International Fertilizer Industry Association

# IFA Technical Conference

## Paris, France

## 5-8 November 1984

**International Fertilizer Industry Association** - Secretariat: 28 rue Marbeuf - 75008 Paris - France
Tel. +33 1 53 93 05 00 - Fax +33 1 53 93 05 45/47 - ifa@fertilizer.org - www.fertilizer.org

# GRANULATION OF NPK COMPOUND FERTILIZERS AT THE NEW FERTILIZER COMPLEX OF INA-PETROKEMIJA, YUGOSLAVIA

J A Hallsworth & W F Fortescue, Davy McKee, UK

D Fresl, Ina Petrokemija, Yugoslavia

## SUMMARY

The NPK Granulation plant is one of several new high capacity plants which comprise a major expansion of the fertilizer complex at Kutina in northern Yugoslavia. The complex is based on locally available natural gas and imported P and K raw materials. The NPK Granulation plant was commissioned mid 1983.

A feature of the design of the Granulation plant is the extreme flexibility which was built in. It is able to operate both as a "Slurry Route" plant (producing DAP and NPK's) using a pressure reactor or alternatively in the agglomeration mode at low recycle using MAP powder (produced in-situ) or other raw materials such as TSP powder and ammonium sulphate. A pipe-cross reactor is also incorporated into the design for use on certain product grades. With heavy emphasis placed on the minimisation of all effluents from the site, the NPK plant employs high efficiency gaseous scrubbers and was designed to be liquid effluent-free.

The design features of the plant and the operating experiences gained both during and since the commissioning phase are reviewed. The effects of switching from one mode of operation to another are discussed with regard to operability and equipment performance. Finally a brief comparison is drawn between the products made on the new granulation plant and those from an older nitrophosphate plant on the same site.

## PROJECT BACKGROUND

Ina Petrokemija have been producing compound fertilizers at Kutina since 1968 by the nitrophosphate route and have established themselves as significant suppliers of fertilizers in the Croatian, Slovenian and Bosnian regions of Northern Yugoslavia. Increasing demand and export potential led to a decision to expand the works and in 1978 Davy McKee were awarded a contract for the design and supply of five large process plants of which the granulation plant was one. The projected market was such that a high degree of flexibility was required in order that many different product formulations could be achieved based on a variety of raw materials.

For the new facilities, the conventional sulphuric acid/phosphoric acid route to NPK was chosen because of its economic advantage over the nitrophosphate route.

## FEATURES OF THE NPK GRANULATION PLANT

The design was based on a licence provided by Norsk Hydro Fertilizers of England and is similar in principle to several other plants constructed by Davy McKee using this licence. There are however a number of unusual features which will be described in this paper.

Simplified flowsheets of the plant are given in Fig 1 (MAP Production/Gas Scrubbing Sections) and Fig 2 (NPK Granulation).

- Plant Capacity
  Design capacities were as follows:
  1050 MTPD MAP Powder (dry basis)
  1500 MTPD for "solids route" grades eg 18-18-18 (MAP based)
  1320 MTPD for "slurry route" grades eg 10-30-20 (DAP based)

- Design Recycle Ratio
  Although the solids route grades operate at a significantly lower recycle ratio than slurry route grades, the required dryer residence time is greater if urea is incorporated as one of the solid raw material feeds. This applies in the case of 18-18-18 production by the solids route. Furthermore higher air flows are required through the dryer in the case of grades containing urea because of a restriction on drying temperature together with the need to achieve lower product moisture levels. Thus in order to optimise the capital cost against annual requirements, it was decided to base the dryer dimensions on the requirements for solids route operation at 1500 MTPD capacity and to uprate the design throughput for slurry route grades to a figure consistent with the dryer's capability. Consequently the design conditions selected were as follows:

| | Design throughput | Design Recycle Ratio |
|---|---|---|
| Solids route grades | 190 MTPH | 2:1 |
| Slurry route grades | 250 MTPH | 3.5:1 |

- MAP Reactor
  The reactor operates under slight pressure thereby enabling a true solution to be formed.

  Operating Conditions are as follows for the two modes of operation:

| | | MAP Powder Production | Feed to Granulator |
|---|---|---|---|
| Pressure | bar gauge | 2.0 | 1.0 |
| Temperature | °C | 165-170 | 140 |
| $H_2O$ Content of solution | % w/w | 10 | 12-15 |

  Although many similar "Minifos" reactors of this type have been constructed, this is one of the largest to date having a diameter of 3.8m. It was necessary to fabricate the vessel in Incoloy 825 material because of the many different phosphate rock sources envisaged for the adjacent phosphoric acid plant, with varying corrosion implications.

The reactor was fitted with a turbine bladed agitator which has now been eliminated on the most recent draft tube designs. The standpipe arrangement used for level control, introduced for the first time on the Kutina plant, has performed well in spite of the turbulent and foaming conditions. The need for accurate level measurement, which on previous plants has been difficult to achieve, therefore no longer exists.

- MAP Spray Tower

MAP solution from the reactor can be sent either directly to the granulator, as feed for slurry route grades, or to the spray tower for direct production of MAP powder. MAP powder in the form of microprills can be used directly as a fertilizer but more commonly it is considered as an intermediate which can be conveniently granulated in low recycle plants either on site or in other locations.

The spray tower itself (see Fig 3) is of a relatively cheap construction being essentially a plastic curtain strapped loosely to conventional structural steelwork. This is the largest MAP tower designed to date with a single spray nozzle.

- Granulator/Pipe Cross Reactor

The granulator was fitted with a flexible rubber lining (6mm thick Trelleborg "Granuflex") to prevent the build-up of solids on the walls. Because of the many different modes of operation and raw materials envisaged, the internal pipework was designed such that any non-essential piping for a particular product formulation could be simply removed, thus eliminating any unnecessary surfaces where build-up might occur.

