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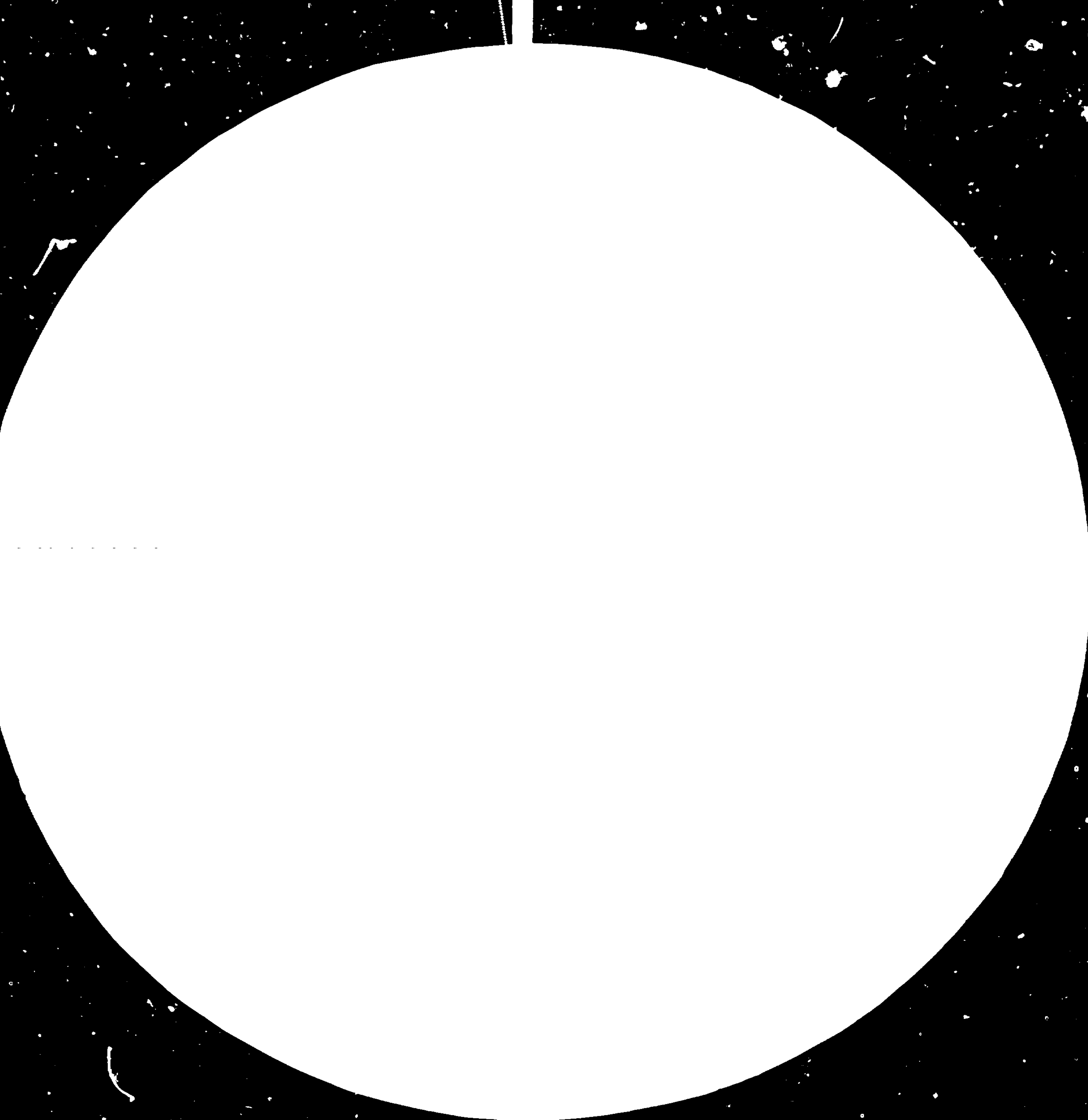

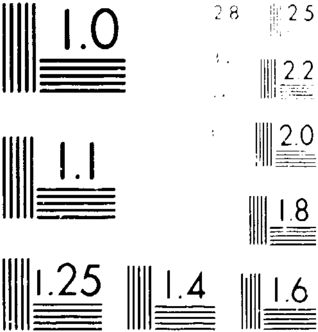
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NITROGEN FERTILIZER INDUSTRY IN EGYPT WITH SOME DETAILS ON HELWAN FERTILIZER PLANT*

by

Mohamed I.M. El Nashar**

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Introduction:

In general importance of fertilizer industry in Egypt as well as in any " underdeveloped country lacking the legacy which an unusual resources (e.g. oil discoveries) is more likely to be in a position where it must build what it wants-industry- largely on the strength of what it already has- agriculture- and this was assured also from the study of economic history of industrial countries(1).

