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START-UP IN THE USSR OF TWO OF THE WORLD'S THREE MOST POWERFUL NPK GRANULAR FERTILISER PLANTS

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1 INTRODUCTION

On the 29th of December 1982, in a factory at BYELORE-CHENSK, 120 km from KRASNODAR, an engineer and a foreman of Générale des Engrais (GESA), a company which has become CdF CHIMIE AZF (Azote et Fertilisants) (Nitrogen and Fertilisers) since its merger with APC, were starting up the tubular reactor installed in the granulator of the fertiliser plant.

The roar of the unit sounded powerful in the midst of the expectant and slightly anxious silence of the crowd which was present: political personalities, press people, television reporters, factory staff and fertiliser plant personnel. All were surprised that the start-up of such a unit, somewhat shrouded in mystery, should be such a simple operation. A few minutes' hesitation were followed by rejoicing and embraces. The television cameras were recording the event. The factory, awarded the title of "factory of the 60th anniversary of the USSR", received a telegram of congratulations from the Central Committee of the Communist Party of the Soviet Union.

Several days later, 1500 km further, a similar operation was to take place at the MELEUS factory, in the Bashkir Republic at the foot of the Urals (Figure 6).

For us, this day was the beginning of the end of a long adventure.

This long adventure had started at the end of 1975, when the engineering company SPEICHIM had asked us for authorisation to offer our process in response to the request of the Soviet Import Organisation TECHMASHIMPORT, responsible for purchasing 3 granular fertiliser units, each with an annual capacity of 800,000 tonnes of NPK (17.17.17).

At the time, no plant of such a size was planned anywhere in the world. The project was ambitious and reflected the major requirements of fertiliser by the agriculture of the Soviet Union. The call for the Générale des Engrais processes was explained, without any doubt, by the good results obtained a few years earlier during the start up of the two granular fertiliser units at VOSKRESSENSK, 90 km from Moscow, which, already at that time, were the largest plants in the world.

The techno-commercial negotiations continued throughout 1976, particularly with the officials of the projects Institute GUIPROCHIM, culminating in the signing of the agreement between SPEICHIM and TECHMASHIMPORT on the 20th of December 1976, for the provision of the process, the engineering and the equipment for three plants located respectively at MELEUS, near the Urals, between UFA and ORENBURG, at BYELORECHENSK, near KRASNODAR (Black sea) and at ROZDOL near the Carpathians (UKRAINE).
The Soviet client assumed responsibility for plant construction.

The meetings and the technical discussions which took place during the various phases of the preliminary project and then during the final project made it possible to specify in detail all the elements of calculations of the design and implementation of the process and the equipment. During this period, which lasted until 1978, it was decided to instal in parallel with the stirred ammoniation tank, a pipe reactor in the granulator.
So far as we were concerned we should have preferred to eliminate the ammoniation tank (preneutraliser), which seemed to us to be an old, obsolete technique, but, for security reasons, it was retained. We shall see later that it has never been started up.

The first start-up, at the MELEUS works, was planned for

September 1979.

Unfortunately, for a variety of reasons, the construction of the three plants was slowed down and then practically halted for many months.

The construction did not restart in a brisk manner at the BYELORECHENSK and MELEUS sites until 1982, to culminate in the ceremonies described earlier. From this date, the BYELORECHENSK and MELEUS plants were deemed to have been started up. In fact, the construction had not been completed and a considerable amount of work remained to be carried out, particularly in the area of electrical equipment, instrumentation and equipment regulation.

The real start-up did not take place until the end of the spring of 1983.

2 THE AGREEMENT

The agreement had been signed for the provision of hardware, engineering, technical documentation and know-how permitting the installation of three factories, each capable of producing 2670 tonnes/day of NPK granular fertilisers, of the 17.17.17 type at the sites to which we have already referred. These plants were also to be capable of producing other formulations, in particular: 13.20.20, 15.20.15 and 10.20.20.

Product quality

The 17.17.17 formula was to be capable of being produced from monoammonium phosphate or diammonium phosphate.

For the theoretical nitrogen content of 17% (permissible range ± 0.3%), the ammonium nitrogen content could vary between 10.2 and 10.5% in the case of monoammonium phosphate and between 12 and 12.5% in the case of diammonium phosphate.

The P_2O_5 was to be in a water-soluble form, in excess of 90%.

The temperature of the finished product was to be below 35°.

The particle size distribution of the product was to be as follows:

- granules from 1 to 4 mm	94 %
- granules from 4 to 6 mm	3 %
- granules below 1 mm	3 %
- granules above 6 mm	0 %

Crushing strength greater than 30 kg/cm2
Free moisture in the final product 0.3% in the case of monoammonium phosphate, and 0.6% in the case of diammonium phosphate.

<u>Guaranteed usages per 1 tonne of finished product</u>

Raw materials or services	unit of measurement	based on monoammonium phosphate	based on diammonium phosphate
Ammonia 100% NH_3	kg	127	149
Nitric 100% HNO_3	kg	310	233
Phosphoric acid P_2O_5	kg	174	174
Potassium chloride 60% K_2O	kg	286	286
Coating	kg	15	15
Oil	kg	5	5
Electricity	kWh	45	45
Steam, 8 bars	kg	290	220
Natural gas 8200/Nm3	Nm3	15	13
Compressed air	Nm3	2.5	2.5
Raw and 25° recycled			
Water	m3	5.5	5.5
Sulphuric acid	kg	15	80

Hygiene standards

Atmospheric content of harmful materials

dust	2 mg/m3	(0.0008 gr./cu.Ft)
fluorine compounds	0.5 mg/m3	(0.0002 gr./cu.Ft)
ammonia	20 mg/m3	(0.009 gr./cu.Ft)

Gaseous chimney stack discharges

dust	30 mg/m3	(0.013 gr./cu.Ft)
fluorine compounds	1.5 kg/h	(3.3 lb/h)
ammonia	10 kg/h	(22. lb/h)
NOX	1 kg/h	(2.2 lb/h)

Liquid effluents

No liquid effluent except for the calcium fluoride suspension formed in the second stage of gas scrubbing and sent to the purification plant.