The granulator is provided with a reversible motor, for use in clearing solids from the granulator internals on shutdown. It has a slope of 2° and a speed of 9 RPM.

As a further feature, a pipe cross reactor was designed for use on certain grades where its use could result in operational cost savings. The pipe reactor is 150mm in diameter and is manufactured in Hastelloy C-276.

- Dryer

Because of the requirement of variable throughput, the dryer was supplied with a variable speed drive. The dryer was fitted with pneumatic hammers and a lump crusher.

- Screens

Rhewum screens of the cloth vibrated type were used. These are provided with simple facilities for varying the angle of inclination and degree of vibration intensity and incorporate an automatic cleaning cycle. They can be easily opened up for cloth replacement.

A split screening arrangement was used ie removal of hot fines, for return to the granulator, on the first set (single deck) and then a second set of product screens (double deck) after cooling for removal of oversize and product polishing. This results in the practice of cold crushing, which is of great advantage in the avoidance of build-up problems on grades containing urea. At the same time, recycle to the granulator remains relatively hot which assists in lowering the recycle ratio.

The hot screens were fitted with a special internal flap device so that some small product size material can, when appropriate, be diverted into the fines stream, particularly on slurry route grades.

- Oversize Crushers
  Hammer and flail type crushers are used employing one solid slow speed rotor and one fast counter-rotating rotor fitted with hammers. Each crusher is mounted directly above the fines hopper, thus avoiding the need for conveying crushed oversize as such.

- Fines Hopper
  A dedicated hopper is provided for collecting all fines, crushed oversize and cyclone dust before recycling to the granulator. This has an advantage in ensuring that at all times the solids returned to the granulator are steadily controlled and monitored, thus avoiding short term fluctuations and disturbances to the granulation conditions. This is of particular importance during low recycle operation.

- Scrubbing System (See Figs 4 and 5)
  The scrubbing system operates in different modes depending upon the mode of operation of the MAP and granulation sections of the plant. Separate dust scrubbers are used for the dryer gases and for the gases emanating from the cooler and dedusting systems. Each scrubber is essentially a void tower with a series of special spray nozzles designed to avoid blockages. At the top section of each scrubber is a droplet catcher which works on the principle of imparting to the gas a rotary movement by means of fixed vanes.

  In the case of the dryer scrubber, the scrubbing medium is always water. For the other scrubber, water is used when manufacturing solids route products. However when the slurry route mode is used, gases from the granulator and the MAP reactor are first passed through a separate ammonia scrubber where ammonia is recovered by phosphoric acid scrubbing. The gases then enter the cooler/dedusting scrubber where they are scrubbed with a 30% $P_2O_5$ phosphoric acid in the lower section and water in the top section. The final water wash is necessary in order to remove traces of fluorine stripped out of the phosphoric acid scrubbing medium.

## INITIAL START-UP

The commissioning period was singularly free of problems, these being limited to a number of minor mechanical difficulties. However several small modifications were incorporated into the plant during the early trials and were found to be beneficial. These were as follows:

- Granulator scraper. A small portion of the granulator shell beyond the outlet weir was not covered by the flexible rubber lining and on a previous plant had suffered some build-up. A fixed scraper was designed and fitted to this portion of the shell as a precautionary measure.

- Suction damper on Secondary Air Fan to Drier Furnace. This damper proved to be insufficiently robust and had to be stiffened.

- Deflector plates. It was found necessary to weld deflector plates inside some of the angled chutes in order to provide even distribution of material to conveyors and elevator boots.

- Cyclone discharges. Dust is discharged from the cyclones on this plant through "mancuna" valves. These are simple rubber socks which seal off the dust discharge, by virtue of the slight vacuum maintained by the air fans, until such time as the weight of accumulated dust forces open the rubber sock to release the dust. The seal is then re-established by the vacuum.

  On start-up it was found that these mancuna valves had been undersized resulting in blockages at the discharge. A further consequence of this was the carryover of excessive amounts of dust to the scrubbing system. The valves were therefore replaced with larger rubber socks which eliminated the problem.

- Fines hopper. The effective capacity of the fines hopper was not being fully utilised due to build-up of solids in the corners. Consequently air blast connections and vibrators were fitted to maintain the hopper contents in a mobile state.

## PLANT OPERATION

The plant has operated successfully both in the solids route and slurry route modes and also for the direct production of MAP powder. Examples of the operation are described below:

- MAP Powder Production
  The operation of this section of the plant has been trouble-free, reaching 60% of design rate within two days of the initial start-up and subsequently operating for long periods at 108% capacity. No special operating supervision is now needed in this area, this being considered an integral part of the responsibilities of the granulation plant operators.

Phosphoric acid produced from Khouribga 75/77 BPL rock and Taiba 80 BPL rock have been used until now. Table 1 indicates the plant performance achieved on one of the first runs carried out.

Table 1 - MAP Powder Production based on Khouribga Acid

| | | | |
|---|---|---|---|
| Reactor temperature | 170°C | | |
| Reactor pressure | 2.1 bar gauge | | |
| Reactor pH | 3.6-3.7 | | |
| Acid strength | 52% $P_2O_5$ | | |
| MAP Analysis | N content | 10.8% w/w | ) |
| | Total $P_2O_5$ content | 55.0% w/w | ) dry |
| | C.S. $P_2O_5$ content | 52.3% w/w | ) basis |
| | W.S. $P_2O_5$ content | 51.7% w/w | ) |
| | $H_2O$ content | 5.4% w/w | |

For this run, liquid ammonia was fed to the reactor although the plant has the facility for ammonia vapourisation in which case a lower phosphoric acid strength would be used. Fresh, unsettled phosphoric acid was fed directly to the MAP reactor and there was no usage of defoamer on either the phosphoric acid plant or the MAP plant.

Subsequent operation using Taiba acid has been equally satisfactory except that a rather low citrate soluble $P_2O_5$ content was obtained. The MAP was also found to have a high $Cr_2O_3$ content which made it unsuitable as an animal feed ingredient.

