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ACID-PHOSPHATE PROCESS.

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To all whom it may concern:

Be it known that I, HERBERT H. MEYERS, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Acid-Phosphate Processes, of which the following is a specification.

The present invention relates to the production of acid phosphate, particularly, but not necessarily restrictedly, for use as a fertilizer.

The leading aim and prime purpose of the invention is the provision of a method or process whereby the acid phosphate may be made at materially less expense than by the present method.

In the customary process of making such acid phosphate, the phosphate-rock is ground dry and is then treated with sulphuric acid of the proper strength, the product being deposited in a den where it is permitted to set or harden and from which, after such setting, it is removed.

One feature of my improved process resides in the wet grinding of the rock, which results in economy of operation because the power required for wet grinding is less than half as much as that needed for dry grinding, or stated somewhat differently, the output of a given mill is much increased by wet grinding, with the further advantage that a type of mill may be used for wet grinding for which the upkeep costs are materially less than on the usual mills used for dry grinding of phosphate-rock.

When phosphate-rock is ground wet about 40% of its weight of water must be used, and if a slurry consisting of such a mixture were acidulated by the ordinary method in a mixer, even with 60° Bé. acid, the mass would not set properly in the den, and when recovered from the den would be too wet for use. It would have to be dried. Under these conditions, it would be equivalent to acidulating rock with from 40° Bé. to 45° Bé. acid, and the weakest acid that can be successfully used for ordinary acidulation is 50° Bé.

It would not be feasible to use stronger than 60° Bé. acid for adding to the wet rock, since 60° Bé. acid is the strongest it is possible to produce by the lead-chamber process without a concentration operation, and to concentrate the acid would be far too expensive, just as a subsequent handling and drying of the acid phosphate would be.

Furthermore, when wet rock is acidulated in a mixer, it has a tendency to ball, that is, form small nodules which are unacted upon in the interior. These are dropped into the den, where they lie dormant, and the result is that the acid phosphate produced contains small kernels of material with a comparatively high percentage of insoluble phosphate.

The subsequent step in the new process is subjecting the wet-ground and acidulated rock to a direct heat drying method which permits the use of the initial or preliminary wet grinding, and any balls tending to form are disintegrated by the motion of the charge through the drier and the application of heat which causes the moisture in the interior of the balls to vaporize and break up the masses.

This new, direct heat, drying process for the manufacture of the usual acid phosphate is preferably or desirably carried out approximately as follows:

The phosphate-rock is ground with from 33% to 40% of its weight of water in a tube or other suitable mill, and the slurry from the mill is run to a mixer where the proper amount of 60° Bé. sulphuric acid is added to it.

The exact amount of acid to be used depends in large measure upon the type of rock being acidulated, for example, if Tennessee rock, analyzing about 70% tricalcium phosphate were used, approximately 78 pounds of 60° Bé. acid would be required for each 100 pounds of rock.

The quantity of water present in the rock slurry is such that the acid, when added, is diluted to between 40° and 45° Bé., whereas according to the old process the usual strength of acid used for acidulating is between 50° and 55° Bé. When this latter strength of acid is used the setting of the mixture is very rapid, but when a slightly more dilute acid, such as 40° Bé. or 45° Bé., is used the mixture is liquid somewhat longer, permitting it to flow easily to a drier after thorough mixing.

Therefore, the mixture of rock and acid is allowed to flow continuously from the mixer to a direct-heat drier, preferably of the inclined, cylindrical, rotary type which is well known.

The combustion gases and slurry preferably travel concurrently through the drier and the charge is so regulated in relation to the amount of fuel consumed, that the discharged product desirably contains about 10% moisture.

The concurrent movement of the charge and gases prevents overheating of the former and the consequent reversion of the soluble phosphate.

The drier should be provided with a drag-chain or scrapers or other means of preventing the charge from sticking to it or building up in it.

As the material moves down through the drier or kiln, it becomes well broken up or disintegrated due to the rotary motion of the kiln and the action of the drag-chain or scrapers.

This action assures uniformity of the product in respect to the chemical condition and produces a well aerated article of good mechanical condition.