The presence of this CaF2 suspension resulted from the requirement of the Soviet buyer for provision of gas scrubbing employing lime in the second scrubbing stage.

In our process, there is normally no liquid effluent, all the scrubbing liquors being recycled to the granulation stage.

Verification of guarantees

This was envisaged for one or other of the 17.17.17 formulations and was to last for 6 days during which 6 x 2670 = 16,000 tonnes of fertiliser were to be produced.

Raw materials

The principal characteristics of the raw materials were as follows:

ammonia	99.6% NH3 H2O 0.4% oil 20 mg/l
nitric acid	55% HNO3 0.1% N2O4

phosphoric acid	54%	P_2O_5
	0.3%	CaO
	4.2%	SO_3
	0.75%	Fe_2O_3
	0.6%	Al_2O_3
	0.04%	MgO
	0.5%	F

3 DESCRIPTION OF THE PLANTS

The 3 plants at BYELORECHENSK, MELEUS and ROZDOL were specified to be identical.

Each of them comprises three sub-groups:

3.1. Manufacture of the concentrated ammonium nitrate solution

The balance-diagram of this sub-group is given in Table 1.

It essentially comprises an ammonium nitrate saturator operating at atmospheric pressure and supplied with gaseous ammonia and nitric acid heated to 60° (Figure 8).

The mist leaving this unit is scrubbed in a scrubber group incorporating a venturi and a cyclone column. The scrubbing liquor from this unit is a dilute solution of ammonium nitrate, kept slightly acidic by an addition of nitric acid controlled automatically by a pH meter.

The ammonium nitrate solution leaving the saturator is conveyed to two falling-film concentrators supplied with hot air at 150°.

The 97-98% concentrated ammonium nitrate solution is stored before being used in the granulation.

The storage tank represents approximately 4 hours' operation.

The gaseous discharges leaving these concentrators are scrubbed in a venturi - cyclone column unit sprayed with the same dilute nitrate solution as the saturator scrubbers.

The nitrate solution produced in these gas scrubbers is conveyed to the saturator.

The steam produced in the saturator, after it has been scrubbed, serves partly to heat the nitric acid. The condensates formed are employed in the granulation gas scrubbing section.

The possibility of installing a demister on the nitrate saturator was envisaged. This equipment was not installed in view of the excellent results obtained with the saturator.

3.2. Granulation

The granulation loop was specified in 1975 with an ammoniation vessel (preneutraliser) and the sizing of the equipment was consistent with this basic assumption. The running rate specified at 650 t/h had been changed to 800 t/h at the client's request. During the negotiations we proposed to the client to replace the preneutraliser with a pipe reactor, but he preferred the two equipments to be installed in parallel, and the granulation loop group was left unaltered.

The balance-diagram of the sub-group is given in Table 2.

The principal units are as follows:

- 1 granulator: Ø 5 m (16'5"), length 8 m (26'3"), adhesion drive.

Motor-driven ammonia distributor with variable positioning. (Figure 7)

- 1 drier: Ø 5.5 m (18'), length 46 m (151'), toothed ring drive. 2 motors - the drier ends in a trommel and a squirrel-cage lump-remover incorporated in the gas outlet hood. (Figure 9)

- 1 chute with automatic self-cleaning between the granulator and the drier.

- 1 stirred 40+m3 working volume ammoniation tank (preneutraliser).(1412 cu.Ft)
  This tank has not been started up.
  A pipe reactor installed downstream of the granulator.

- 6 TRIO grinders, 1.40 m Ø 0.6 m

- 6 two-stage gross screens, 10.5 m2 (113 sq. Ft)

- 6 two-stage rotary screens, 5.1 m2 (55 sq. Ft)

- 2 fans on the drier, rated at 150,000 m3/h with corresponding cyclone batteries. (88 300 ACFM)

- 1 fluidised bed cooler, 45 m2 (484 sq. Ft)

- 1 coater Ø 3.5 m (11'6"), length 8 m (26'3"), equipped with an assembly for spraying amino oil under pressure.

Some of this equipment was at the time (and perhaps still is) the largest ever made, in particular the dryer and the fluidised bed cooler, and required special studies.

3.3. <u>Scrubbing of the granulation gases</u>

The particularly demanding requirements of the agreement, in respect of the plant discharges:

No liquid discharges

Particularly pure gaseous discharges

Fluorine	1.5 kg/h	(3.3 lb/h)
NH_3	10 kg/h	(22 lb/h)

resulted in the specification of a particularly efficient gas scrubbing system which does not interfere with plant operation and which makes it possible to reincorporate the scrubbing liquors completely in the granulation.

At the time, we had already developed such a system in some of our own plants, incorporating venturis and cyclone columns supplied with phosphoric acid and/or sulphuric acid, meeting very severe requirements in respect of pollution.

For reasons of security, our Soviet counterparts asked us to provide a second scrubbing stage supplied with milk of lime, as we had done in the earlier plants at VOSKRESSENSK. The CaF_2 suspension thus produced was to be treated in a purification station external to the plant.

In fact, since it has never been possible to have lime available, we have modified the circuits. The plants have operated without any liquid discharge and meeting the requirements of the agreement in respect of the gaseous discharges.

The balance-diagram of this granulation gas scrubbing sub-group is given in Table 3.

The first scrubbing stage is made up in the following manner:

- a venturi-cyclone column unit treats the gases leaving the granulator. It is sprayed with an acid solution of ammonium sulphate.

- two venturi-cyclone column units mounted in parallel treat the drier gases. They are sprayed with the same solution as that serving the granulator.

The 2nd scrubbing stage consists of two venturicyclone column units between which the gases leaving the 1st stage are distributed. The scrubbing solution is acidified water.

4 START-UP OF THE INSTALLATIONS

Both at the MELEUS and BYELORECHENSK sites, the real start-up of the plants did not take place until the end of the spring of 1983. At MELEUS, a preliminary attempt at starting up was halted for several weeks after the discovery of a fault in the mounting of the toothed wheel on the dryer.