- NPK Granulation by Solids Route

During the first year of plant operation, the main demand has been for high potash grades. There has also been some production of high urea grades mainly to confirm the design capability of the plant in this mode.

Three examples of solids route operation are summarised in Table 2:

Table 2 - Operating Data for Solids Route Operation

| | Case A | Case B | Case C |
|---|---|---|---|
| Product | 7-29-29 | 2-25-25 | 18-18-18 |
| Recycle Ratio | 1.5:1 | 1.6:1 | 2:1 |
| $H_2O$ in Granulator product | 3% | 2.45% | 1.2% |
| $NH_3$ addition to Granulator | 2.1% | 2.4% | 1.6% |
| Solids temp exit Granulator | 82°C | 93°C | 77°C |
| Drier Inlet Air temperature | 290°C | 258°C | 119°C |
| Drier Outlet Air temperature | 101°C | 111°C | 87°C |
| Solids temp exit cooler | 65°C | 68°C | 68°C |
| Product moisture | 1.6% | 1.3% | 0.7% |
| Product pH | 6.0 | 2.9 | 5.6 |
| Product size analysis | 95% 1-4mm | 92% 1-4mm | 93% 1-4mm |

Some characteristics of these production runs are outlined below:

a Case A. Raw materials used were imported MAP (11-56-0) from Tunisia and East German potash. It was not found necessary to add sulphuric acid to the granulator nor was product coating needed. Scrubber blowdown was recycled to the granulator and thus the plant was able to run at a recycle ratio of 1.5:1 with zero liquid effluent.

b Case B. This was an unusual run insofar as the phosphate source was Tunisian granular TSP which had been purchased at a very low price. Use of large quantities of granular rather than powder TSP presented some difficulties because, due to its hard nature, it was not efficiently crushed in the intake lump breaker. Thus a relatively high quantity of water was added to the granulator in order to provide satisfactory granulation conditions. Addition of sulphuric acid to the granulator was contemplated but found not to be necessary.

The oversize pulveriser suffered some degree of build-up during the two week run as normally happens on TSP grades.

Product coating was not needed.

c Case C. 18-18-18 was successfully made at design capacity using MAP powder, potash and urea prills as the raw materials. None of the problems often reported on high urea formulations occurred, for example there was no screen blinding, no drier build-up and no crushing problems. The product was coated with china clay and oil containing amine in order to impart good storage properties. A small quantity of the product was retained in bulk storage for six months and in bags for ten months and was found to be substantially free of caking.

- NPK Granulation by Slurry Route

Recently there has been little market demand in Yugoslavia for slurry route grades such as DAP and 16-20-0. However a two week run was carried out to manufacture 10-30-20 and subsequently the plant has made substantial quantities of 8-26-26 based on both Khouribga and Taiba acid. The latter grade was envisaged as a solids route grade when the plant was designed but operation was switched to the slurry route when a mechanical failure occurred on the MAP scraper gearbox. Slurry route production of 8-26-26 exceeded expectations in that a recycle ratio of only 2:1 was needed.

Operating data on these grades is presented in Table 3.

Table 3 - Operating Data for Slurry Route Operation

| | Case D | Case E |
|---|---|---|
| Product | 8-26-26 | 10-30-20 |
| Recycle Ratio | 2:1 | 4:1 |
| Reactor temperature | 143°C | 144°C |
| Reactor Pressure | 1 bar gauge | 1 bar gauge |
| Reactor pH | 6.0-6.2 | 6.2 |
| $H_2O$ in Granulator product | - | 1.8% |
| Solids temp exit Granulator | 75-80°C | 80-85°C |
| Drier Inlet Air temperature | 190°C | 183°C |
| Drier Outlet Air temperature | 85°C | 88°C |
| Solids temp exit dryer | 70-75°C | 82°C |
| Product moisture | 1.0% | 1.1% |
| Product pH | 6.1 | 6.9 |
| Product size analysis | 95% 1-4mm | 91% 1-4mm |

It should be noted that the data reported for 10-30-20 production was from the first slurry route run attempted on the plant. Conditions were not fully optimised and it is expected that, in subsequent runs, the recycle ratio will be reduced to 3.5:1 or lower.

Granular MAP has also been produced by the slurry route but with supplementary MAP powder also fed to the system to boost the output.

## CHANGING THE MODE OF OPERATION

There is a fundamental difference in the mechanism of granulation by the solids route and the slurry route respectively and it has been necessary for the granulator operators in particular to learn the different techniques required.

In the case of the solids route, the system is "granulation efficiency controlled". The procedure therefore is to establish the optimum pH and then granulate with steam to achieve the maximum possible generation of product size material in the granulator. This results after screening in the minimum amount of fines and oversize being recycled to the granulator.

On the other hand, slurry route granulation is liquid phase controlled. There is an excess of liquid phase and heat in the slurry feed to the granulator and there is thus a defined requirement for fines recycle as calculated from the heat and mass balance. Granulation efficiency as such is unimportant in this case because there will always be sufficient product size material generated. Fines recycle can be supplemented by either crushing some product size material or by adjusting the screen flaps to divert "small product size" material to the recycle chute. The available options are useful in terms of operational flexibility.

The operators at Kutina have now mastered both techniques to the extent that they find them equally easy. Switching from one mode of operation to the other is a simple procedure incurring practically no downtime.

The slurry route product is harder than that derived from the solids route (see Table 5) because the granulation mechanism is predominantly one of layering as opposed to agglomeration. Nevertheless there has been no significant difference in equipment wear or degree of build-up between the two methods.

