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THE PERLOMATIC PROCESS TA/84/8

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1 - SUMMARY

The industrial experience of a Spouted Bed granulator for Sulfur forming gave interesting data on the possible use of such a granulation technique for miscellaneous products.

2 - THE ORIGINAL PERLOMATIC

The process was developed from 1970 onwards, the main target beeing then Sulfur forming. An industrial unit producing 300 - 350 t/d Sulfur granules has been operating in Canada. After a somewhat difficult start-up the plant was eventually able to produce premium grade sulfur granules. The unit was later on shut down, mainly because of its relatively low capacity when compared to the 2 000 t/d prilling towers.

Anyway the data collected during the running period allowed to substantially improve the process. It is now possible to design a highly reliable plant with a strongly increased production capacity.

A summarized flow-sheet of the original process is given by the enclosed fig. 1.

The granulator itself is a cylindrical vessel, with a conical bottom. The product to be granulated is sprayed, as a melt or a slurry, at co-current with an air flow producing in the vessel a moving bed of granules. Granulation and cooling (or drying) are achieved simultaeously. The flow of product coming out from the granulator is screened ; the oversized granules are crushed and, along with the fines, recycled in the granulator.

The on size product is cold enough (in the case of Sulfur) to be sent directly to storage.

As a whole the plant is very simple and compact.

The main draw-back is that all of the process air goes through the granulator. Consequences are :

- The unit capacity of the plant is limited, the cross section of the granulator beeing prohibitive for high production rates (e.g. 1 000 t/d)

- The electrical power consumption is somewhat high, all the process air working under "high energy" conditions - the pressure drop of the Spouted Bed beeing 600 mm water gauge, as an average.

- The relatively low temperature of the bed may in some cases hinder the granulation (production of dust).

3 - THE IMPROVED PERLOMATIC

The basic flow sheet is modified as shown on fig. 2, by adding a cooler between the granulator and the screen.

Some additional improvements - design of the screen
- design of the crusher
- air outlet of the granulator

allow a better control of granulation and impede producing and carrying over fines and dust in the unit.

Under those conditions the flow of process air is splitted into two parts
- about 20 % through the granulator
- about 80 % through the cooler

It is thus possible either to significantly reduce the size of the granulator for a given production rate, or to increase by a factor 3 to 4 the production capacity for a given granulator.

Above that the cooler pressure drop beeing lower than the granulator pressure drop the specific consumption in kwh/ton decreases.

4 - UREA GRANULATION

Starting from the hereabove reasoning a semi-industrial unit (5 t/h capacity) was erected for testing of Urea granulation in our Toulouse plant in 1981-1982.

The targets were :

- direct granulation of Urea starting from a 98-99 % slurry
- possible swelling of prilled Urea to cater with some specific demand of the market

4.1 - Plant characteristics

The perlomatic itself is 1.8 m diameter by 6 m high.

The screening, crushing, recycling section is designed for a recycle ratio of 3 the expected value beeing about 2 (The cooling effect of cold recycle is a part of the process).

The practical operating conditions have been settled as follows :

slurry water content	: 1 % to 2 % H_2O
air in Perlomatic	: 7 000 kg/h
air in cooler	:33 000 kg/h
recycle ratio	: 2.2 to 2.5
bed temperature	: 75°C to 95°C
temperature of recycle	: 50°C
granulometric analysis (outlet of Perlomatic)	: oversized 5 % on size 45 % undersized 50 %

The flows of air, recycle ratio, temperature of recycle may vary according to the temperature of the air entering the Perlomatic and the cooler.

4.2 - Operating conditions

The starting up of the plant is easy and very fast ; design capacity is reached in about half an hour and the plant run in a very steady way as well for granulation as for swelling of prills.

Any average size of granules (d 50) between 2 mm and 3.5 mm is available ; granules bigger than 4 mm can be obtained too by changing the screen cloth.

All the parts of the plant in contact with granules stay very clean (no plugging) as long as the cyclones after granulator and cooler are properly insulated and steam heated.

The residence time of granules in the Perlomatic is short, about 1 minute. Bed pressure drop can vary between 450 and 600 mm water gauge according to the operating conditions.