We decided not to employ the preneutraliser but only the pipe reactor for producing of the ammonium phosphate slurry . The BYELORECHENSK factory was chosen for the production of 17.17.17 based on diammonium phosphate and that at MELEUS for the 17.17.17 based on mono-ammonium phosphate.

A long period of very laborious operation of the plants began and was characterised by some slowness in the mechanical or electrical commissioning of the equipment and particularly by very frequent interruptions in the supply of raw materials and services, making continuous operation of these plants impossible.

Thus, in the month of September 83, it was still impossible to achieve continuous operation of these plants for more than 72 hours. The search for the optimum value of various manufacturing parameters was therefore far from easy. We were beginning to despair of succeeding in achieving an industrial proving operation, nevertheless essential before the guarantee test.

When, at the end of September 83 at BYELORECHENSK and at the end of October 83 at MELEUS, it appeared that it was possible to supply the plants continuously with raw materials and services, and that means had been provided to enable the stock of final products to be despatched, we decided to attempt the 6-days guarantee trials at each of the sites without further delay.

5 GUARANTEE TRIALS

The guarantee trials were run at BYELORECHENSK from 22nd to 28th September 83 and at MELEUS from 18th to 24th October 83.

The average daily outputs obtained during these 6 days were 3,014 t/day at BYELORECHENSK and 3,033 t/day at MELEUS, against 2,670 tonnes guaranteed.

All the guaranteed values were met in practice, even those which appeared the most demanding, such as discharges into the atmosphere. The majority of the measured values were substantially better than those guaranteed. In particular, it may be noted that during the entire part of the trials at MELEUS the combustion chamber was stopped.

The only minor point of disagreement which arose concerned the particle size distribution of the commercial product. This was connected to the non-availability of standard screens in the laboratories.

All of the results of guarantee trials in the 2 factories at BYELORECHENSK and MELEUS are collated in Tables 4 and 5.

6 CONCLUSION

This long adventure finally ended well for two of the three gigantic plants. Completion of construction of the third plant, at ROZDOL, is expected at the end of 1985. Its start-up should be greatly facilitated by the experience acquired in starting up the first two.

The day of its start-up ought to be a public holiday at ROZDOL as was the case at BYELORECHENSK and MELEUS and it should be possible to say, as was written on a poster celebrating the start-up of the BYELORECHENSK factory,"it is a day of celebration (a red date) in the history of the chemical factory. The control desk of the NPK plant came to life. The command "run" was given, and the pink granules shot forward into the hoppers ...

Accept, Motherland, the vitamins of fertility!"
(Figure 10)

We are negotiating to add a pipe reactor to the dryer of these units, which would raise their capacity to over 160 t/h and would considerably ease the operation.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
BILANS	REPERE LIGNE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
	MATIERE	NH_3	NH_3	HNO_3	HNO_3	L.A.N	GAS	L.A.N	GAS	L.A.N	GAS	Liquid	Liquid	Liquid	GAS	GAS	Liquid	Liquid	Liquid	Liquid	Liquid	GAS	water	
	FLOW. Tonne	8.2		30.3	0.3	19.4	18.1	19.4	1.4	38.8	4.6	38.8	10.15	20.3	13.6	3.2	82.5	20.3	40.6	123.7	1.9	18.2	1.9	
	H2O Tonne			20.9	0.2	2.2		0.8		1.6														
	CIRCUITS	1	1	1	1	2	1	2	2	1	1	1	2	1	1	1	1	2	1	1	1	1	1	
APPAREILS	REPERE APPAREIL				K110			E112		R120			D141					D140		R145				
					Reactor			Concent.		Tank			Column					Column		Tank				
	DIMENSIONS ft				Ø 18.04			Ø 7.9		Ø 19.7			Ø 4.9					Ø 7.2		Ø 10.8				
	ft				L 49.2			L 31.2		L 14.8			L 19.7					L 28.9		L 14.8				
	NOMBRE				1			2		1			1					1		1				