## EFFLUENTS

Considerable attention was paid in the design to the avoidance of gaseous and liquid effluents due to the strict regulations in Yugoslavia. The design basis for gaseous emissions was as follows:

| | | Solids Route | Slurry Route |
|---|---|---|---|
| Ammonia | $mg/am^3$ | 35 | 50 |
| Particulates | $mg/am^3$ | 35 | 35 |
| Fluorine | $mg/am^3$ | 7 | 7 |

These figures, which were derived from allowable ground level limitations for the complex, have been consistently achieved.

The plant was also designed such that any liquid blowdown from the scrubbing systems could be recycled to the granulator, thus avoiding a liquid effluent stream. Due to a number of reasons unrelated to the process, this method of operation has not always been adopted until now but it is intended to operate in this manner in the future.

## FUTURE PRODUCTION

The plant design has anticipated a very wide range of possible products. In principle the following range of formulations is possible depending upon market requirements:

- Solids Route Operation. NPK's in any nutrient ratio with total nutrient contents ($N + P_2O_5 + K_2O$) ranging from 21 to 54. The tendency will be towards the higher analysis grades and indeed for PK's and some of the low Nitrogen NPK's the total nutrient content can be as high as 65.

- Slurry Route Operation. NP's such as granular MAP, DAP, 28-28-0 and 16-20-0 but including other formulations if necessary. Also NPK's mainly in the ratios 1-3-2, 1-1-1, 1-2-3, with total nutrient contents ranging from 30 to 60.

- Pipe Reactor Operation. Initially the products made by this method are likely to be 12-48-0 and 5-20-30.

The design also took into account the possibility of micronutrient addition to NPK's and production, at reduced outputs, of granular ammonium nitrate and CAN.

In the immediate future, the potential range of products obtainable from the new granulation plant may not be fully attained because of the need to integrate the production schedule with that from the old nitrophosphate plant. This latter plant, which is of the type wherein the calcium nitrate is converted into salts that remain in the product, has a number of restrictions on product formulation. At Kutina it is operated in such a way as to optimise the consumption of nitric acid whilst maximising product output.

Products from the nitrophosphate plant are limited in analysis to a few basic formulations such as 13-10-12 and 18-9-9. However if TSP, MAP or phosphoric acid are added as additional raw materials in the nitrophosphate plant, the $N:P_2O_5$ ratio can be increased to 1:2 (eg 9-18-27) or even to 1:3 although this presents some difficulty.

By making use of phosphoric acid or MAP from the new facilities as feedstocks to the old nitrophosphate plant, the integrated schedule of main formulations envisaged during the next two years is as follows:

Table 4 - Future Production Schedule

| | NEW PLANT | | OLD PLANT (Nitrophosphate) | |
|---|---|---|---|---|
| | Analysis | Ratio | Analysis | Ratio |
| MAJOR PRODUCTS | 18-18-18 | 1:1:1 | 15-15-15 | 1:1:1 |
| | 6-26-26 | 1:4.3:4.3 | 9-18-27 | 1:2:3 |
| | 10-30-20 | 1:3:2 | 18-9-9 | 2:1:1 |
| | 10-20-30 | 1:2:3 | | |
| | *5-20-30 | 1:4:6 | | |
| | *(chloride free) | | | |
| MINOR PRODUCTS | 12-52-0 | 1:4.3:0 | 11-11-16 | 1:1:1.4 |
| | 18-46-0 | 1:2.55:0 | 13-10-12 | 1:0.8:0.9 |
| | 5-22-35 | 1:4.4:7 | 13-10-12 + insecticide | 1:0.8:0.9 |
| | 6-18-36 | 1:3:6 | | |
| | 4-12-44 | 1:3:11 | | |
| | 5-14-35 | 1:3:7 | | |

## PRODUCT QUALITY AND USE

The major demand for these fertilisers in Yugoslavia is as follows:

- 6-26-26 As a base dressing for wheat and maize and for leguminous plants, vineyards and orchards.

  Other applications where a low Nitrogen Compound is most effectively added in Autumn. This is followed in Spring by straight N addition.

- 10-30-20 For dressing of various crops on Phosphorus-deficient soils.
- 5-22-35 For sugar beet. Statistics have shown that, for high sugar production, much more Potassium should be added than has previously occurred.
- 6-18-36 For sugar beet, orchards, vineyards and other plants not sensitive to chloride, particularly on potassium-deficient soils.
- 5-20-30 and 5-14-35 For tobacco, apple, plum, sour cherry, strawberries and vegetables sensitive to chloride.
- 18-18-18 For Spring application to many crops.

There are a number of differences in product quality between the fertilizers made on the two plants at Kutina. These are summarised below for three of the major products:

Table 5 - NPK Product Quality Comparison

| | NEW PLANT | | OLD PLANT |
|---|---|---|---|
| | Solids Route 18-18-18 | Slurry Route 10-30-20 | Nitrophosphate Route 15-15-15 |
| Ammoniacal N | 41% | 100% | 51% |
| Nitrate N | - | - | 49% |
| Urea N | 59% | - | - |
| WS $P_2O_5$ | 94% | 98% | 35% |
| CS $P_2O_5$ | 100% | 100% | 99% |
| pH | 5.6 | 6.9 | 4.1 |
| *Bulk Density $kg/m^3$ | 970 | 1110 | 1210 |
| Hardness kg | 2.1 | 6.5 | 4.2 |

* tamped

As is well known, products made by the nitrophosphate route contain part of the nitrogen in the form of nitrate ions and have a relatively low $P_2O_5$ water solubility. In the case of the new plants, all the nitrogen in the products is present in the ammoniacal form apart from those occasions when high analysis compounds incorporating urea are made. Water solubility is close to 100%. There is a considerable demand in Yugoslavia for low nitrogen, high PK grades for autumn application with deep ploughing where there is an advantage in having the nitrogen in the ammoniacal form. This is to allow slower release of the nitrogen without excessive leaching.

The pH measurements in the above table indicate that the products from the new plant are slightly less acidic than the nitrophosphate products. This is confirmed by similar acidity data which correlates the amount of calcium carbonate in kg required for neutralisation of acidity formed in the soil using 100 kg of fertiliser. For both types of fertiliser, occasional applications of lime to the soil will be necessary.

