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Short Communication

New, Concentrated, Unwashable, Long lasting, Ecological Nitrogen Fertilizer

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INTRODUCTION

Polycyanamide (PCA), most concentrated, long lasting, ecological nitrogen fertilizer, contains CA. 66% of nitrogen and is unsoluble in water and organic solvents. In soil properties, PCA hydrolyze slowly to ammonia salts and is washed out about 30% yearly. PCA can be used even in big enhance, in few years intervals, without overdosing and pollution of environment. PCA can be obtained from ammonia and CO_2 by dehydration of urea [1].

Nitrogen fertilizers presently in use, such as ammonia, ammonium salts, nitrates and urea, are water soluble and despite their fast action they can be easily washed out of soil, even to 50%. They may content up to maximum 46% nitrogen (urea). Washed nitrogen compounds diminish fertilized soil, polluting water and make toxical blossoming of lakes and sees. Enhancing amount of soluble fertilizers can be also poisonous to the some plants [2]. Slower acting calcium cyanamide and urea derivatives as polymethelenureas or isobubutylidenediurea are, in fact, hard soluble and decompose in a few months but some of their components (cyanamide, formaldehyde) influence to a certain extent toxically on plants and flora in soil and are even recommended sometimes as soil sterilizers. A few years long is the action of manure, additionally improving the soil structure. The purpose of our work was obtaining the insoluble, long lasting nitrogen fertilizer with possibly big percentage of nitrogen. We have found that these concentrated, slow acting of multi-years lasting nitrogen fertilizer is Polycyanamide (PCA). PCA was obtained through dehydrating the urea. According to, the product has the structure of polyguanidinhydroxynitrile, of molecular mass to 4×10^4. PCA can be obtained also from amonium chloride and sodium carbamate with the yield reaching to 87%. PCA can be obtained from urea in conditions of obtaining of melamine but at the temperature exceeding the temperature of triazine and cyanuric ring decomposition (370°C-500°C). The product is soluble only in concentrated acids, for example in sulfuric acid and is fairly stable thermally, at the temperature of 375°C remains out 75% of it and at 750°C there is still 50% [3]. The compound contains 66.7% of nitrogen, which means the largest contents of nitrogen of all existing nitrogen fertilizers. It does not contain chemically bonded formaldehyde, so it should not exert a harmful effect on plastics and flora, after hydrolyzation. It was necessary to prove the rate of its decomposition at soil conditions.

DESCRIPTION

Polycyanamide (PCA) was obtained while heating urea with $ZnCl_2$ (under molar ratio 1:1) for 4 hours in the autoclave, at the temperature of 360°C under the pressure of 8-10 atm. The product obtained in this way was rinsed with water. The precipitate was washed out with ammonia water until zinc compounds were removed and filtered out. The product was dried up at 393 K until constant weight. The efficiency of clean, dry product was 44%. Thermal characteristics of the product through the method of differential thermal analysis. It results from the diagram that the exothermal decomposition of the PCA occurs at the temperature of 387°C-462°C, while maximum loss of PCA mass at 750°C did not exceed 60% of the weight [4]. The samples heated up to 900°C did not change their appearance. It was assumed to take the solubility in citric acid as the criterion of usability of PCA. An assembly was prepared of tared glass filter with porous G3 of 4 cm diameter fixed on a vacuum flask of 250 ml capacity, the side tube of which was connected with a glass pipe shaped as a smoking pipe, so that the upper edge of the filter would be placed at a slightly lower level than the upper end of the glass pipe. This unit was filled with a water solution of citric acid to maintain the level of the solution in the filter over the fixed ceramic plate was. The glass filter was weighed. A weighed portion of 1,2393 g PCA was introduced and kept in the 2% citric acid solution at temperature of 20°C during 478 days with the sun light [5]. After this time the glass filter was detached from unit and the remaining polycyanamide residue in filter was washed several times with distilled water until the acidity disappeared. Until drying it up to constant weight at the temperature 110°C, 0.7856 g of the compound remained on the filter, which is 36.6% of weight *i.e.,* about 30% loss yearly. Polycyanamide hydrolyses to ammonium salt carbonate and citrate. The calculation shows that after 5 years, 16% of the used PCA would remain. Therefore, it can be accepted as it is a fertilizer of long duration.

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Owing to the slow decomposition and unsolubility, the PCA is a fertilizer practically unwashed from soil, preserving the ground for a long time (of multiyears duration), securing economically, a 100% utilization contents of nitrogen in opposition of relatively rare of fertilization by fertilize of high nitrogen contents (nitrogen contents 3-fold higher than in calcium cyanamide, 2-fold than in ammonium nitrate and 1, 5 more than in urea) will diminish necessary labour from 5 to 10 times in comparison with classic fertilizers. Slow, uniform decomposition of PCA in soil will provide a constant and uniform delivery of soluble nitrogen compounds for plants, particularly in warmer vegetation period. A considerable velocity of hydrolysis of abstracted monomolecular compounds from PCA for eg. cyanamide (about 1 month) much higher than the rate of PCA decomposition, will practically ensure immediate hydrolysis of the compounds into ammonium salts [6]. It seems that receiving PCA through dehydration of urea would not necessarily require the use of zinc chloride and could be done through similarly to conventional synthesis of melamine from urea but at temperature higher than thermal stability of melamine (633 K) and lower than temperature stability of PCA (about over 427°C.

CONCLUSION

Polycyanamide, obtained from urea could serve as a concentrated, long lasting, unwashable nitrogen fertilizer which could be introduced to soil even in large quantities, in few years intervals, without the over dosage and pollution of environment. It seems that the use of PCA could bring considerable and multilateral advantages for the national economy.

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