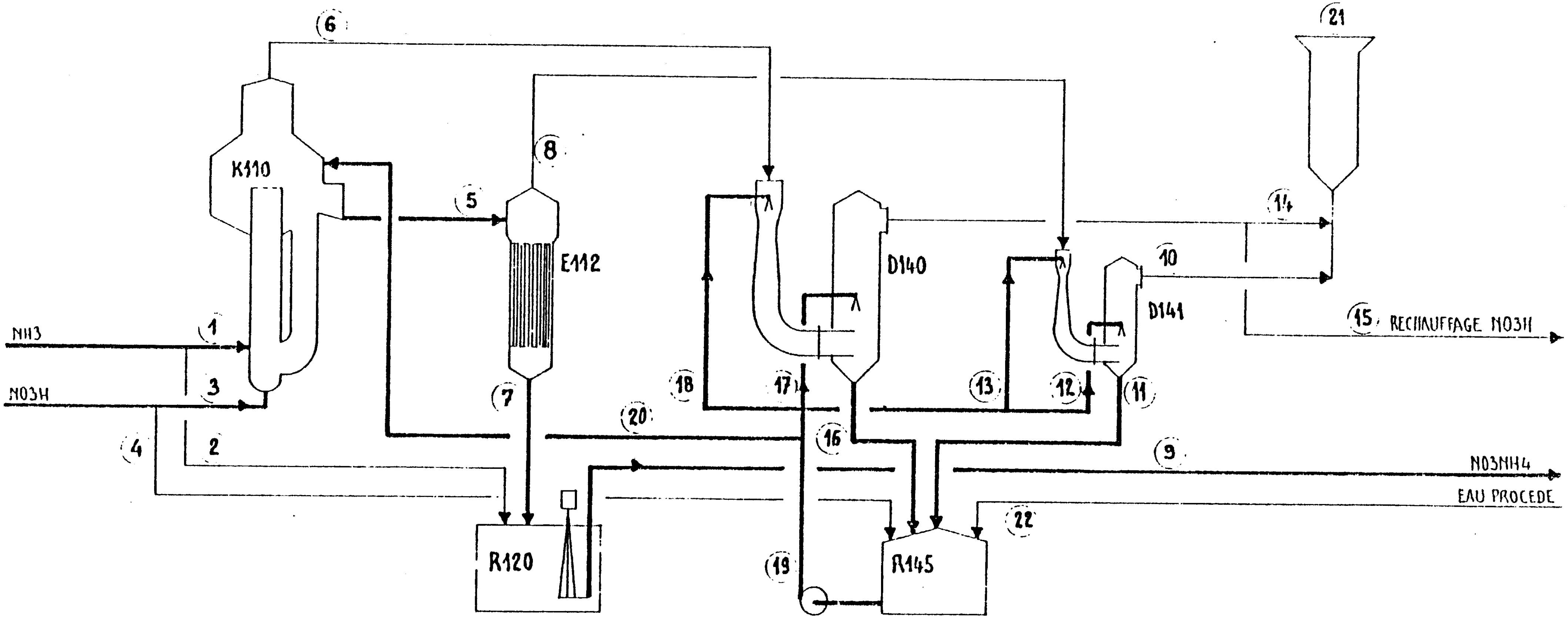


TABLE 1

BILANS	REPERE LIGNE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
	MATIERE	P_2O_5	P_2O_5	P_2O_5	NH_3	NH_3	NH_3	NH_3		Liquid	Liq A.N	N.P.K	NPK	NPK	NPK	NPK	NPK	NPK	NPK	K_2O	NPK	GAS		
	FLOW Tonne	21.9		21.9	12.0	-	9.1	2.9		3.9	38.5	644.3	321.15	37.5	59.1	37.5	129.2	10.7	515.1	23.0	553.9			
	H20 Tonne	7.1		7.1						9.1	1.6	8.3	2.0	0.2	0.35	0.2	0.8	0 07	3.1	0.1	3.2			
	CIRCUITS	1	1	1	1	1	1	1		1	1	1	2	6	6	6	1	6	1	1	1	1		
APPAREILS	REPERE APPAREIL		K160	K170			E 151				M220	M230	12	B330	S310		S320	E410	M450					
			REACTOR	PIPE.CROSS			Evapor.				GRANULATOR	DRYER	ELEVATOR	CRUSHER	SCREEN		SCREEN	COOLER	COATING MIXER					
	DIMENSIONS		V: cu ft				S: sq ft				ø 16.4	ø 18.04			S: sq ft		S: sq ft	S: sq ft	ø 11.5					
	ft:		1412.6				218.5				L 26.2	L 157.5	500 Tonne	25 Tonne	113		54.9	484.4	L 26.2					
	NOMBRE		1				1						2	6	6		6							

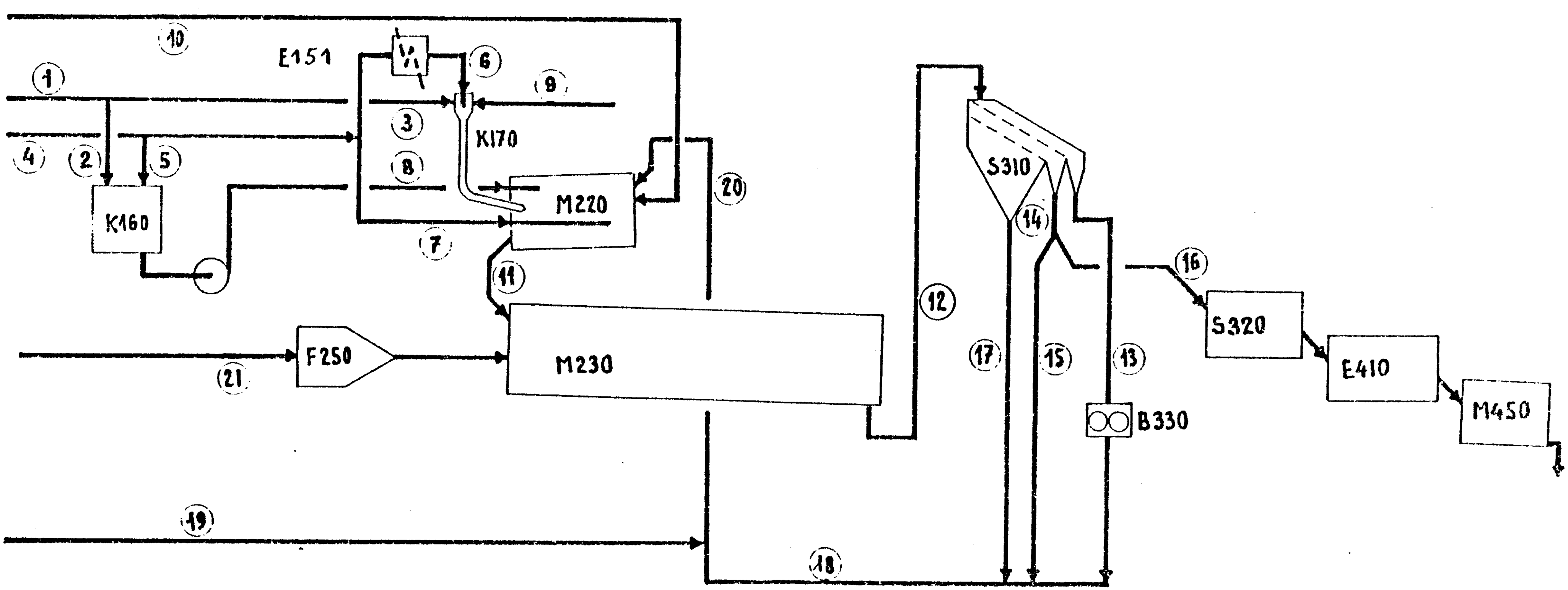


TABLE 2

	REPERE LIGNE	1	2	3	4	5	6	7	8	9	10	11
BILANS	MATIERE	Gas		Liquid	Liquid		Liquid	H_2SO_4	Liquid	Liquid	Gas	Liquid
	FLOW Tonne	35.		13.0	40		40	3.9	3.2	124	139	162
	DEBIT cu.ft.$\times 10^3$	1391.4									5350	
	CIRCUITS	1		1	1		2	1	1	1	2	2
APPAREILS	REPERE APPAREIL									D510		
			VENTURI		VENTURI					COLUMN		VENTURI
	DIMENSIONS ft									ø 8.04		
	ft		L: 8.2		L 9.8					L 39.04		L 31.1
	NOMBRE		1		1					1		2

