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PATENT SPECIFICATION

NO DRAWINGS

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COMPLETE SPECIFICATION

Improvements in and relating to Fertilizers

We, IMPERIAL CHEMICAL INDUSTRIES LIMITED, a British company, of Imperial Chemical House, Millbank, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

THIS INVENTION relates to mixed fertilizers and to processes for their manufacture.

According to the present invention there are provided granular mixed fertilizers comprising ammonium nitrate and finely divided rock phosphate, preferably Christmas Island rock phosphate, in which the N:P₂O₅ ratio by weight lies within the range of from 90:29 to 1:2, preferably 1.6:1 to 0.6:1, for example fertilizers having the approximate composition N . . . 12% to 27% by weight, preferably 14% to 22% by weight and P₂O₅ . . . 8.7% to 24%, preferably 14% to 22% by weight of the finished fertilizer composition, and in which the total number of these plant food units per 100 parts of fertilizer by weight is at least 20, but excluding the granular mixed fertilizers claimed in Patent 902363.

Hereinafter Christmas Island rock phosphate is designated "C.I. rock phosphate".

Provided the analysis is within the range given above, other ingredients may be present if desired.

In mixed fertilizers nitrogen is usually expressed as such, phosphorus as P₂O₅ and potassium as K₂O. When the proportions of these constituents are expressed as percentages, then their sum in a given fertilizer is the number of plant food units therein.

The fertilizers according to the present invention are adapted for use in Malayan soils, or for tropical or sub-tropical situations.

One preferred form of fertilizer has the

following approximate plant food content by weight:—

N	-	-	-	-	21%	45
P ₂ O ₅	-	-	-	-	14.6%	

and is suitable for use on mature rubber in certain circumstances, for example with older mature rubber plantations where potash and magnesium are not required or there ceases to be an economic return from their use. These circumstances will occur where the plantations of high yielding rubber clones, which have been treated with a complete N:P₂O₅:K₂O:MgO fertilizer, get older and thus normally the nutrients will be decreased as the rubber yields begin to fall. If such plantations have been previously treated with a complete fertilizer for many years, the need for K₂O and MgO will diminish.

The second preferred form of fertilizer has the following approximate plant food content by weight:—

N	-	-	-	-	14.5%	65
P ₂ O ₅	-	-	-	-	21.5%	

and is suitable for use on mature rubber in certain circumstances, such as for example where phosphate is a major requirement and the availability of potash in the soil is adequate. Thus, it is suitable for use on mature young rubber clones susceptible to windbreak because with these it is advisable to decrease the ratio of nitrogen to phosphate. This is because the use of heavy applications of nitrogen seems to increase the tendency for the trunks of clones susceptible to wind-break to snap. It is to be remembered that the incidence of wind-break is the characteristic of some clones only in early maturity.

Advantages of the compositions are that the availability of their P₂O₅ content especially when finely divided C.I. rock phosphate is used is relatively high, while the cost is low

[Price 4s. 6d.]

and this availability is adequate for the Malayan terrain.

It is desirable that the ingredients be relatively fine in order to obtain granules of substantially uniform composition. Commercially available sacks designated as fine are usually satisfactory e.g. ammonium nitrate grading between B.S.S. 16 to B.S.S. 100 or less. Preferably the bulk of the material, e.g. at least 90%, should pass B.S.S. 18 and more preferably should pass B.S.S. 52.

According to a further feature of the invention the granular nitrogen/phosphorus fertilizers described above are produced by introducing ammonium nitrate and finely ground phosphate rock, preferably C.I. rock phosphate, and recycled undersize product if desired, to a cylindrical rotary drum, or a mixer which has a rotating mixing member or members, together with a small proportion of water, for example up to 6%, desirably 1 to 6%, mixing for a sufficient time in the mixer to produce granules, drying the granules e.g. by passage through a rotary drier, grading the granules between e.g. 1 and 4 mms., for example by means of sieves, and recycling undersize product if desired to the mixer, the granules being rapidly cooled subsequently to drying. Preferably the granules are coated with, for example, 0.2% to 0.4% by weight of oil, e.g. a petroleum oil, and thereafter with about 2% to 4% of a finely divided solid material which is relatively inert under storage conditions, for example C.I. rock phosphate, china clay, kieselguhr, ground anhydrite. A suitable grading of C.I. rock phosphate for this purpose is 90% passing B.S.S. 52, or finer.

In another form of the invention the granules may have a water resistant coating e.g. of paraffin wax to prevent moisture pick up and to delay release in the soil of plant nutrients, especially ammonium nitrate.

The ammonium nitrate may be introduced in particulate form: it may also be introduced as a concentrated solution containing e.g. 0.5% to 15% of water, which is preferably hot, e.g. 80° C. to 160° C. or more. Higher temperature are used with the more concentrated solutions, e.g. 130° to 140° C with 95% to 98% solutions aforesaid. Part or all of the water needed for granulation may be introduced as ammonium nitrate solution. The amount of water required in the mixer will depend on a number of factors, among which the amount of recycled undersize material is important. A typical amount is, for example, up to about 5% of water by weight of the total mixture, although at higher temperatures it is often possible to use less, e.g. down to 1%.