4.3 - Product quality

The physical aspect of granules is fair ; they are somewhat less bright and spherical than prilled urea.

Characteristics

Nitrogen content	: 46 to 46.2
Moisture content	: 0.25 to 0.35
Biuret content	: 0.9 to 1.0
Bulk density	: 750 kg/m3
Crushing strenght	: 38 kg/mm2 for d = 2 mm

Storage

No storage problem. No caking. Much better than prilled urea.

5 - PROCESS DEVELOPMENT

Based on the experiments in the semi-industrial plant, the unit capacity of a Perlomatic Granulation plant could be

1 000 t/d for Sulfur Granulation

600 t/d for Urea Granulation

To increase the production capacity for Urea Granulation it would be necessary to spray a slurry with a higher water content ; this improvement supposes a better spraying. Additional tests shall be undertaken to check this point.

Eventually the granulation of Ammonium Nitrate must be studied too.

Fig. 1

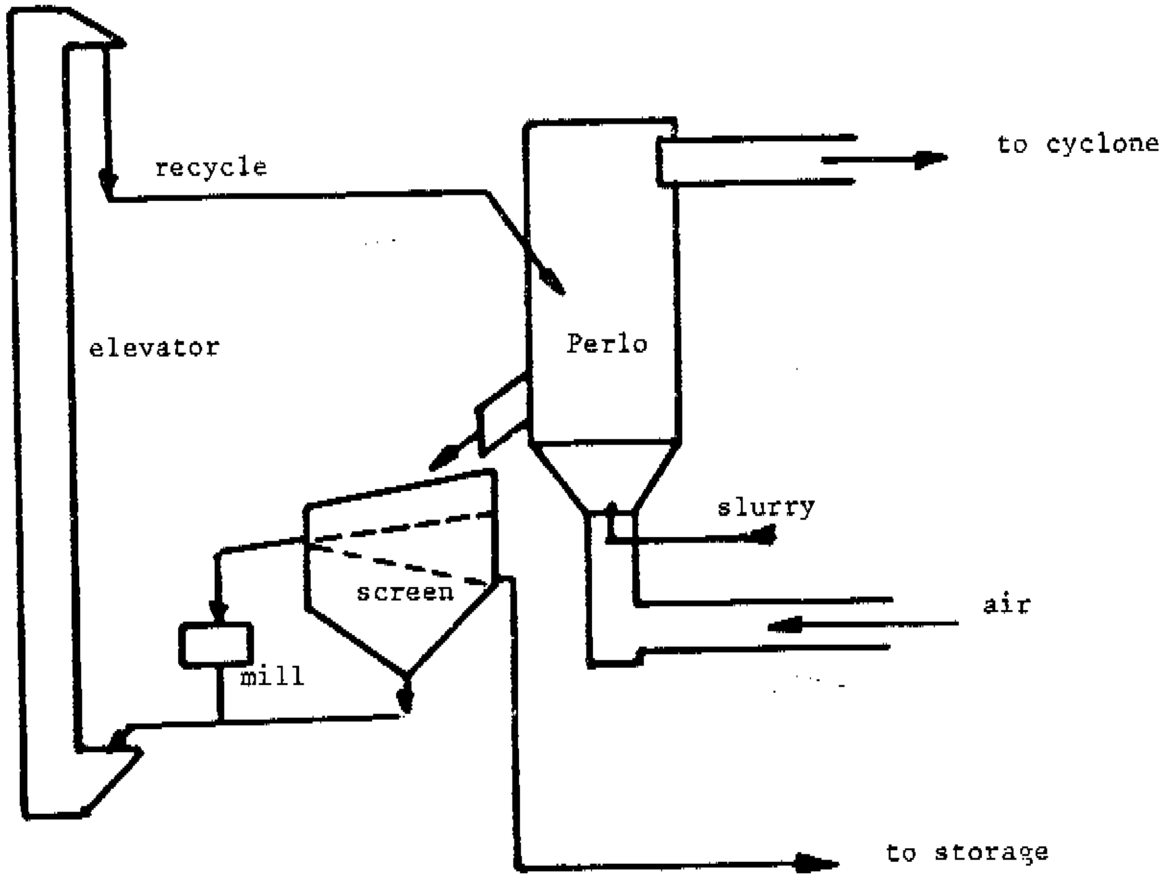
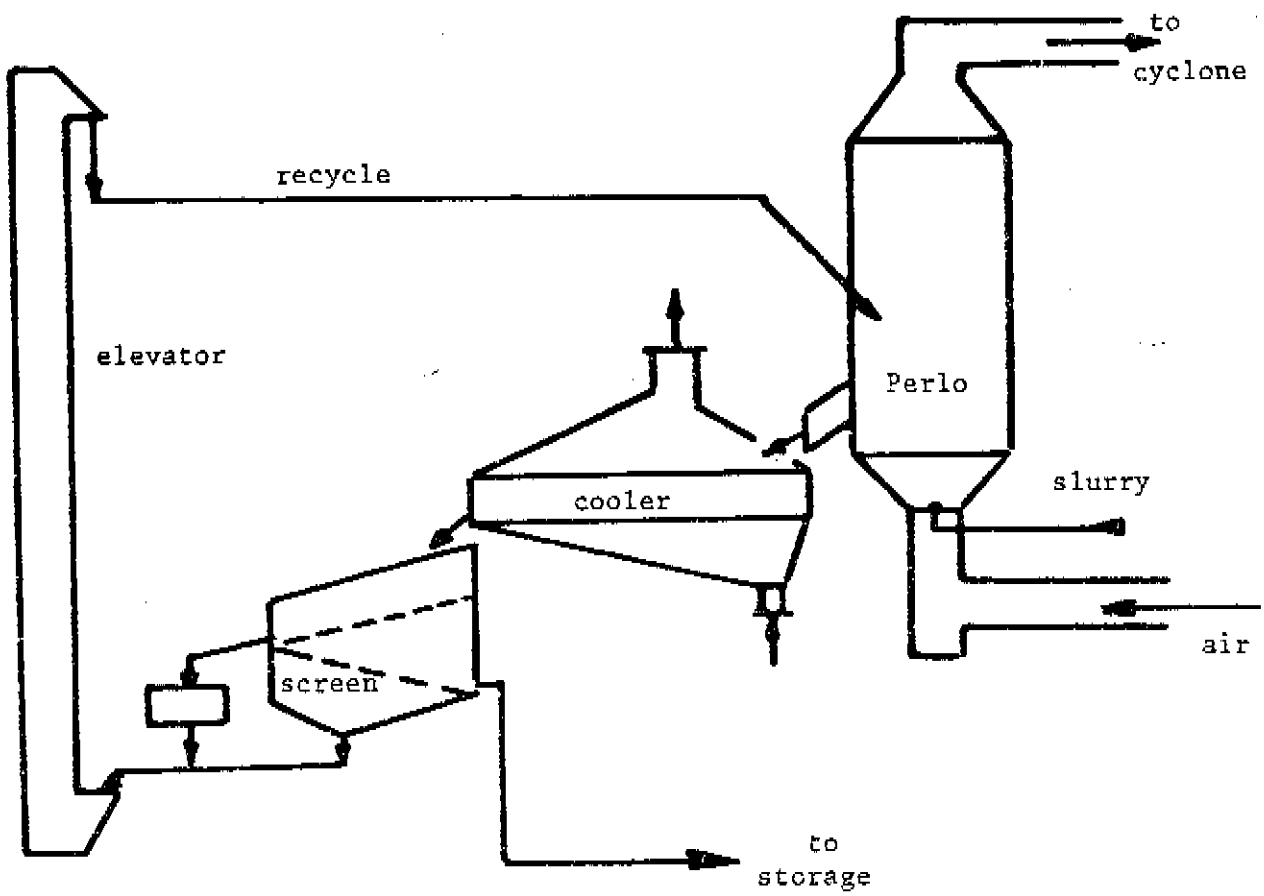

recycle
to cyclone
elevator
Perlo
slurry
screen
air
mill
to storage

Fig. 2


to
cyclone
recycle
elevator
Perlo
cooler
slurry
screen
air
to
storage

TA/84/8 The perlomatic process by C. Debayeux, CdF Chimie AZF, France

DISCUSSION: Rapporteur R. SCHOEMAKER, UKF, Netherlands

Q - Mr J.D. CRERAR, Norsk Hydro Fertilizers Ltd, United Kingdom

a) How can NPK fertilizers be made on the Perlomatic fluid bed process? Has it been tested?

b) Please give more details about the spray nozzles in the fluidised bed. How do they differ from NSM process?