	REPERE LIGNE	12	13	14	15	16	17	18	19	20	21	22	23
BILANS	MATIERE	Liquid	Liquid	Gas	Gas	Liquid	Liquid	Liquid	Liquid	Gas	Liquid	water	Gas
	FLOW Tonne	150	451	15.5	150	11.9	162	150	431.2	188.3		35.7	
	DEBIT cu.ft.$\times 10^3$			794.6	5562					7112.4			
	CIRCUITS	4	2	2	2	2	2	4	2	2	2	1	2
APPAREILS	REPERE APPAREIL	R542	D540					R552	D550				
		TANK	COLUMN				VENTURI	TANK	COLUMN				STACK
	DIMENSIONS ft	ø 12.5	ø 12.8	ø 3.28				ø 12.5	ø 13.9				
	ft	L 15.7	L 63.0				L 19.7	L 15.7	L 70.2				L 492
	NOMBRE	1	2	2			2	1	2				2

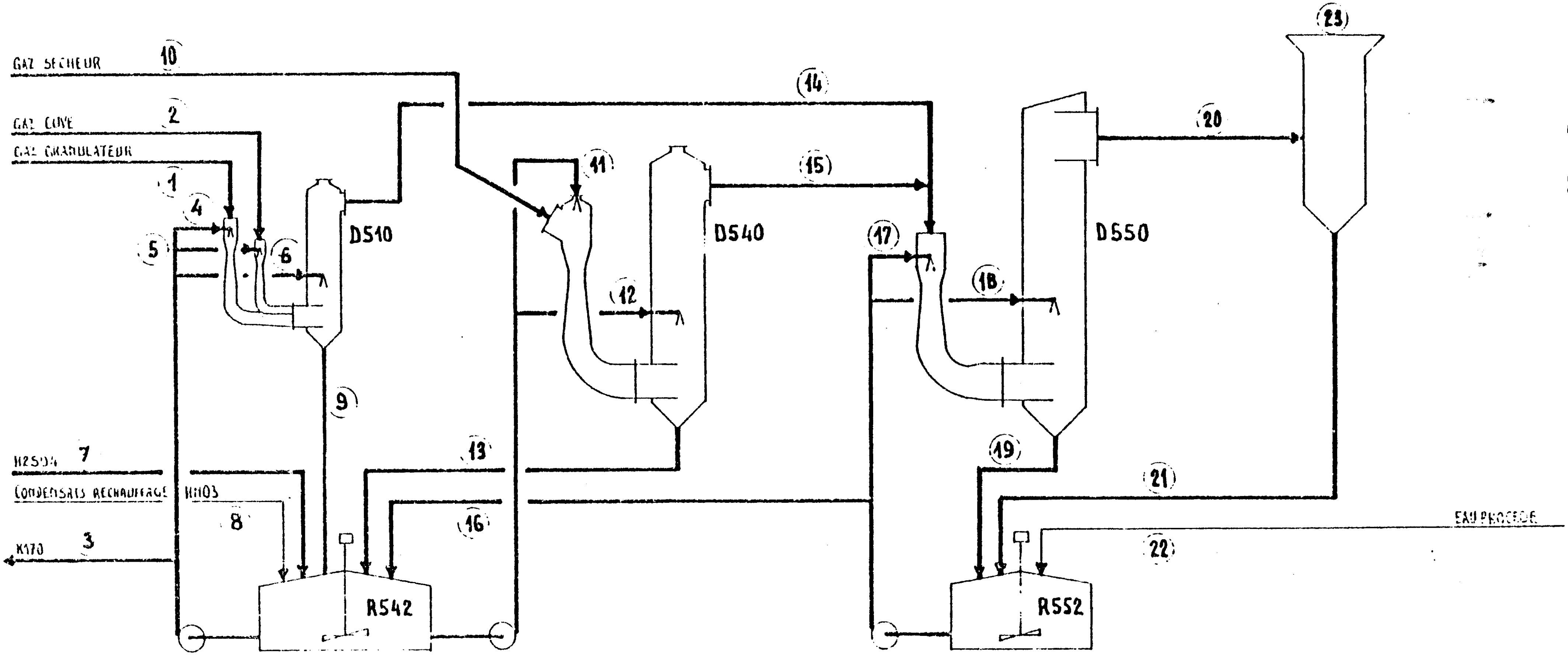


TABLE 3

Table 4 RESULTS OF GUARANTEE TEST-RUNS AT BIELORETCHENSK

	Units	Guarantee values	Average results during the guarantee runs
Duration	hours	144	141 (3 h current breaks)
Daily production	tonnes/d	2 670	3 014
Product quality			
Total N+P2O5+K2O content	%	51	53.26
total	%	17 ± 0.3	17.97 (absence of filler and coating)
NH4-N	%	12 - 12.5	12.79 (" " ")
NO3-N	%	5 - 4.5	5.18 (" " ")
P2O5	%	17 ± 0.3	17.62 (" " ")
water soluble P2O5	%	90	92.70
K2O		17 ± 0.3	17.67 (absence of filler and coating)
temp. finished product	°C	< 35	
crushing strength	kg/cm2	> 30	60
moistiure	%	< 0.6	0.37
Consumption			
Ammonia (100 % NH3)	tonne/t	0.149	0.146
Nitric acid (100 % NHO3)	"	0.233	0.225
P2O5	"	0.174	0.170
potassium chloride (60 % K2O)	"	0.286	0.283
coating agent	"	0.015	0
oil	"	0.005	0
sulphuric acid	"	0.08	0.03
electricity	kwh/t	45	25.2
8 bar steam	tonne/t	0.220	0.107
natural gas (PCI recycled = 8 200)	Nm3/t	13	not measured -
fresh and adjusted water	Nm3/t	5.5	0.222
Noxious substance content of the atmosphere			
Dust	mg/m3	2	2.22
fluorine	"	0.5	0.13
ammonia	"	20	3.64
Discharge in the atmosphere			
Dust	mg/m3	30	12,30
fluorine compounds	kg/h	1.5	0.38
ammonia	kg/h	10	ammonia leakage 15.91

