

PATENT SPECIFICATION



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COMPLETE SPECIFICATION

Improvements in or relating to the Production of Phosphate-containing Fertilizers

We, SOCIETE INDUSTRIELLE D'ACIDE PHOSPHORIQUE ET D'ENGRAIS (S.I.A.P.E.), a Corporation organised under the laws of Tunis, of Sfax, Tunis, 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:—

10 The present invention relates to the production, in the shape of pellets and/or powder, of phosphate-containing fertilizers such as simple or triple superphosphates and compound fertilizers with a super-
15 phosphate base.

Fertilizers are conventionally manufactured with a superphosphate base in a powdered form, for example by crumbling a cake with a superphosphate base previously
20 set in a mass and then drying the crumbled product.

It is also a conventional procedure to granulate such superphosphate fertilizers to dimensions similar to those of wheat
25 grains, in two stages. In the first stage, the fertilizer is mechanically stirred with a small amount of water so as to obtain damp pellets (or granules) of the required size: in the second stage, the pellets are
30 dried while being prevented from setting in a mass by mechanical stirring. Some of the pellets are generally recycled and added to the material used in the first stage. These recycled pellets, on the one hand
35 dilute the new pellets and prevent their sticking together, and on the other hand serve as supports for new material so that larger pellets are formed.

In both methods, sulphuric or phosphoric
40 acid with a small amount of water is generally used for making the superphosphate by action on a phosphate-containing earth. If the fertilizer is a triple superphosphate, and if the phosphoric acid is obtained by
45 direct action of sulphuric acid on a phos-

phate, the phosphoric acid is generally concentrated in a special apparatus before being used.

An object of the present invention is to provide a method for the production of 50 phosphate-containing fertilizers in powder or pellet form using only one stirring apparatus.

According to the invention, there is provided a process for preparing a phosphate-
55 containing fertilizer in the form of pellets and/or powder in a single stage, which comprises forming an aqueous slurry of the fertilizer constituents in the desired proportions, injecting the slurry under pres-
60 sure into a rotary drier heated with a concurrent flow of hot gas to form the desired pellets and/or powder, sifting the resulting pellets and/or powder to separate those particles that are larger than a predeter-
65 mined size, crushing such larger particles and recycling to the rotary drier separately from the injected slurry the crushed particles together with any particles that are smaller than another predetermined size.
70 The drying oven is preferably of the rotating type provided with conventional devices for regulating the feeding of the materials. The temperature of the hot gas and the time during which the products
75 remain in the drier is chosen so that a product having the desired degree of dryness is obtained at the outlet from the drier. The products issuing from the drier are
80 sifted to separate the powders and pellets of a desired granular size, a portion of oversize products being recycled in the drier after having been crushed, with perhaps a certain proportion of the finally
85 obtained commercial product.

The initial slurry may be prepared in a mixer of the usual type, consisting of a simple mixing tub provided with a stirrer and an outlet for directing the slurry towards the spraying device in the drier.
90

The temperature of introduction of the drying gas and the time during which the products remain in the drier are preferably chosen so that the products issuing from the drier contain less than 10% and preferably from 5% to 6% by weight of water, as shown by titration, such factors being determined by calculation or through experiments known to those skilled in the art.

10 The injection of the slurry into the drier may be effected by passage under pressure through a tube, conveniently provided with means for regulating the temperature of introduction of the slurry. The pressure is preferably of substantially 2 kg/cm².

Experience has shown that such spraying by passing the slurry through a tube, creating a moderate turbulence, is sufficient to transform the slurry into homogeneous liquid drops, and that, with slurries having a superphosphate base, there is practically no formation of mists which give rise to the formation of dusts. When these drops are suddenly projected into a stream of hot gas, the excess water is apparently instantaneously vaporized, while the evolved steam prevents the powdered or pelletized products from setting in a mass. As a result, these drops, together with the products which are recycled, form grains similar to those which would have resulted from the first stage of the conventional pelletizing mentioned above.

The temperature of the hot gas can be adjusted so that the production of steam which accompanies the mixing of drops of slurry with the hot gas causes the temperature of the gas to drop almost immediately, and so no chemical alteration of the fertilizer is likely to take place, even if the temperature of the gas exceeds that which is generally used in such a drying process.

Small modifications in the injection pressure, or in the turbulence of the slurry as it is injected, can be made so as to modify the size of the pellets and/or powder, which may for instance, be of 2 to 4 mm or less than 0.5 mm average diameter. A rise in pressure, or in turbulence, causes a decrease in the average diameter of the pellets and/or powder obtained. Increase in turbulence may be obtained, for example by inserting helical fins inside the spraying tube, or by any other mechanical means, fixed or movable, tending to impart a more or less complex helical motion to the jet of sprayed slurry.

The initial slurry may consist either of a paste of simple or triple superphosphate resulting directly from the action of sulphuric acid or phosphoric acid on a phosphate in the mixer preceding the drier, or of a slurry obtained by mixing water with simple or triple superphosphate from any previous production, in either case with or

without nitrogenated and/or potassium products, such as an ammonium sulphate or nitrate, potassium sulphate or chloride, for obtaining fertilizers, whether complex or not.

When at least part of the slurry is prepared by the direct action of sulphuric or phosphoric acid on a phosphate, it is possible to use dilute acids such as recuperation dilute sulphuric acid or unconcentrated phosphoric acid conventionally prepared by action of sulphuric acid on phosphate.

After the acid has reacted on the phosphate, the superphosphate is dried in the drier in which the pelletizing operation is taking place. The consumption of heat in this operation, calculated with reference to the unit mass of water removed, is substantially less than would be necessary to concentrate the acid, since, in this case, there is only water to be vaporized and there is no need to remove water from the acid. Further, heat is produced by the initial reaction so less heat need be supplied from outside.

