

ISMA* Technical Meetings

Cambridge, United Kingdom

15-17 September 1953

**In 1982, the name of the International Superphosphate Manufacturers' Associations (ISMA) was changed to International Fertilizer Industry Association (IFA).*

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LE 385
TECHNICAL MEETINGS 1953
Paper (a) 1

September 1953

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GRANULATION OF SUPERPHOSPHATE

By C. Heudier, (Cie de Saint-Gobain.)

The growing demand in certain countries for granulated fertilisers and in particular for Superphosphate, has induced the Cie. de Saint-Gobain to concentrate their research on the production of granulated Superphosphate.

Numerous processes have been worked out and a certain number of them have been exploited on an industrial scale. The literature on patents, both French and foreign, is very extensive in regard to this subject and the processes can be divided into two groups:-

(1) Processes including a drying stage where expenses for fuel are incurred.

(2) Processes which do not include fuel charges. The process most generally adopted comprises remoistening and granulating the superphosphate and eliminating the moisture introduced. The whole of the product thus obtained is screened, the coarse portion being disintegrated and the fines recycled for granulation. Certain modifications of this process permit of a reduction in the quantity of water required for granulation and consequently also of the fuel being used for drying. Certain modifications envisage granulation apparatus other than the rotary drum, in order to increase the hardness of the granule and the percentage of granules saleable as a genuine granulation product.

The processes of the second group enable the manufacturer to eliminate the drying operation entailing an expense in connection with fuel. One of the processes comprises taking the superphosphate as it leaves the den, i.e. still hot, and treating it in such a manner as to form granules which are then passed through the rotating drum to increase their hardness. Another process treats the superphosphate leaving the den in the same manner but the product is heated at the same time at temperatures between 60° and 100° its liquid phase being maintained between certain precise limits. Another process advocates the application of pressure until the superphosphate becomes relatively liquid. Finally, another process comprises granulating the super with simultaneous addition of a suitable solution, e.g. sodium silicate, in order to make the particles adhere to each other so as to form granules.

The second type of centrifugal atomiser (Fig. 3, appendix) is used in the Italian installations of lead chambers and in two intensive installations in France.

The acid enters through the hopper a, and impinges on the disc b, and on the discs c and d, after having been partially atomised on the surfaces by impact at an orthogonal angle e. The acid not atomised by the impact on the surface falls on to the radial grooves of the discs c and d, where it is submitted to a new impact which completes the atomisation of the liquid. The maximum volume which can be completely atomised by this apparatus is 1,500 litres per hour.

The third type of centrifugal atomiser (fig. 4, appendix) was put into service in October 1952 in a works for the intensive manufacture of sulphuric acid at La Rochelle-Pallice; it is also being employed in the two intensive installations at CEREA and MANTOVA (Italy). The same type will be used in the other installations which are ready to operate or which are in course of construction.

The acid, coming through distributor a and nozzles b, arrives at a certain pressure on a series of superimposed and identical discs, where it hits small blades, the form and angle of which result in a complete atomisation. With this apparatus, the size of which is similar to the others, i.e. 25 to 30 centimetres in diameter, it is possible to atomise up to 5,000 litres per hour.

The mist obtained with this apparatus is of a remarkable fineness and homogeneity. The use of this apparatus for the distribution of acid in partially filled towers (denitration tower and first reaction tower), as well as in the empty towers (reaction towers or Gay Lussac towers) foreshadows the simplification of installations and an increase in their specific production.

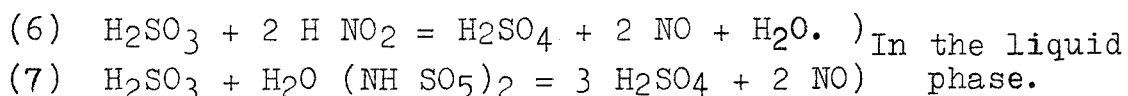
A single apparatus for atomisation according to the same principle will replace with advantage several of the atomisers of the other types in the lead chambers.

COMPOSITION OF ATOMISED ACID

We stated at the beginning of this paper that our process differs from the Gaillard process not only in the functioning and efficiency of the atomiser, but also inasmuch as the atomised acid in the lead chambers has a variable composition. During the operation of the chambers it had been constantly observed that a satisfactory functioning occurred within certain limits of density of the acid produced, limits which varied in each chamber and depending also on the composition of the gas, the nitrous supply, exterior temperature and so on. To put it very plainly, one could say that there was either an excess or a lack of water. In comparatively forced productions the most frequent disturbance is characterised by an excess of water in the gaseous phase and by a lack of water in the liquid phase. A decrease in exterior temperature rapidly readjusted the situation.

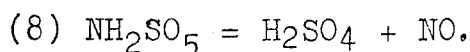
It is therefore understandable that the atomisation of acid, in supporting in each chamber the reaction in the liquid phase as far as volume, density and temperature are concerned, should not only increase the production capacity per cubic metre (thanks to the elimination of calories) but also considerably improve the functioning by rendering it more regular and stable.

nates in iron reaction chambers, where the acid is concentrated and strongly nitrous.

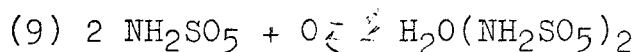


In order to explain the abnormal reactions which cause a loss of nitric oxides by a reduction to N_2O , we have assumed a transitory formation of a component, such as NH_2SO_5 , proposed by Raschig and later accepted by Lunge.