Table 5

RESULTS OF GUARANTEE TEST-RUNS AT MELEUS

	Units	Guarantee values	Average results during the guarantee runs
Duration	hours	144	144
Daily production	tonnes/d	2 670	3 033
Product quality			
Total N+P2O5+K2O content	%	51	51.9
total	%	17 ± 0.3	16.9
NH4-N	%	10.2-10.5	10.3
NO3-N	%	6.5-6.8	6.6
P2O5	%	17 ± 0.3	17.15
water soluble P2O5	%	90	93.4
temp.finished product	°C	< 35	32
crushing strength	kg/cm2	> 30	103
moistiure	%	< 0.03	0.2
Consumption			
Ammonia (100 % NH3)	tonne/t	0.127	0.126
Nitric acid (100 % NHO3)	"	0.310	0.299
P2O5	"	0.174	0.170
potassium chloride (60 % K2O)	"	0.286	0.284
coating agent	"	0.015	
oil	"	0.005	0.004
sulphuric acid	"	0.015	0.0008
electricity	kwh/t	45	28.6
8 bar steam	tonne/t	0.290	0.153
natural gas (PCI recycled = 8 200)	Nm3/t	15	0.4
fresh and adjusted water	Nm3/t	5.5	0.3
Noxious substance content of the atmosphere			
Dust	mg/m3	2	3.85 (flaps not cleaned)
fluorine	"	0.5	0
ammonia	"	20	22.7 (leakages in loses and flanges)
Discharge in the atmosphere			
Dust	mg/m3	30	16.6
fluorine compounds	kg/h	1.5	0.17
ammonia	kg/h	10	5.5

FIGURE 6 - THE NPK PLANT AT MELEUS

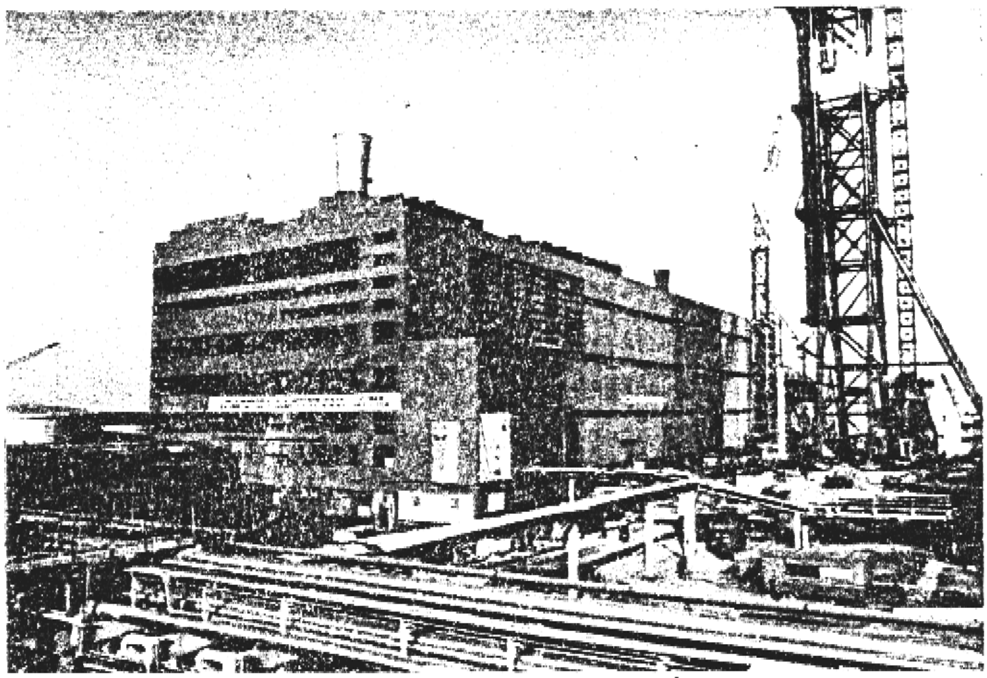
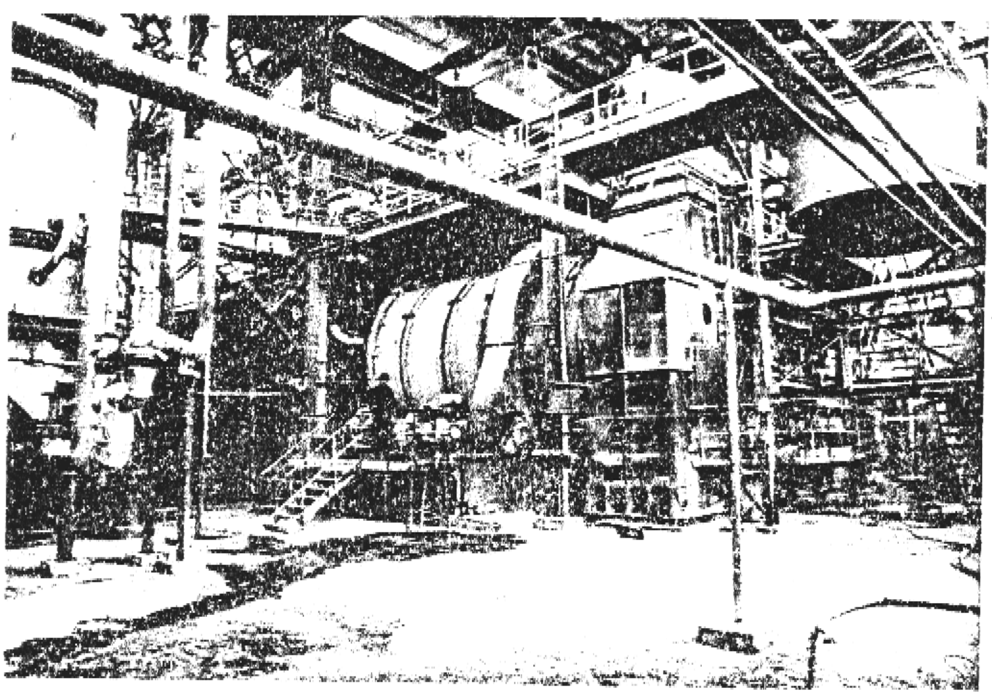