In almost every case, agriculture has been the big paying activity from which industrialization can be financed, as well as the one large consuming section of the economy which would provide a market for the new industrial goals;

Much more can be added to the national income by the same amount of capital if it is invested in development of e.g. agriculture equipment, fertilizers ..... etc.

In addition, Egypt suffers the rapid increase of population with about 2.2% yearly and the number is expected to be 58(2) million in year 2000,while the cultivated area is increasing with a slow rate. So far achieving the nutrition security the cultivated land is planted the cultivated land

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(1) " Bryce ", M.D., Industrial Development, 1960.

(2) National Bank 1979, Indicators for National Development.

is planted more than one time(cultivation density in Egypt is about 1.9), in the same time there is shortage in the mud **precipitation** due to the erection of the high dam, so the soil becomes deficient in one or more nutrients specially nitrogen and this should be compensated using the fertilizers.

Government plants covering not only vertical extension but also horizontal one (about 3 million Fedan should be added to the planted area in desert)(1) needs large amounts of chemical fertilizers.

Self sufficiency in fertilizers is very important since some statistics cleared that deficiency of production in agriculture sector during the war periods were due to difficulty of importing fertilizers(2). We must not forget also the importance of saving the scarce foreign currency used in importing fertilizers.

We must draw the sight to the **close relationship between** the objective of this research and the concept of "Industrial Planning ", " Industrial Planning is defined as the group of

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(1) Ministry of Industry, paper for the committee for national fertilizer plan, July, 1980.

(2) National council production book,1955 p.206, research for an evaluation of the fertilizer industry in the O.A.R. with reference to the " Kima " Factory, 1963".

poljcies and procedures necessary to fulfil two objectives:

1. Realising the industrial development.
2. Realising the industrial productivity, this could be fulfilled through:
   a. Minimization of cost of production.
   b. Maximization of labour product.
   c. Needs satisfaction."(1)

The above exposure assured the need for utilizing any unemployed capacities in " Helwan, Fertilizer Plant" trying to achieve maximum possible productivity that should not be less than 80% of the design capacity which equals about 96000 tons 33.5% N of calcium ammoniam nitrate.

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(1) Dr. Raafat Besada, Translated from Arabic " Concept of Industrial Planning " Memo. No. 263, July 1972, Page 12.

PART I

CONFRONTATION OF REQUIREMENTS WITH PRODUCTION OF NITROGENEOUS FERTILIZERS

1. World production, trade, consumption(1).

Table No.(1): Nitrogenous Fertilizers: Production, Trade Consumption by Economic Classes.

1000 M.T.N.

	1974/75	75/76	76/77	77/78
		Production		
All Developed Countries	34606	35235	36414	38202
All Developing Countries	7908	8612	9811	11408
World Total	42514	43847	96225	49611
		Imports		
All Developed Countries	2822	3272	4021	4299
All Developing Countries	5130	4847	4756	5730
World Total	7952	8119	8777	10029
		Exports		
All Developed Countries	7465	6581	7831	8946
All Developing Countries	686	502	675	1133
World Total	8151	7083	8506	10079
		Consumption		
All Developed Countries	27501	30738	31315	31430
All Developing Countries	11095	12402	13800	16338
World Total	38596	43140	45115	47766