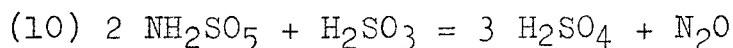
In the diluted and practically denitrated acid this compound would decompose :



If the acid were more concentrated and sufficiently nitrous this compound would oxidise.



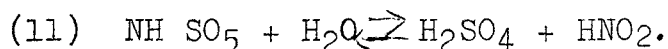
In normal conditions the NH_2SO_5 would react with the sulphurous acid:



giving rise to an irrecoverable loss of oxides of nitrogen.

In reactions taking place in iron chambers, and in general in all intensive processes which bring sulphurous gases into close contact with acids of high density and nitrosity, it is indispensable that the oxidising character of the acid be such that the determination of the total content in N_2O_3 by the nitrometer give a value which is slightly higher (by about 5%) than that obtained by determination with permanganate.

It has been assumed that the sole sulpho-nitrous component present in acid is the nitrosylsulphuric acid NH_2SO_5 which, when diluted separates into $\text{H}_2\text{SO}_4 + \text{HNO}_2$.



We believe that it is difficult to assume that there is an appreciable content of free HNO_2 in acid with a higher density than 61° Bé, although an acid with normal characteristics contains NO_2 which is free or present in a very unstable combination. The formation of HNO_3 from NO_2 seems to us probable.

In any case, the low proportion of these components, which are more highly oxidised, side by side with a high proportion of very stable NH_2SO_5 , cannot explain the high oxidising power of acids employed in our process where the nitrous content remains fairly low.

These acids have a composition which can vary between certain limits of density and nitrosity: 61 to 65° Bé, 5 to 10% N_2O_3 ; with an H_2SO_4 content which can vary from 73 to 76%.

In accordance with our hypotheses the most highly oxidising acids correspond to a general formula of :

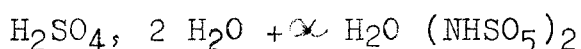


FIG. 1

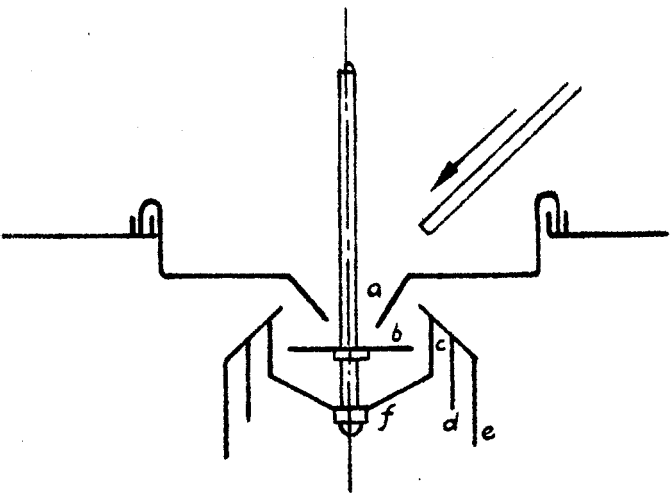


FIG. 2

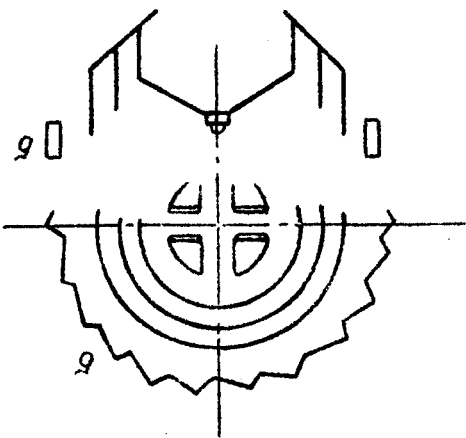
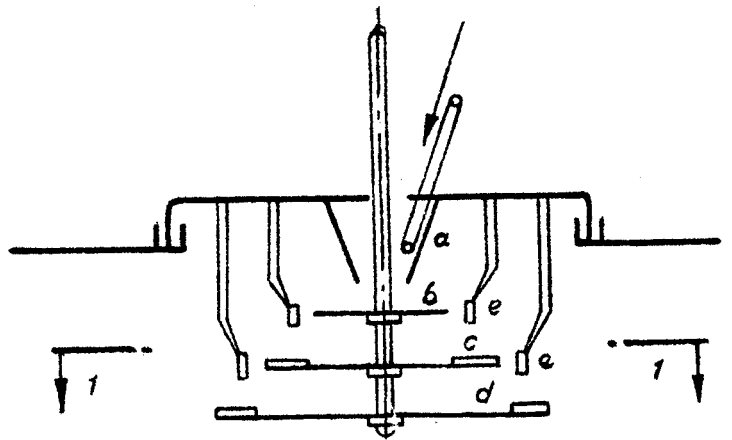


FIG. 3



Sección 1-1

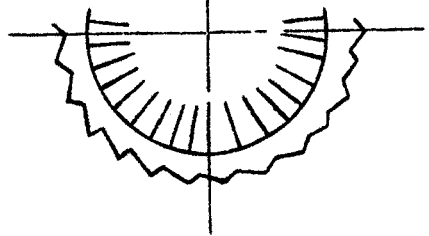


FIG. 4