FIGURE 7 - GRANULATOR



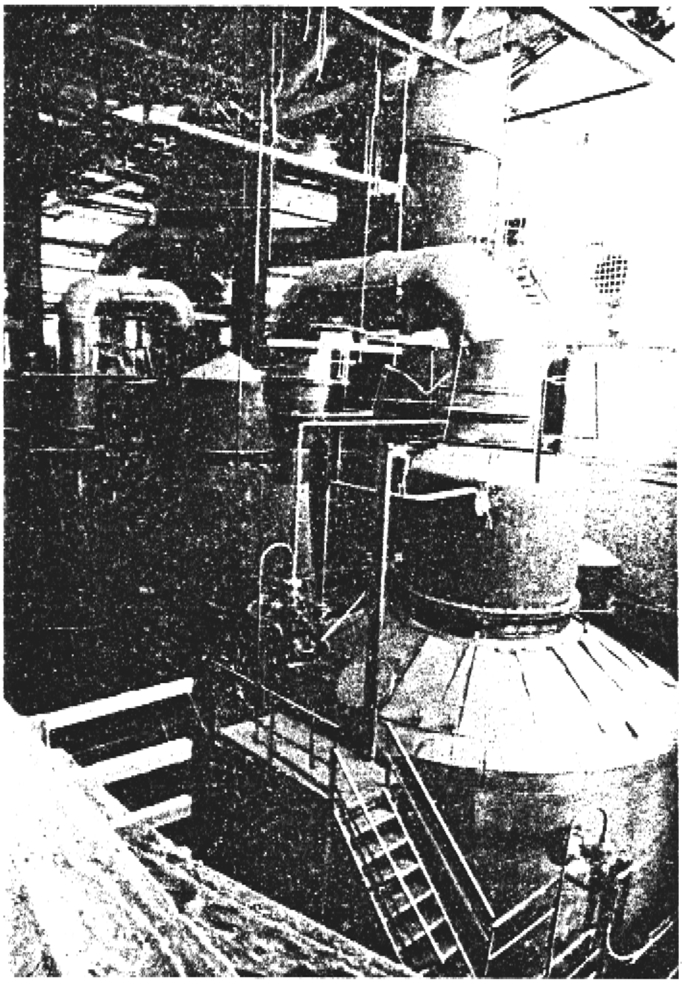
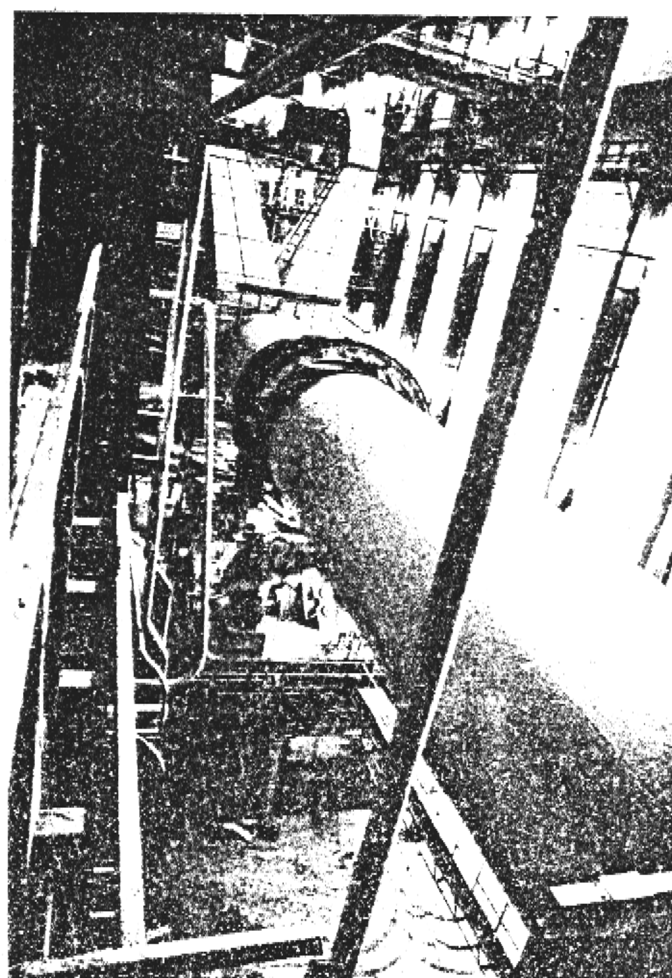