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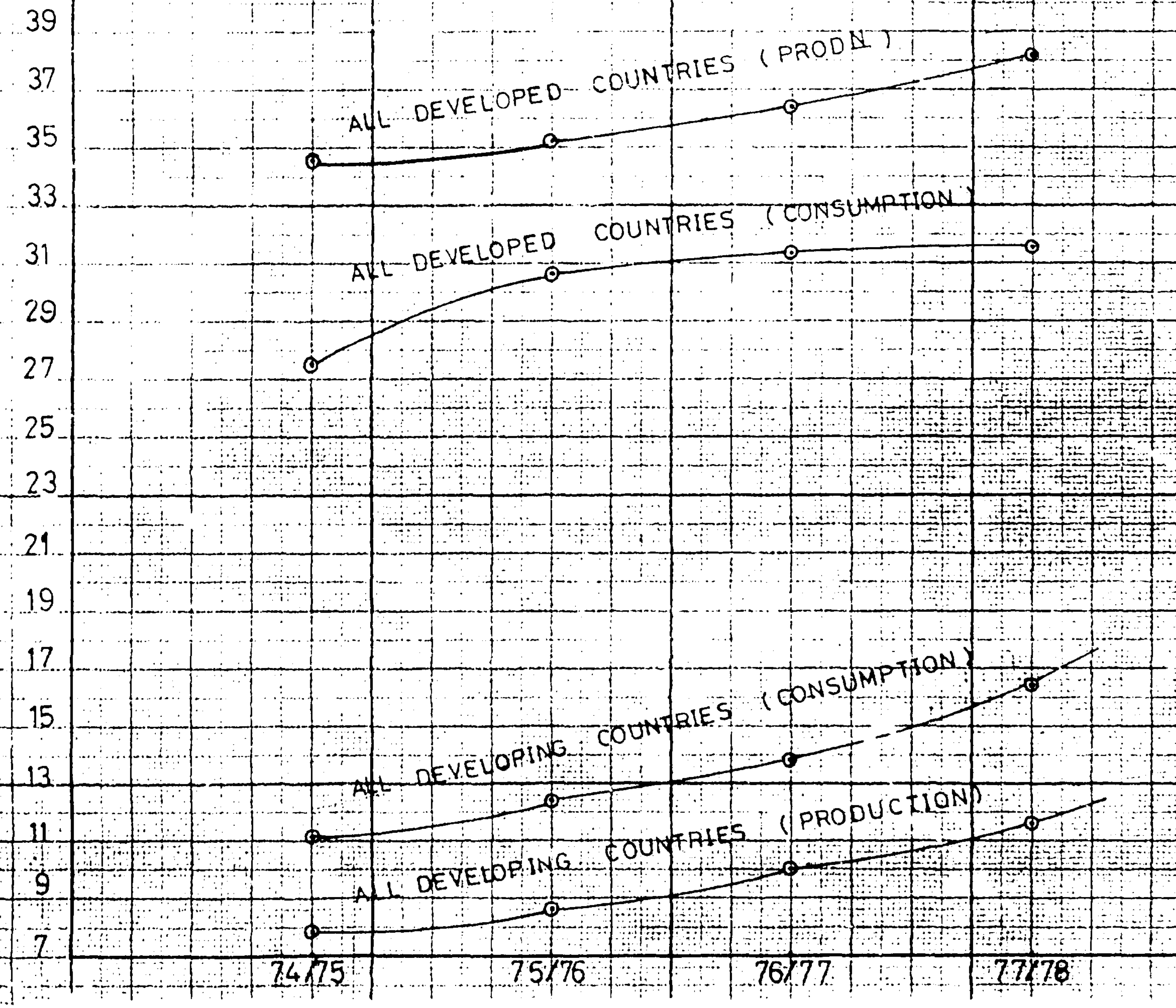
(1) FAO Fertilizer Yearbook, 1978.



PRODUCTION CONSUMPTION OF N FERTILIZERS

"AN INDICATION FOR DEVELOPMENT" **FIG (1)**

2. Egypt and Africa, production, imports and consumption.

Table No.(2): Production, Imports & Consumption for Africa and Egypt of Nitrogenous Fertilizers: MT"N".

	1974/1975	75/76	76/77	77/78
		Production		
Africa	551735	594649	649344	759350
Egypt	100200	150540	169913	195171
		Imports		
Africa	660147	701432	723193	612355
Egypt	263500	227400	227343	258184
		Consumption		
Africa	1072793	1252001	1310707	1323077
Egypt	360000	415000	427724	459504

Comments on tables:

In table No. 1 we notice the continuous growth of consumption of Nitrogenous fertilizers in the world specially in developing countries which still have small values of consumption, about 50% of that for developed countries.