The product as discharged from the kiln is conveyed to the storage pile.

The direct-heat rotary drier is preferable for this process, because it is simple in construction and operation and has no complicated moving mechanism on its interior which is difficult to operate and to repair.

The interior of the rotary drier is easily accessible and the charge is very readily prevented from building up or sticking to its interior.

The advantages of this new process may be summarized as follows:

The rock may be ground wet, whereas in the usual den system, the rock must be ground dry in order to obtain satisfactory results on acidulation. Wet grinding is much cheaper than dry grinding, probably not half as expensive.

The initial investment for a plant of this type is materially less than that required for a den system of equal capacity.

The process is continuous and not an intermittent one.

The product is in good physical and chemical condition without further treatment.

The heat in the drier assists in hastening the chemical reactions which in turn are exothermic, and, therefore, aid in the drying. The process, therefore, is much more rapid than the usual one.

The slight excess of water used in wet grinding assures ease of handling and uniformity of condition of the charge entering the drier, and, further, it prevents the danger of overheating the product by assuring an atmosphere of steam at all times in the kiln.

The product is equal in every respect to ordinary acid phosphate and costs substantially less to produce.

The cost of the fuel for drying is a very small item and it is offset many times by the various savings introduced.

It will be readily understood by those skilled in the art that the new process is not limited and restricted to the precise and exact details presented because these may be modified within comparatively wide limits without departure from the heart and essence of the invention and without the sacrifice of any of its substantial benefits and advantages.

It may be noted in passing, that, with dry grinding of phosphate rock, it is first necessary to dry the rock at an appreciable expense, whereas, when wet grinding is practiced, the initial drying is not required and the cost of such drying saved.

I claim:

1. The process of producing acid phosphate, consisting in wet grinding the phosphate-rock, acidulating such wet ground rock, and heating and drying said acidulated rock at a temperature to produce available acid phosphate as a product.

2. The process of producing acid phosphate, consisting in providing acidulated ground phosphate-rock, and heating and drying such acidulated rock at a temperature to produce available acid phosphate as a product.

3. The process of producing acid phosphate, consisting in providing acidulated ground rock, and heating and drying such acidulated rock during agitation of the latter at a temperature to produce available acid phosphate as a product.

4. The process of producing acid phosphate, consisting in wet grinding the phosphate-rock with about 33% to 40% of its weight by water, adding to the slurry thus formed approximately 78 pounds of around 60° Bé. sulphuric acid for each 100 pounds of rock, and heating and drying such acid slurry, while conveying and agitating the same, by combustion gases traveling concurrently with the charge until the product contains about 10% moisture.

5. The process of producing acid phosphate, consisting in wet grinding the phosphate-rock, adding to such slurry about 60° Bé. sulphuric acid until the acid slurry is of about 40° to 45° Be., and heating and drying such acid slurry, while agitating and conveying the same, until the product contains about 10% moisture.

6. The process of producing acid phosphate, consisting in wet grinding the phosphate-rock, adding to such slurry about 60° Bé. sulphuric acid until the acid slurry is of about 40° to 45° Be., and heating and drying such acid slurry.

7. The process of producing acid phosphate, consisting in wet grinding the phosphate-rock, adding to such slurry about 60° Bé. sulphuric acid until the acid slurry is of

about 40° to 45° Be., and heating and drying such acid slurry while agitating and conveying the same.

8. The process of producing acid phosphate, consisting in wet grinding the phosphate-rock, adding sulphuric acid to the slurry, and heating and drying such slurry in contact with hot combustion gases while agitating and conveying the slurry and at a temperature to produce available acid phosphate as a product.

9. The process of producing acid phosphate, consisting in wet grinding the phosphate-rock, adding sulphuric acid to the slurry, and heating and drying such acid slurry in contact with hot combustion gases while agitating and conveying the slurry and at a temperature to produce available acid phosphate as a product, the gases and slurry traveling concurrently.

In witness whereof I have hereunto set my hand and seal.

HERBERT H. MEYERS. [L. S.]