the same regardless of the phosphate fertilizer source.

How commercial phosphate fertilizer is manufactured

Materials

Rock phosphate is the raw material used to manufacture most commercial phosphate fertilizers on the market.

In the past, ground rock phosphate itself has been used as a source of P for acid soils. However, very little rock phosphate is currently used in agriculture due to low availability of P in this native material, high transportation costs and small crop responses.

Process

Most commercial phosphate fertilizer manufacturing begins by producing phosphoric acid.

The generalized diagram in Figure 1 shows the steps taken to manufacture various phosphate fertilizers. Phosphoric acid is produced by either a dry or wet process.

Dry vs. wet process

In the dry process, an electric furnace treats rock phosphate. This treatment produces a very pure and more expensive phosphoric acid – frequently called white or furnace acid – primarily used in the food and chemical industry.

Fertilizers that use white phosphoric acid as the P source are generally more expensive because of the costly treatment process.

The wet process involves treating the rock phosphate with acid-producing phosphoric acid – also called green or black acid – and gypsum, which is removed as a by-product. The impurities that give the acid its color haven't been a problem in the production of dry fertilizers.

Orthophosphoric acid

Both the wet and dry treatment processes produce orthophosphoric acid, the phosphate form that's taken up by plants.

The phosphoric acid produced by either the wet or dry process is frequently heated, driving off water and producing a superphosphoric acid. The phosphate concentration in superphosphoric acid usually varies from 72 to 76 percent.

The P in this acid is present as both orthophosphate and polyphosphate. Polyphosphates consist of a series of orthophosphates that have been chemically joined together. Upon contact with soils, polyphosphates revert back to orthophosphates.

Adding ammonia

Ammonia can be added to the superphosphoric acid to create liquid or dry materials containing both nitrogen (N) and P. The liquid, 10-34-0, is the most common product.

The 10-34-0 can be mixed with finely ground potash (0-0-62), water and urea-ammonium nitrate solution (28-0-0) to form 7-21-7 and related grades. The P in these products is present in both the orthophosphate and polyphosphate form.

When ammonia is added to phosphoric acid that hasn't been heated, it produces monoammonium phosphate (11-52-0) or diammonium phosphate (18-46-0), depending on the ratio of the mixture. The P present in these two fertilizers is in the orthophosphate form.

Cost and outcome

The cost of converting rock phosphate to the individual phosphate fertilizers varies with the process. More importantly, the processes have no effect on the availability of P to plants.

Comparison chart: Common fertilizer sources

Percentages of water-soluble and available phosphate in several common fertilizer source

P_2O_5 source	**N**	**Total**	**Available P_2O_5**	**Water soluble P_2O_5**
Superphosphate (OSP)	0%	21%	20%	85%
Concentrated Superphosphate (CSP)	0%	45%	45%	85%
Monoammonium Phosphate (MAP)	11%	49%	48%	82%
Diammonium Phosphate (DAP)	18%	47%	46%	90%
Ammonium Polyphosphate (APP)	10%	34%	34%	100%
Rock Phosphate	0%	34%	38%	0%

Method for obtaining nitrogen-phosphorus fertilizer

The invention relates to the production of nitrogen-phosphorus mineral fertilizers. The essence of the invention lies in the fact that extractive phosphoric acid is ammoniated with a concentration of 52÷57 wt.% in terms of phosphorus pentoxide and with a content of magnesium phosphates in the amount of 0.6÷1.9 wt.% in terms of MgO to obtain a solution of diammonium phosphate with pH 6.6÷8.0, which is then clarified by settling to a mass fraction of magnesium phosphates of 0.06÷0.4 wt.% in terms of MgO, the clarified solution is neutralized with nitric acid to pH 3.8÷4.6, obtained at In this case, a solution of monoammonium phosphate and ammonium nitrate is mixed with a melt of ammonium nitrate, the resulting nitrate-phosphate solution is evaporated,

neutralized with ammonia, granulated by prilling and treated with an anti-caking agent. The technical result is to increase productivity and reduce the loss of ammonium nitrogen.