A - a) There is no theoretical problem for granulating a NPK slurry. Hot air must be used. Lab tests have proven it possible. But some caking is likely to happen, mainly with fertilizers containing calcium sulphate. We have not experimented the process long enough to have a clear opinion.

b) Spray nozzles are very simple and inexpensive. No air addition. We have been using "Lechler" or "Spray System" nozzles.

Q - Mr. D. IVELL, Norsk Hydro Fertilizers Ltd, United Kingdom

For urea granulation, what percentage of material would be between 2 and 4 mm in the product, when operating at a recycle rate between 2.2-2.5?

A - The percentage of material between 2 and 4 mm can be adjusted in a wide range by modifying the operating conditions (e.g.: screen cloth).

As recycle is needed for bed cooling no special effort was made to increase the onsize product amount.

Typical values are:	4 mm:	5%
	2 to 4 mm:	35 to 55%
	2 mm:	60 to 40%

Q - Mr. B.K. JAIN, FAI, India

What is the essential difference between Perlomatic process and other fluidised bed granulation techniques? Has there been any necessity felt in your process for the addition of formaldehyde to improve the storage properties of urea granules and to reduce dust formation? Comparative steam and power consumption figures per tonne of urea production may be given.

A - The essential difference betwen Perlomatic and other fluidised bed process is that:

- there is no perforated plate to support the bed
- there is only one spray nozzle.

There is no necessity to add formaldehyde for the granulation step itself (no dust formation). But formaldehyde is needed to improve the storage properties when a 98% slurry is sprayed.

The steam consumption per ton of urea is about 50 kg. This value may vary according to the dedusting system (bags or washing tower).

The power consumption for the granulation step itself is about 22 kwh per ton. Some power will be needed for the dedusting step; depending on the process it may vary from 8 to 15 kwh/ton. The total power consumption should then be between 30 and 35 kwh/ton.

Q - Mr. R. MONALDI, Fertimont SpA, Italy

In your paper it is stated that the perlomatic itself is 1.8 m diameter and the rate of granulated urea is 5 t/h coming from the slurry with water content 1-2%. This production rate seems low for a spouted bed having the above size as the operating conditions demonstrate.

In fact the amount of air, 8000 kg/t of product, is bigger than in all other processes (NSM, MTC, TVA, Fertimont). The increase of the water in the slurry, for example up to 5%, could give an increase in production of about 40%; but that increment, in accordance with our experience, should give notable difficulty in the spouted bed during the drying up of the urea granules because the amount of air passing through the annulus is too small.

I should like to know how you think to solve this problem.

A - The given value of 1.8 m refers to the body of the Perlomatic, not to the cone which is the working item. The upper diameter of the cone is about 0.9 m and the lower diameter about 0.2 m.

The amount of air (8000 kg/t) may vary widely depending on the air temperature at the Perlomatic inlet, and at the cooler inlet. It depends too on the temperature of the urea after cooling and the recycle rate. Values of 7000 kg/t could be reached.

The increase of water in the slurry gives no difficulty at all in the spouted bed with slurry containing 3.5 to 4% water. Problems arise with the residual water content in the urea granules, which gives poor storage properties when too high (above 0.3%) regardless of the formaldehyde amount. It is clear that, in order to work with a high water content, it will be necessary to improve the spray nozzle operating conditions.

Q - Mr. S.K. MUKHERJEE, FAI, India

a) Crushing strength given in the paper is 0.38 kg/mm2 for d = 2 mm. Is this correct?

b) Is the screening of urea effective when operating under conditions of between 72-76% relative humidity?

A - a) The crushing strength is normally 0.5 to 0.7 kg/mm2 for d = 2 mm.

b) The screening of urea was made on a product at a temperature of about 50°C; under our climatic conditions the relative humidity is normally 55% to 65% and no special problem arose. If the R.H. is higher (75-80%) some problems may happen if the urea is not warm enough.