In table No.2 we notice the following from comparing the anual data of year 77/78:

a. Production of N. fertilizers in Africa represents 1.53% of the world production.

b. Imports of Africa represents 6.1% of world imports.

c. Consumption of Africa represents 2.77% of the world consumption.

d. Egypt production represents 25.7% of Africa production.

e. Egypt Imports represent 42.2% of Africa imports.

f. Egypt consumption represent 34.7% of Africa consumption.

g. It is noticed also that:

(1) Egypt is the biggest producer of "N" fertilizers in Africa after " South Africa e country.

(2) Egypt is the biggest import country for "N" fertilizers in Africa.

(3) Egypt is the biggest consumer for "N" fertilizers in Africa.

3. Index No. of prices for some countriee.

Following table No.3 shows the prices index numbers of fertilizers as paid by farmer (1970 = 100) in some chooaen Countries:

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(1) FAO, Table I p. 32 year 1978.
(2) FAO, Table II p. 35 year 1978.
(3) FAO, Table IV p. 42 year 1978.

Table No. 3

	1970	1971	1972	1973	1974	1975	1976	1977
South Africa	100	103.8	112	121.5	156.3	196.8	207.6	238.1
United States	100	103.4	106.8	116	189.8	246.6	210.2	205.7
Japan	100	104.2	108.7	122.9	178.5	206.5	215.5	219.4
France	100	106	11.2	118.2	164.5	193.4	191.4	197.2
Australia	100	104	105.3	119.7	276.3	322.4	298.7	310.5

4. Estimates of present demand.

Domestic demand of nitrogenous fertilizers 15.5% N_2 until year 2000.

(1) According to estimates of Ministry of Agriculture:

Table No. 4

Year	80/81	84/85	89/90	99/200
Demand 1000 tons	4365	4799	5399	6598

This estimation is based on the assumption that new added planted areas is rated by 200,000 fedan/ year up till year 1990, and by 300,000 fedan/ year up till year 2000.

(2) According to estimates of Ministry of Industry:

Table No. (5)

Year	85	90	95	2000
Demand (1000 tons)	4015	5170	6590	8300

Assumptions of Ministry of Industry is based on the old estimated demand for Ministry of Agriculture for 1985 (4,051, 000 ton) and adding 5% yearly increase in the required tons of 15.5% N.

We notice that the estimated production values are not consistent with that of demand due to the time needed for exuting projects (4-5 years/ proj.) and this clears the importance of this research which aimed for increasing productivity of one of the already installed units.

5. Present production capacities for nitrogeneous fertilizers in Egypt.

Table No. 6(1)

Comparison for possible capacity and actual production of present factories in 1979 (1000 tons).

FERTILIZER TYPE / COMPANY	CALCIUM AMA NITRATE 31% N_2		CALCIUM NITRATE 15.5% N_2		CALCIUM AMM. NITRATE 33.5% N_2		AMM. SULPHATE. 20.6% N_2		UREA 46.5% N_2	
	Capacity		Capacity		Capacity		Capacity		Capacity	
	possible	Actual	possible	Actual	possible	Actual	possible	Actual	Possible	Actual
KIMA	340	298.29								
SUES	300	213.959	210	209.461			120	96*	TALKHA 540	432*
ELNASR FOR COKE					80.5	66.022	11	10.276		
ABU-KIR				120	96*				450	104.657

(1) Dr. Abd El- Aty Saleh, Follow up of objectives of the Ministry of Industry's Companies for 1979?

* Estimated prodn. for companies that didn't produce in 1979 to be about 80% of the design capacity.

- Total possible capacity (15.5% N_2) 3,069,765 tons.
- Actual production in 1979 (15.5% N_2)= 1,703,300 tons.
- Shortage of actual present capacity w.r.t. estimation of Ministry of Industry up till year 2000 = 6,596,700 tons.
- Shortage of present design capacity w.r.t. estimation of Ministry of Agriculture up till year 2000 = 3,231 tons.

6. Government policy for covering the future demand of nitrogenous fertilizers up till year 2000.

1. Projects to be executed in Suez Company:

- Di-ammonium phosphate (20.8% N_2) = 480000 ton / year.
  (15.5% N_2) = 636000 ton / year.