The mixing of the ingredients may if desired be conducted outside the granulating mixer. But, especially where ammonium nitrate

is used in solution, mixing may be done in the granulating mixer.

Suitable mixers for granulating comprise, for example, paddle mixers, stirred pan mixers such as that sold under the Registered Trade Mark "EIRICH", pan granulators, drum mixers and blungers.

A blunger is preferred because of its greater simplicity and flexibility of operation. A blunger comprises a trough-shaped vessel in which rotate two axial shafts provided with a number of blades arranged so that the blades on one shaft are staggered longitudinally relative to those on the other for effective mixing or "blunging".

A blunger is capable of dealing with all the mixtures mentioned above and yields clean granules of good hardness.

The product from the mixer is fed to the drier, preferably a rotating cylindrical drier, which may be fed with hot air flowing co- or counter-currently to the granules. Relatively short residence times in the drier are sufficient.

The product from the drier is sieved on screens of appropriate mesh to yield, e.g. 1.5 to 3.5 mms. granules.

Where sufficient ammonium nitrate is used in the mixture and the water content is low enough, the heat of crystallisation may be used for drying the granules.

When manufacture is conducted in warm humid climates it is often beneficial to use cold air for rapidly cooling the product prior to coating and thus preventing caking when it is in storage. This has particular advantage when the heat of crystallisation of ammonium nitrate is used to dry the product.

EXAMPLE 1

This relates to the 21:14.6:0 fertilizer referred to above and has the approximate finished composition by weight:—

Ammonium nitrate - - - -	60%	
C.I. rock phosphate (of which		
3% is in the coating) - - -	39.5%	
Oil*—approximately - - -	0.3%	110
Free moisture - - - -	0.2%	
*Petroleum lubricating oil of medium viscosity.		

The fertilizer is coated with about 3% of C.I. rock phosphate, or other relatively inert material.

The substantially dry ingredients comprising finely granulated ammonium nitrate and C.I. rock phosphate (90% passing B.S.S. 52) are mixed and fed to a blunger to which is also fed recycled undersize product amounting to about 75% of the throughput, and water amounting to 2% to 3% at a granulation temperature of 70° C. to 80° C. Higher temperatures can also be used. The product from the blunger is fed to a rotary cylindrical

co-current drier furnished with inlet air at 120° C. to 130° C. or even higher, in which the average residence time may be for example about 15 minutes, or more. Suitable solids and air temperatures at the exit of the drier are 96° C. and 100° C. respectively.

Instead of the solid ammonium nitrate, concentrated solutions of ammonium nitrate could be used and the heat of crystallisation of the ammonium nitrate used for drying.

EXAMPLE 2

This relates to the 14.5:21.5:0 fertilizer already referred to has the approximate finished composition by weight:—

15	Ammonium nitrate - - -	41.5%
	C.I. rock phosphate (of which 3% is in the coating) - -	58.0%
	Oil*—approximately - - -	0.3%
	Free moisture - - -	0.2%
20	*Petroleum lubricating oil of medium viscosity.	

The fertilizer is coated with about 3% of C.I. rock phosphate or other relatively inert material.

25 The ammonium nitrate is employed as an 85% solution and is introduced to the blunger at a temperature of about 90° C. To the last mentioned are also introduced ground C.I. rock phosphate (90% passing B.S.S. 52) and recycled undersize product amounting to about 75% of the throughput. The proportion of water in the mixer in the blunger is 2% to 3%, and the granulating temperature 70° C. to 80° C. The product from the blunger is fed to a rotary cylindrical co-current drier furnished with inlet air at 120° C. to 130° C. or even higher.

In both of the Examples, the ammonium nitrate may be introduced as a 95% to 98% solution at a temperature of about 140° C. and the temperature in the blunger may be 90° C. to 100° C. Operation in this way results in decreased drying costs because less water is to be evaporated. Thus water quantities in the range of 2% to 3% and even down to 1% may be used if the temperature is high enough.

A suitable form of phosphate to use in the practice of the invention is C.I. rock phosphate of which a typical sample has a P₂O₅ content of 37% by weight and a size grading as follows:—

	B.S. Sieve	% by weight passing
	5	100
55	10	99.8
	18	98.7
	36	85.2
	72	70.0
	120	54.2
60	170	40.0

Patent 902363 claims granulated mixed fertilizers comprising ammonium nitrate; finely divided rock phosphate, preferably Christmas Island rock phosphate; a potassium salt, preferably the chloride; and desirably a magnesium compound preferably present in an amount corresponding to at least 2% by weight of magnesia, but such fertilizers are excluded from the Claims of the present specification.