Furthermore, since in the products handled according to the invention the greater portion of the sulphuric or phosphoric acid is already neutralized, the chemical activity of the products, even when hot, remains low. The apparatus may therefore be built out of ordinary materials and requires less maintenance than would have been the case if concentrated acid had been used. It should be added that the use of dilute acid facilitates the wetting of the phosphate and makes a more powerful and rapid reaction with the phosphate.

In either case, even when the slurry is prepared directly from a phosphate attacked by a concentrated acid, with or without an addition of complementary materials, a single pelletizing apparatus is used and replaces the large assembly normally necessary in previously known methods.

The invention will now be described more particularly with reference to the accompanying drawing which shows, diagrammatically, an example of an installation suitable for carrying out the method.

This installation comprises a mixer, consisting of a mixing tub 1 provided with a stirrer 2 and with an outlet 3 to a slurry pump 4 which delivers slurry, under a pressure of 2 kg/cm², to an injection nozzle 5 opening into a rotary drier 6. The latter is a cylinder, of about 2 metres in diameter, and 20 metres long, of a type similar to a cement oven, and provided with inner helical fins to agitate the materials while the drier rotates. This drier is heated by the combustion gases from a fire box 7 which

enter the drier below 900°C.

Beyond the drier, a sifting installation is arranged, represented diagrammatically by sieves 8, 8a, and 8b, and a crusher 9.

The larger pieces are collected by the sieving arrangement at 11 and are fed to the crusher 9 before being fed back to the drier 6 through pipe 10a and pipe line 10. Some of the smaller particles are separated 10 and fed through pipe 10b into pipe line 10 for recycling. The commercial products are drawn off at 12 and 13.

The invention will now be illustrated in the following Examples, wherein reference 15 is made to the apparatus described above.

EXAMPLE 1

Some 65% Gafsa phosphate, crushed to an 80% extent to a particle size of 1.5 mm., 20 was stirred in the mixer 1 with such an amount of 30% phosphoric acid that there was 1 part by weight of P_2O_5 in the phosphate for every 2.9 parts of P_2O_5 in the acid.

The mixture obtained, consisting of a clear slurry, at 55°C., was injected into the drier 6 through the tube 5, while there was also introduced, into said drier, an amount of previously prepared superphosphate, recycled through the pipe line 10 at the rate of 2 parts by weight for one part of superphosphate formed in the slurry. The temperature of the gases in the drier was 550°C., and the gas velocity was 3 35 metres/sec.

There was collected, at the outlet from the drier, while experimentally regulating the rotation speed (normally 2.7 r.p.m.), a mixture of pellets and fine granules with 40 6% humidity, a few pieces being over 4 mm. in diameter.

The latter were eliminated at 11 by the sieve 8, of French AFNOR sieve standard 37, and crushed in the crusher 9 to be recycled to the drier 6 through pipe 10a and pipe line 10. Particles of diameter between 2 and 4 mm. were separated by the sieve 8a, of French AFNOR sieve standard 34, at 12; by means of the sieve 8b, of French 50 AFNOR sieve standard 33, products of diameter between 1.5 and 2 mm. were separated and then fed back through pipe 10b into pipe line 10; fine superphosphate between 0 and 1 mm. was delivered at 13, 55 and together with the product separated at 12 represents the commercial product. French sieve standards 37, 34 and 33 correspond approximately to 5, 9.2 and 12.5 mesh per inch.

There was thus obtained:

4% fine superphosphate between 0 and 1 mm. diameter,

30% pelletized superphosphate between 2 and 4 mm. diameter and 66% product 65 which was recycled at 10a, 10b and 10.

EXAMPLE 2

By operating, as described in Example 1 except that the injection tube was modified with inner helical fins to create a certain turbulence in the sprayed slurry, there 70 was obtained:

29% fine superphosphate between 0 and 1 mm. diameter,

5% pelletized superphosphate between 2 and 4 mm. and 66% product which was 75 recycled at 10a, 10b, and 10.

What we claim is:—

1. Process for preparing a phosphate-containing fertilizer in the form of pellets 80 and/or powder in a single stage which comprises forming an aqueous slurry of the fertilizer constituents in the desired proportions, injecting the slurry under pressure into a rotary drier heated with a con- 85 current flow of hot gas to form the desired pellets and/or powder, sifting the resulting pellets and/or powder to separate those particles that are larger than a predetermined size, crushing such larger particles 90 and recycling to the rotary drier separately from the injected slurry the crushed particles together with any particles that are smaller than another predetermined size.

2. Process according to Claim 1, wherein 95 the temperature of the hot gas and the time of drying are such that the resulting pellets and/or powder contain less than 10% by weight of water.

3. Process according to Claim 2, wherein 100 the temperature of the hot gas and the time of drying are such that the resulting pellets and/or powder contain 5%-6% by weight of water.

4. Process according to any of the pre- 105 ceding claims, wherein the slurry is injected under a pressure of substantially 2 kg/cm².

5. Process according to any of the preceding claims, wherein the slurry has a 110 simple or triple superphosphate base, which is prepared immediately before injection by the reaction of dilute or concentrated sulphuric or phosphoric acid on a phosphate.

6. Process according to any of Claims 1 to 4, wherein the slurry has a superphosphate base, which is prepared previously and diluted with water.

7. Process according to any of the pre- 120 ceding claims, wherein nitrogenated and/or potassium products are added to the slurry.

8. Process for the production of phosphate-containing fertilizers in the form of pellets and/or powder substantially as 125 hereinbefore described with particular reference to the drawings.

9. Apparatus substantially as hereinbefore described for carrying out a process according to any of the preceding claims. 130

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