Overall, product quality from the new plant has been excellent being characterised by low hygroscopicity, good storage and handling properties and high solubility.

## CONCLUSIONS

The new granulation plant at Kutina is characterised by its ability to produce an unusually wide range of products thus satisfying any foreseeable market requirements in Yugoslavia and the neighbouring countries. The design also envisaged a diverse spectrum of raw material types and qualities thus enabling Ina Petrokemija the flexibility to purchase at favourable rates.

Operation during the first year has been highly satisfactory and devoid of any significant technical problems and Ina Petrokemija are now in a strong position to consolidate and expand their market position.

Acknowledgement

Thanks are due to Stephen Smith of Norsk Hydro for reviewing the contents of this paper.

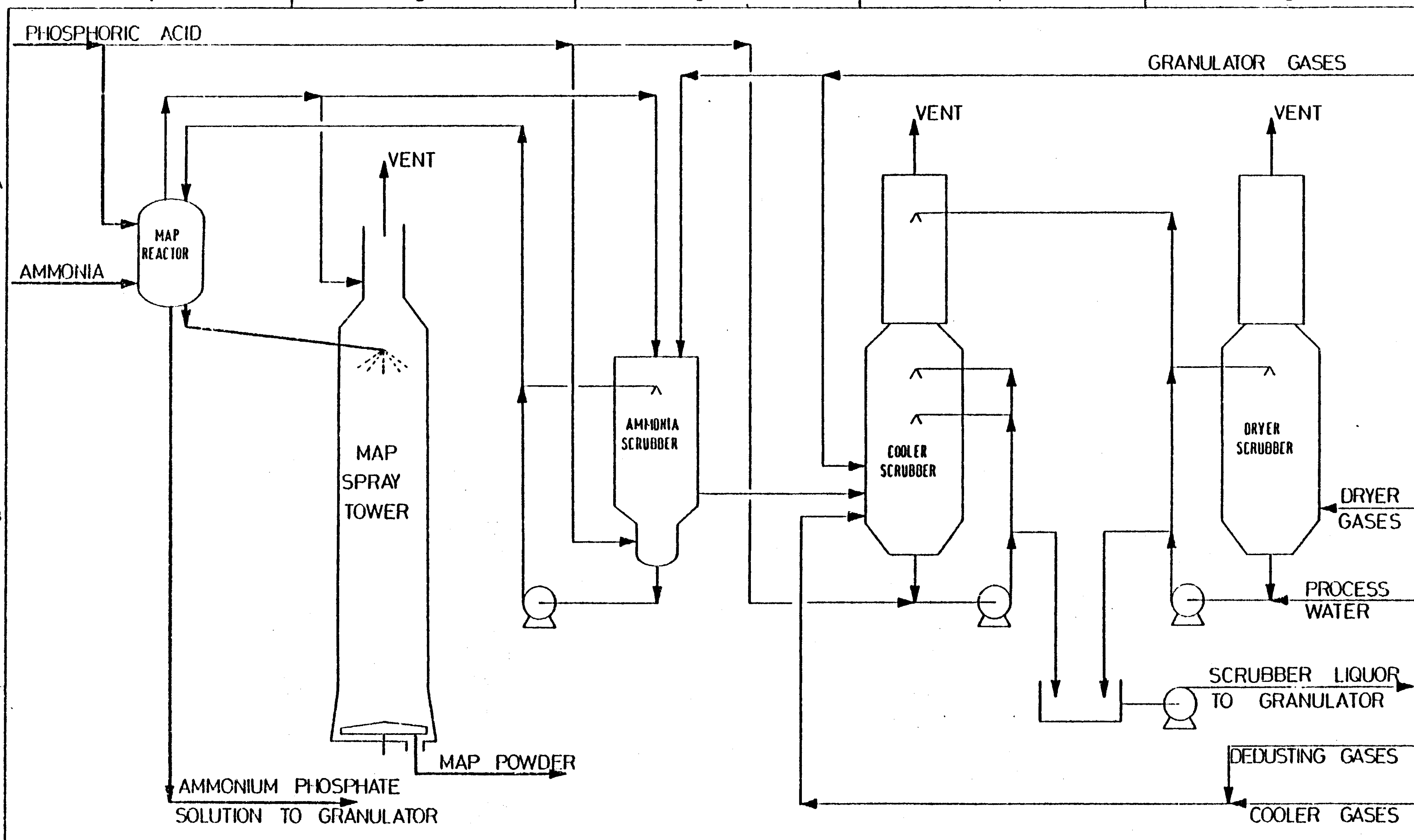


FIG.1 SIMPLIFIED FLOWSHEET-MAP PRODUCTION/GAS SCRUBBING

Davy McKee (LONDON) LTD.