A known method for producing complex granular nitrogen-phosphorus fertilizers, which consists in the fact that the extraction phosphoric acid is ammoniated, the melt of ammonium nitrate is mixed with a solution of monoammonium phosphate, it is neutralized, the nitrate-phosphate solution is evaporated and the product is granulated. When a melt of monoammonium phosphate is mixed with a melt of ammonium nitrate, rapidly precipitated precipitates are formed in it, the composition of which depends on the extractive phosphoric acid (hereinafter EPA) used for the synthesis of monoammonium phosphate. Precipitation complicates the process of further processing of the nitrate-phosphate solution, causes clogging of pipelines, control devices and equipment for granulation, which reduces the reliability and limits the productivity of the process of obtaining fertilizer by prilling.

A known method for producing a complex nitrogen-phosphorus mineral fertilizer, including ammonization of EPA, obtaining and evaporating a solution containing ammonium nitrate and phosphate, neutralizing it with ammonia and granulating the product by prilling. In a known method, EPA is used, obtained by sulfuric acid opening of apatite concentrate. In the case of using an apatite concentrate with a high content of magnesium as a raw material, the latter is stored in EPA in a large amount in the form of soluble orthophosphates, and also forms insoluble precipitates, for example, in the form of gels when interacting with silica. Since the known method involves the supply of EPA to the reactor-neutralizer above the mixing point of ammonia with nitric acid, the precipitates formed after ammoniation and evaporation lead to frequent clogging of pipelines, instrumentation and granulation equipment, which reduces the reliability of the process equipment, leads to the need for frequent stoppages of the technological process, and this limits the productivity of obtaining fertilizer by the prilling method.

There is a known method for producing complex nitrogen-phosphorus fertilizers, which consists in mixing an ammonium nitrate solution with a solution of ammonium phosphates, neutralizing and evaporating the nitrate-phosphate solution, granulating the product, followed by treating the granules with an anti-caking agent. In a known method as a solution of ammonium phosphates use 20÷30 percent by weight (hereinafter - wt.%) solution of ammophos. The diammonium phosphate contained in ammophos decomposes when mixed with a solution of ammonium nitrate and

evaporated, which leads to loss of ammonia nitrogen. Impurities contained in ammophos, the composition of which depends on the brand of fertilizer and feedstock, form precipitation and solid deposits in pipelines, equipment elements, clog the holes of spray and filter devices during prilling granulation, which reduces the reliability of the method. At the same time, frequent stops of the equipment lead to a decrease in the performance of the known method.

A known method for producing complex nitrogen-phosphorus fertilizers, which consists in the fact that extractive phosphoric acid is ammoniated with a concentration of 52÷54 wt.% in terms of phosphorus pentoxide, the resulting phosphorus-containing solution is mixed with an ammonium nitrate solution in two stages, the resulting nitrate-phosphate solution is neutralized, evaporate, granulate, treat the granules with an anti-caking agent. In the known method (1st variant), EPA is ammonized to monoammonium phosphate, due to which the impurities contained in EPA form precipitates, leading to clogging of holes in spraying equipment, melt filters during prilling granulation, and also create deposits in equipment elements and in pipelines, which limits the performance of the known method and reduces the reliability of the equipment.

Closest to the claimed method of obtaining complex nitrogen-phosphorus fertilizers, which consists in ammonizing extraction phosphoric acid, obtaining a solution of monoammonium phosphate and ammonium nitrate, mixing it with ammonium nitrate to obtain a nitrate-phosphate solution, evaporating it, neutralizing it, granulating it and treating it with an anti-caking agent. reagent. In the known method, EPA is ammonized to monoammonium phosphate, due to which the impurities contained in it pass into a solution of monoammonium phosphate and form rapid precipitates in it and in the nitrate-phosphate solution. When using EPA with a high magnesium content, the amount of precipitation and deposits on the elements of the equipment increases, which causes frequent clogging of the equipment for granulation and pipelines when using the prilling method for granulation, and this reduces the reliability of the equipment, limits the productivity of the known method due to downtime. Diammonium phosphate impurities contained in the monoammonium phosphate solution obtained by ammoniation decompose at elevated temperatures, causing loss of ammonium nitrogen.

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