Subject to the foregoing disclaimer what we claim is:—

1. Granular mixed fertilizers comprising ammonium nitrate and finely divided rock phosphate, preferably Christmas Island rock phosphate, in which the N:P₂O₅ ratio lies within the range of from 90:29 to 1:2 by weight and the total number of these plant food units per 100 parts of fertilizer by weight is at least 20, but excluding the granular mixed fertilizers claimed in Patent 902363.

2. Granular mixed fertilizers as claimed in Claim 1 in which the said ratio lies in the range 1.6:1 to 0.6:1.

3. Granular fertilizers as claimed in Claim 1 containing 12% to 27% by weight of nitrogen and 8.7 to 24% by weight of P₂O₅.

4. Granular fertilizers as claimed in Claim 2 containing 14% to 22% by weight of nitrogen and 14% to 22% by weight of P₂O₅.

5. Granular fertilizers as claimed in Claim 4 specially suited for mature rubber containing about 21% by weight of nitrogen and about 14.6% by weight of P₂O₅.

6. Granular fertilizers as claimed in Claim 4 specially suited for mature rubber containing about 14.5% by weight of nitrogen and about 21.5% of P₂O₅.

7. Granular fertilizers as claimed in any of Claims 1 to 6 in which the granules are within the range of from 1.0 to 4 mms.

8. Granular fertilizers as claimed in any of Claims 1 to 7 coated with oil and with a finely divided solid material.

9. Granular fertilizers as claimed in Claim 8 in which the proportion of oil is from 0.2% to 0.4%, and of finely divided material is from 2% to 4%, by weight of the finished fertilizer.

10. Fertilizer claimed in Claim 8 or 9 in which the said finely divided coating material is rock phosphate and this is included in the P₂O₅ content of the finished fertilizer as expressed in any of the preceding claims.

11. Process for producing the granular nitrogen/phosphorus fertilizers claimed in any of Claims 1 to 10 which comprises introducing ammonium nitrate and finely ground phosphate rock, preferably Christmas Island rock phosphate, and recycled undersize product if desired, to a cylindrical rotary drum or a mixer which has a rotating mixing member or members, together with a small proportion of water, mixing for a sufficient time to pro-

co-current drier furnished with inlet air at 120° C. to 130° C. or even higher, in which the average residence time may be for example about 15 minutes, or more. Suitable solids and air temperatures at the exit of the drier are 96° C. and 100° C. respectively.

Instead of the solid ammonium nitrate, concentrated solutions of ammonium nitrate could be used and the heat of crystallisation of the ammonium nitrate used for drying.

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This relates to the 14.5:21.5:0 fertilizer already referred to has the approximate finished composition by weight:—

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B.S. Sieve	% by weight passing
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36	85.2
72	70.0
120	54.2
170	40.0

Patent 902363 claims granulated mixed fertilizers comprising ammonium nitrate; finely divided rock phosphate, preferably Christmas Island rock phosphate; a potassium salt, preferably the chloride; and desirably a magnesium compound preferably present in an amount corresponding to at least 2% by weight of magnesia, but such fertilizers are excluded from the Claims of the present specification.

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10. Fertilizer claimed in Claim 8 or 9 in which the said finely divided coating material is rock phosphate and this is included in the P₂O₅ content of the finished fertilizer as expressed in any of the preceding claims.

11. Process for producing the granular nitrogen/phosphorus fertilizers claimed in any of Claims 1 to 10 which comprises introducing ammonium nitrate and finely ground phosphate rock, preferably Christmas Island rock phosphate, and recycled undersize product if desired, to a cylindrical rotary drum or a mixer which has a rotating mixing member or members, together with a small proportion of water, mixing for a sufficient time to pro-



- duce granules, drying the granules, grading the granules, and recycling undersize product to the mixer if desired, the granules being rapidly cooled subsequently to drying.
- 5 12. Process as claimed in Claim 11 in which the cooling takes place subsequently to sieving.
- 10 13. Process as claimed in Claim 11 or 12 in which drying is conducted in a rotary drier.
14. Process as claimed in Claim 11, 12 or 13 in which the proportion of water in the mixture in the mixer is in the range of from 1% to 6% by weight.
- 15 15. Process as claimed in any of Claims 11 to 14 in which the ammonium nitrate is introduced as a concentrated aqueous solution.
- 20 16. Process as claimed in Claim 15 in which the said solution contains from 99.5% to 85% of ammonium nitrate.
17. Process as claimed in Claim 16 in which the said solution contains from 95% to 98% of ammonium nitrate.
18. Process as claimed in Claim 17 in which the ammonium nitrate solution is at a temperature of 130° C. to 140° C.
19. Process as claimed in any of Claims 11 to 18 in which the heat of crystallisation of the ammonium nitrate is used to dry the granules.
20. Process as claimed in any of Claims 11 to 19 in which the cooled granules are coated with oil and with a finely divided inert solid material.
21. Process as claimed in Claim 20 in which the inert material comprises particulate Christmas Island rock phosphate.

WALTER SCOTT,
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