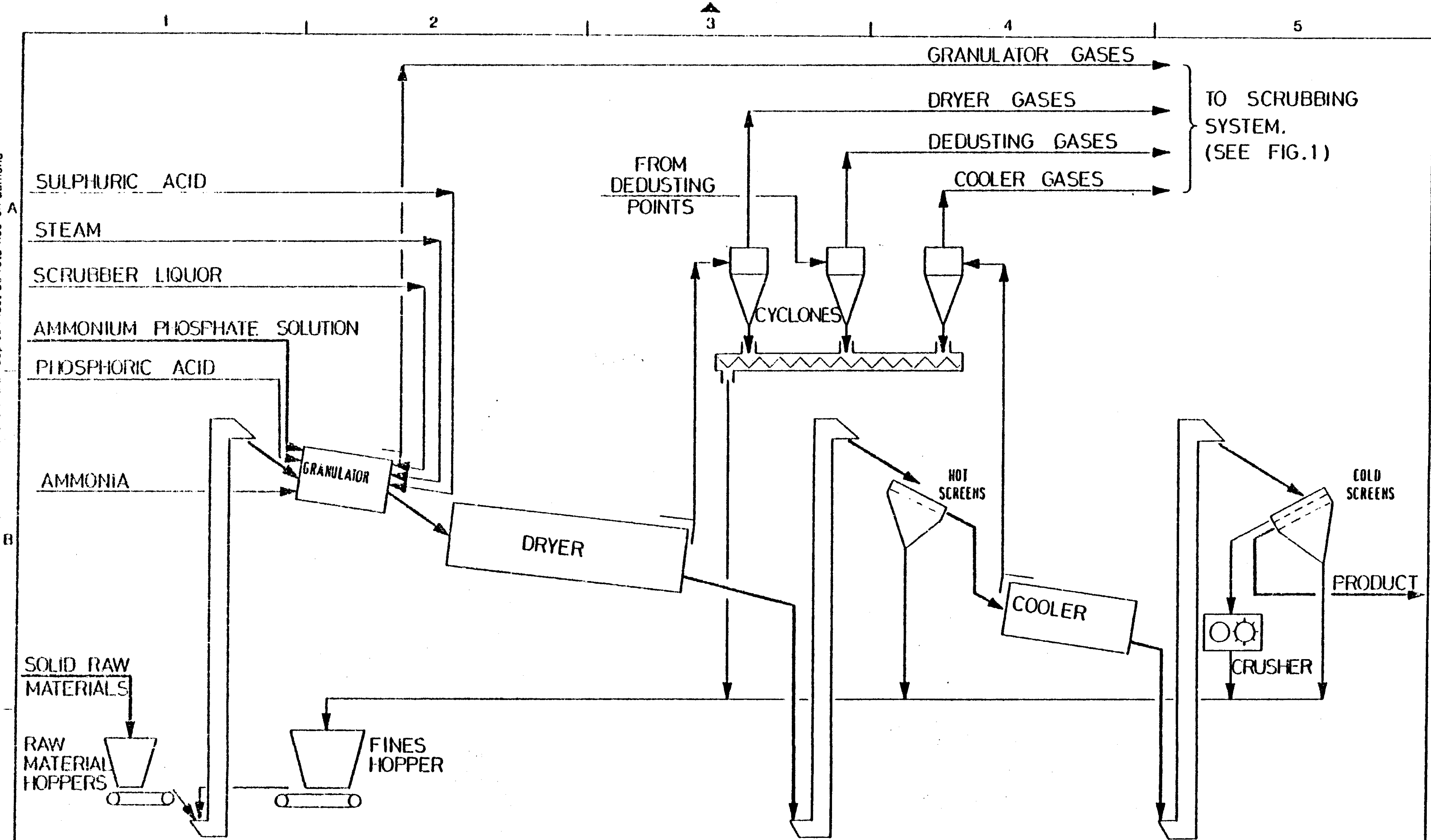


FIG. 2. SIMPLIFIED FLOWSHEET – NPK GRANULATION

Davy McKee (LONDON) LTD.
A Davy Corporation company

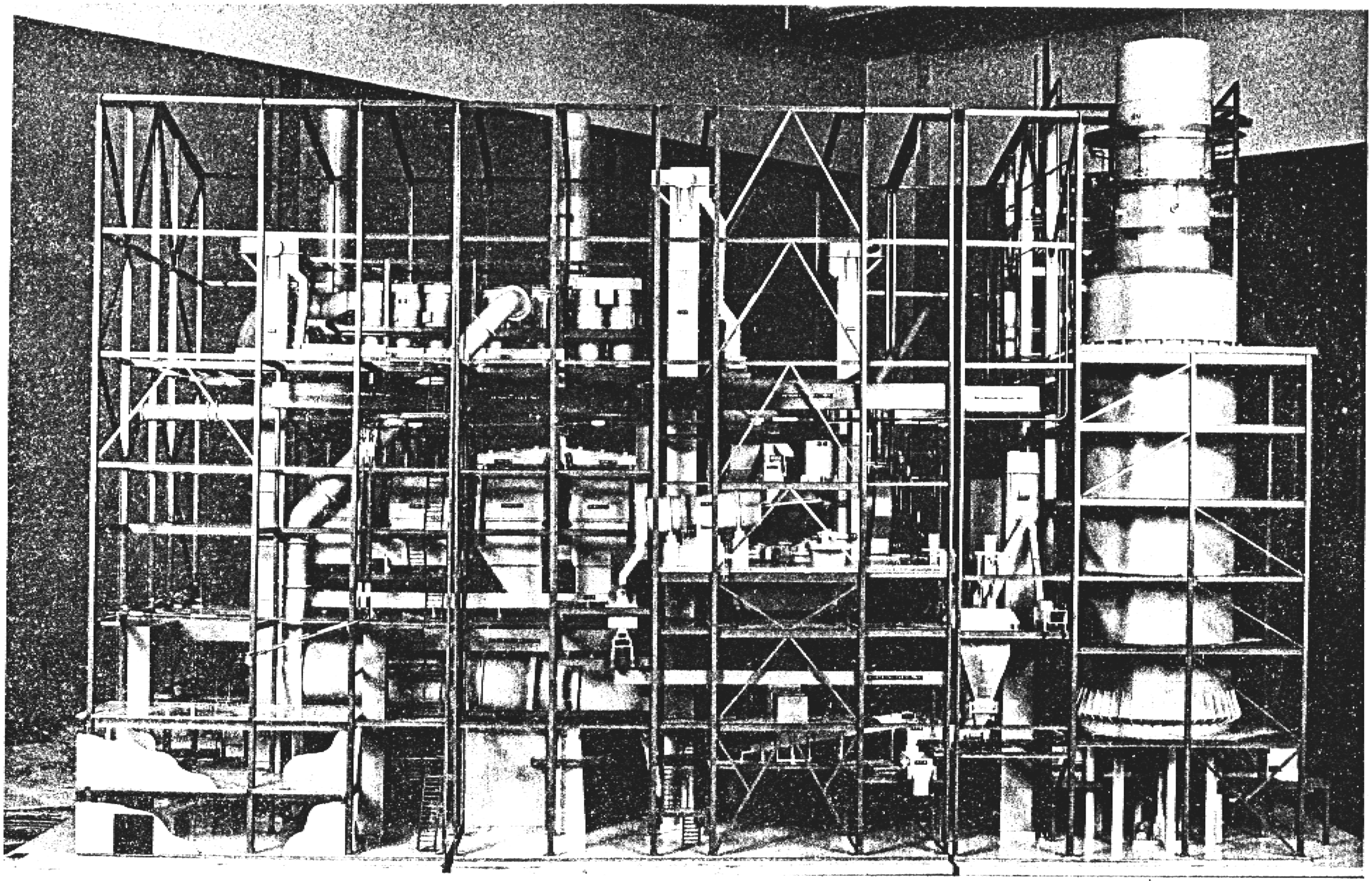

FIG 3 - PLANT MODEL (VIEW LOOKING SOUTH) SHOWING IN THE CENTRE THE HOT SCREENS AND AT THE RIGHT THE MAP SPRAY TOWER