- Calcium Amm Nitrate (31.0% N_2) = 360000 ton/ year.
  (15.5% N_2) = 720000 ton / year.

- Ammonium sulphate (20.6% N_2) = 240000 ton/ year.
  (15.5% N_2) = 318000 ton/ year.

Total Nitrogeneous fertilizers (15.5% N_2) shoulb e produced in Suez = 1674000 ton/ year.

2. Projects to be executed but its location is not determined yet.

   Ammonia unit: Prod<u>n</u> Capacity 1000 ton/ day.

This Ammonia can be used for producing:

a. Amm. Nitrate fertilizer 31 - 34%. or / and

b. Urea, or / and

c. Used as direct fertilizer.

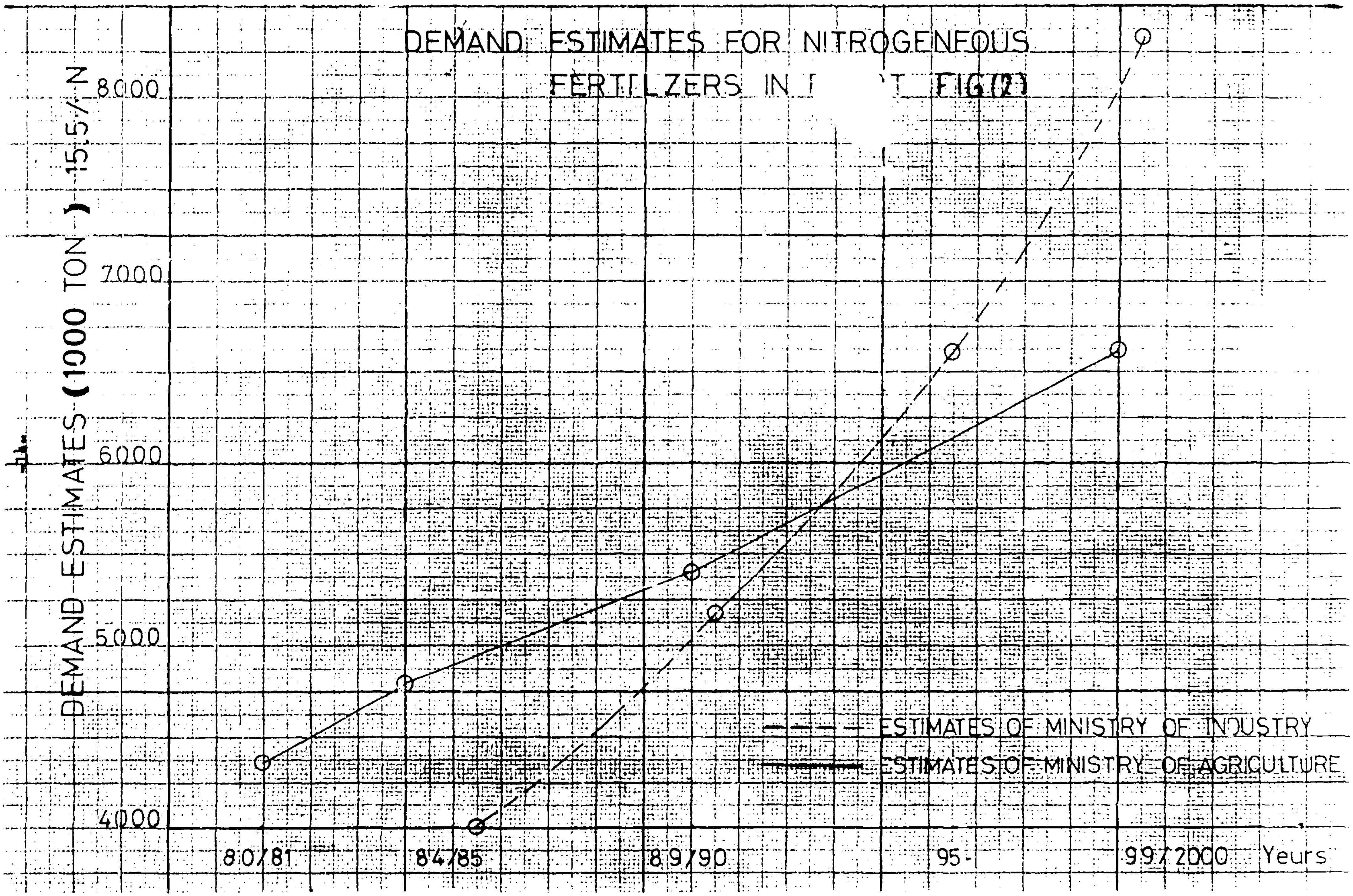
This ammonia produced is equivalent to 1,590, 000 ton/year 15;5% Nitrogeneous fertilizer.