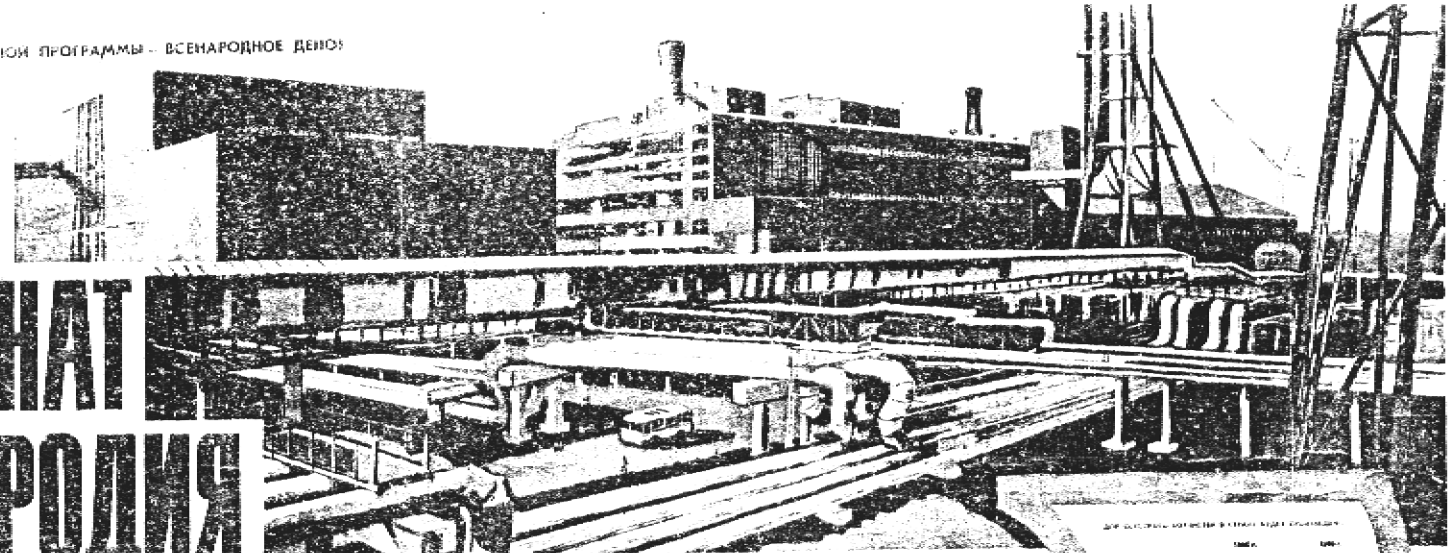
FIGURE 8 - AMMONIUM NITRATE SATURATOR

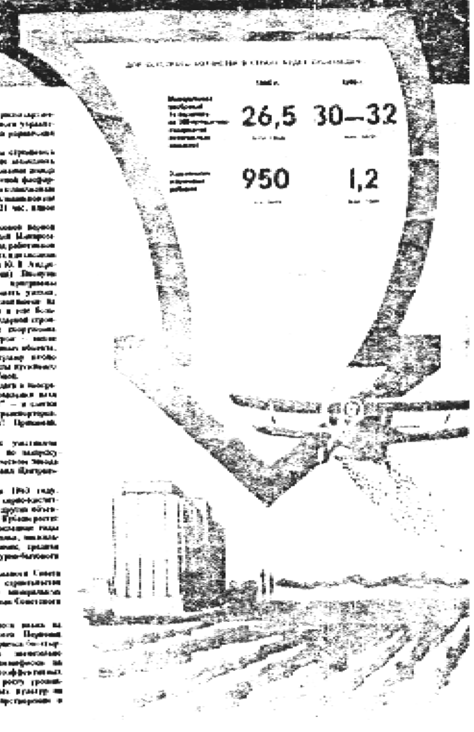
FIGURE 9 - DRYER



ВЫПОЛНЕНИЕ ПРОДОВОЛЬСТВЕННОЙ ПРОГРАММЫ – ВСЕНАРОДНОЕ ДЕЛО!

РАСТЕТ КОМБИНАТ ПЛОДОРОДИЯ





С БОЛЬШОЙ ТРУДОВОЙ ПОБЕДОЙ!

FIGURE 10 - POSTER ABOUT THE BIELORETCHENSK PLANT

TA/84/2 Start-up in the USSR of two of the world's three most powerful NPK granular fertilizer plants by P. Chinal, CdF Chimie AZF, France

DISCUSSION: Rapporteur J. CARIOU, COFAZ SA, France

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

From the tables 2 and 3 it is not easy to evaluate the quantity of the NH3 that enters in the scrubber. I should like to know the quantity of the NH3 that escapes from the granulator.

A - When the plant is running in DAP the total amount of NH3 through the scrubbing system is 12% of the NH3 in the product.

Q - Mr. L.K. RASMUSSEN, Superfos, Denmark

Which material is used to heat 62% HNO3 to 60°C?

A - Normally with 56-58% acid, 25/20 low carbon stainless steel. No experience with 62% acid, but it should not raise any difficulty.

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

Please give more details on how liquid effluent is avoided?

A - The acid and the scrubber liquor discharged from the gas scrubber are introduced in the pipe reactor and the water is found as steam in the drier and in the granulator.

Q - Mr. G. BRUSASCO, Fertimont SpA, Italy

Considering a production capacity of the ammonium nitrate plant reported in the material balance of table 1, a pressure reactor with steam recovery can reduce to zero the steam consumption and export 6-7 t/hr of pure steam at 6 bar. Why you have not considered to introduce this energy saving in such a huge plant?

A - Yes, but a lot of steam was available on the plant.

Q - Mr. V. SCHUMACHER, BASF, Germany

Would you please give some more technical details about the "motor driven ammonia distributors" and the "automatic self-cleaning chute"?

A - At the beginning a mobile chute was built in to avoid scaling on the ammonia pipes in the granulator. Recently AZF developed a chute which avoids internal bearings. It is driven by a shaft and bears the pipe reactor.

Q - Mr. N. KOLMEIJER, Windmill Holland, Netherlands

Is it more economic to achieve a very large production capacity, as in USSR, in one line, or in two lines with half the capacity in parallel?

A - It would take too long to discuss all the economic parameters, but we favour more and more very big units (for instance in USSR in the last 15 years).

Q - Mr. S. BOUCHERAT, SCPA, France

Does the very great length of the drier (40 m) not result in the breaking of granules and the increase of the recycle ratio?

A - No, numerous measurements were made in the AZF driers in the USSR and on NPK plants, both conventional (slurry process) and with pipe reactors.