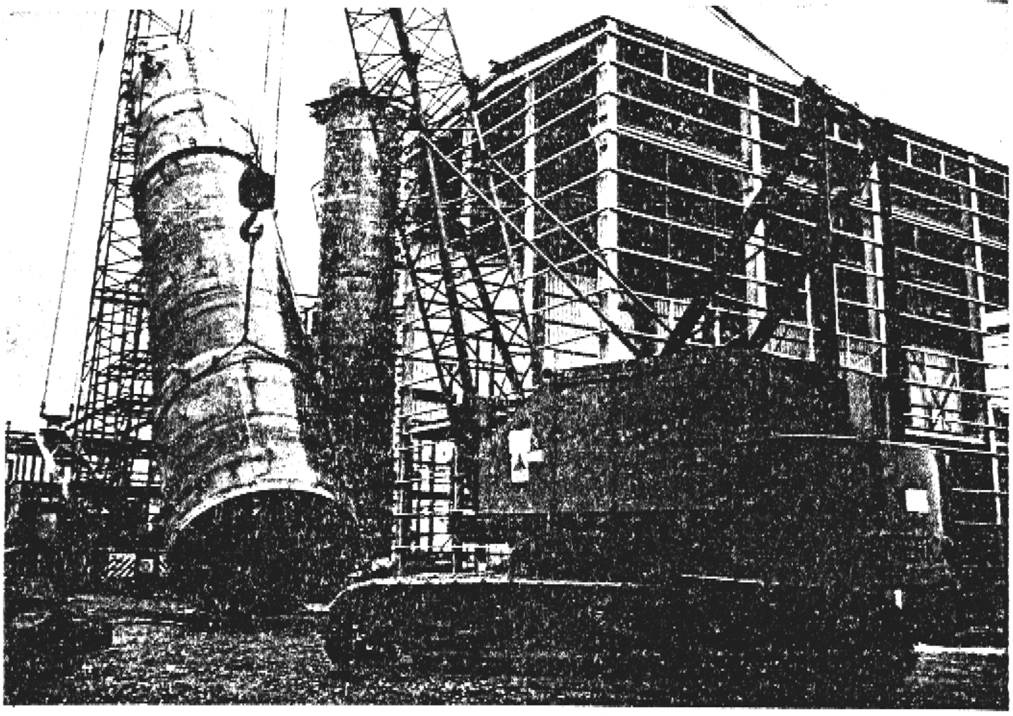

FIG 4 - ERECTION OF THE GAS SCRUBBERS

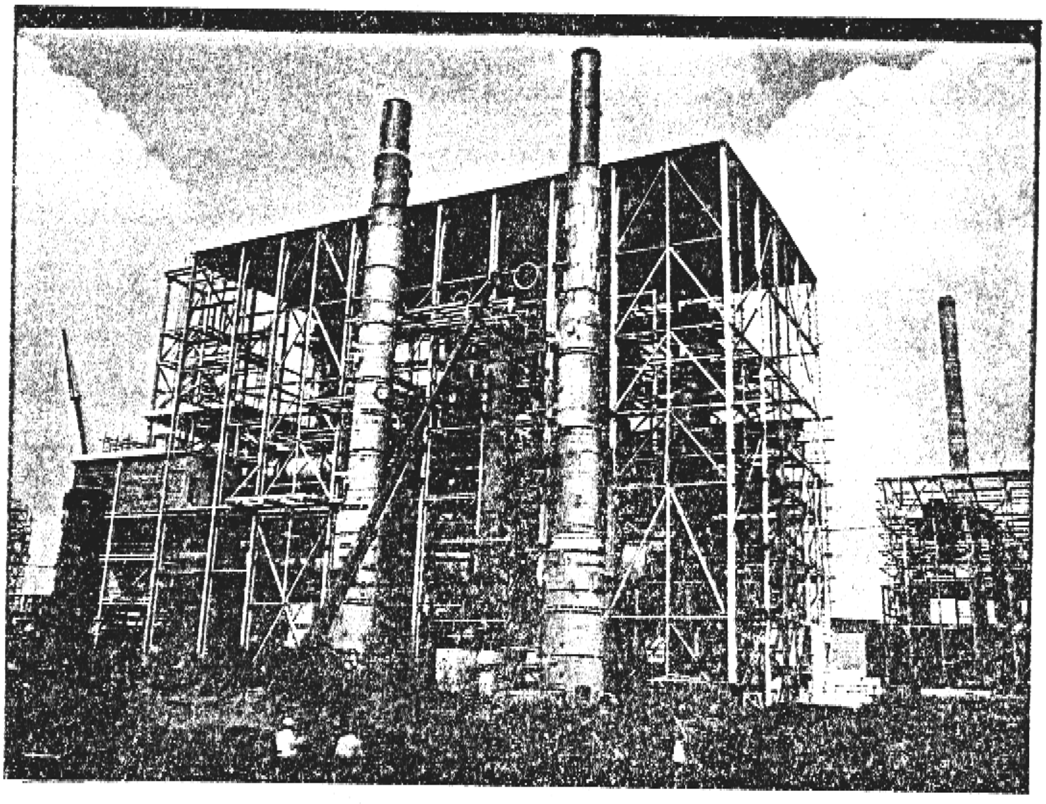

FIG 5 - VIEW OF PLANT (LOOKING NORTH) DURING FINAL CONSTRUCTION STAGE. THE SCRUBBERS CAN BE SEEN IN THE FOREGROUND OUTSIDE THE MAIN BUILDING.

TA/84/4 Granulation of NPK compound fertilizers at the new fertilizer complex of INA-Petrokemija, Yugoslavia by J.A. Hallsworth & W.F. Fortescue, Davy McKee, United Kingdom, D. Fresl, INA-Petrokemija, Yugoslavia

DISCUSSION: Rapporteur S. SWANSTROM, Kemira Oy, Finland

Q - Mr. J.H. MARKHAM, ICI PLC, United Kingdom

Do you anticipate increased use of triple superphosphate for production of low nitrogen formulations and, if so, will corrosion be a problem due to liberation of hydrochloric acid gas?

A - The major grades that are produced at the moment in Yugoslavia tend to be high PK products with low nitrogen. These have been produced consistently on the plant in the 18 months of operation and we have also produced similar grades on other plants for very long periods. Clearly there will be a presence of HCl gases in these overhead gases but we have not experienced any significant corrosion. This has been firmly established over many years.

Q - Mr. J. LE PAGE, ICS, Senegal

Why is MAP from Tunisia used?

A - When the plant was initially started up INA purchased some granular TSP from Tunisia at a low price. This was partly because the price was so benaficial and also as material to the initial dry runs on the plant.

Q - The transit of MAP solution from the reactor to the tower is it by pumping or by the pressure of the reactor?

A - It is a pressure reactor. It is of the type that I was describing in a previous paper except that the reactor has an agitator because it is in fact an old design.

Q - The plastic curtain, is it located inside the casing of the tower?

A - There is no shell to the spray tower. The curtain is a self-standing curtain which is just strapped to structural steelwork. So there is no solid shell surrounding or inside the curtain.

Q - Mr. G. CALIS, UKF, Netherlands

What is the water content of the MAP solution before spray drying?

A - In the case of spraying to the MAP tower it is about 10% and for spraying into the granulator it is 12-15%.

Q - Mr. R. SCHOEMAKER, UKF, Netherlands

Your scrubbing scheme shows acid scrubbing for the cooler gases and water scrubbing for the dryer gases in which I expect to be more ammonia than in the cooler gases. Is this correct and, if so, can you comment on it?

A - The reason that we have acid scrubbing on the cooler gases is in fact because the gases from the ammonia scrubber are passing through the cooler scrubber. When we are operating on the solids route there is no acid scrubbing of the cooler gases. It is only because of the influence of the gases from the granulator that we have a final acid wash in the cooler scrubber.

Q - Mr. V. SCHUMACHER, BASF, Germany

What is the temperature of the fines recycled from the fines hopper?

A - This depends a little on which product is being made but it is generally about 60-65°C, it can be up to 70 for certain products. It depends of course to some extent on the drying temperature. For the high urea compounds we are drying at a lower temperature which ultimately affects the recycle.

Q - Mr. M. MIYAMOTO, Nissan Chemical Industries, Japan

At a designed recycle ratio of 3.5:1 for slurry route, what specific consumption figure of urea can the process accommodate?

A - We have produced products such as 26-13-0 and 27-27-0 which contain about 40-45% urea. So this is a figure that we would consider to be a reasonable maximum.

Q - Why does hot fines recycle to granulator assist in lowering the recycle ratio? And to what extent?

A - Generally for solids route products the higher the recycle temperature the better, because this assists in the actual granulation agglomeration process. For slurry route products again high temperature is beneficial because it increases the evaporation rate. But for slurry route products there is a limit and really the higher the granulator temperature the higher the ammonia losses, so it does depend to some extent on the products. But in principle we screen in two stages as mentioned keeping the recycle temperature pretty high.

Q - In solid route case, how is the optimum pH achieved to obtain maximum product size granulation?

A - This is done by fine adjustments of the granulator conditions of the various liquid feeds and the actual figure of pH is fixed based on experience. We generally aim for around about 6-6.2 in the granulator but this has to be adjusted a little in practice, depending on the grade of the MAP and the actual conditions.

Q - Mr. P. ORPHANIDES, PFI, Greece

Size of granulator?
Size of main dryer?
Size of screens?
Forms of ammonia sparger?

A - The granulator is 3.6 m in diameter and 7.6 m long.

The dryer is 4.2 m diameter and 36 m long.

I do not remember the actual area of the screens but we had a total of 6 screens on the plant, 4 screens in the hot screening system and 2 in the cold screening.

The internal parts are similar to those found in any other plant.

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

With solid feed, what has been the experience with the homogeneity of the finished product granules?

A - With any solids agglomeration process the raw materials are stuck together in the granule and so they do not have the product form that you would get with a slurry route. In other words it is not an onion skin type of granulation. But the properties are good, the handling properties are good, storage is good, very little caking. It is a procedure that we have used very widely and it is perfectly satisfactory.

Q - With urea grades, what is the hardness of the granules (crushing strength) with solid feed relative to similar formulas with urea through slurry route?

A - We have not made much product at all by the slurry route incorporating urea on this plant. In principle the hardness with the slurry route product will be somewhat higher, by the scales that we use probably about double the hardness.