That is o say that total production that would be added is about 3,264,000 ton 15.5% N_2.

These ammonia units would depend in their production on Natural gas utilization since the net of natural gas can cover the areas of Red Sea & Delta.

Natural gas has the advantage of high percentage of methane (= 90%) and after cracking gives the Hydrogen which is the source of Amm. synthesis.

(Other sources such as c.O.g. has lowers H% age).



DEMAND ESTIMATES FOR NITROGENEOUS FERTILZERS IN [illegible] FIG(2)

PART II

EXPOSURE FOR THE CONDITIONS OF C.A.N.PLANT

Historical background for the plant installation:

This project was one of the projects of the first five years plan investment share in the plan L.E. 9106(1). The contract was signed on 10 th of July, 1962 for the supply and operation of plant by the West Germany Dedier Company at a cost of L.E. 5, 948,000(2) for the 1st stage, production capacity (two lines) of 200,000 tons calcium Ammonium Nitrate fertilizer 20.5% N_2 (actual investments N L.E. 11,000,000).

In July 71 the plant was received two lines mounted but only one line production with efficiency of 72% of the design capacity.

Second line production began in March 1974 after the availability of c.o.g. necessary for it and this work was excuted in absence of the foreign German experts.

Exposure for production change of Nitrogenous fertilizer at Helwan Plant since its start up:

Table No.7

	71	72	73	74	75	76	77	78
Production of Fertilizer 33.5% ton	1329	23333	52462	61838	62579	54295	66605	66022

---

(1) Niazy Hassan, Evaluation of the fertilizer industry I.N.P. 1963.
(2) The same source.

Notes on tha bove table:

1. The design capacity is 120,000 ton 33.5% N_2
2. From 71 to 73 one line capacity.

   From 74 to 79 two lines capacity.
3. The maximum capacity that could be achieved is about 61.4% in 1977.
4. Continuous decrease in the real productive capacity until it reached 55% in 1979.

   Some other indicators concerning decrease of the productivity:

Items	Years		
- Production value in 1000 L.E.	3773	3466	3502*
- Average number of labour force	1531	1617	1646
- Gross value of labour salaries in 1000 L.E.	991	1082	1337
- Productivity of L.E./salaries of labours	3.8	3.2	2.6

Total investments in C.A.N. plant up till:

31/12/79 = 27,525,000

Local L.E. = 18,480, 000

Foreign L.E. = 9,045,000

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* Production value increased only due to price increase of the product. (Price/ ton 33.5 N_2 fertilizer in 77,78 L.E.

Price/ ton 33.5% N_2 fertilizer in 79 LE 44).

- Actual cost for ton is L.E. 126.221.
- Subsides provided to the company couldn't cover this cost since it reached 3,810, 000 pounds in 1979.

Necessity for increasing productivity of CAN Plant. Achieving for at least 80% of the design capacity will lead to:

a. Utilization of the present unemployed production factors (equipment- labour ... etc) for increasing the plant profit which is reflected at the end on the national economy.

b. Achievi ng the government policy as projected in the Budget for 1930 -81 which said " Replacement of equipment and innovation of the present enterprises for increasing its productivity has the first periority in the investment plan than the new projects".

c. Trial to satisfy partialy a part of the amounia required for the new projects in the plant.

e.g.:

- Conc. Nitric acid plant ; NH_3 required	1500 ton/ year.
- Project for conc. nitric acid	4500 ton/ year.
- Pure Amm. Nitrate plant	8500 ton/ year.
TOTAL NH_3 REQUIRED	14500 ton / year.

Technical data covering the processing stages :

1. Air separation·

Preparation of pure O_2 from air.

2. Hydrogenation:

Conversion of organic sulpher to $H_2 S$ and saturation of unsaturated hydrocarbons.

3. Desulpherization:

Removal of H_2S by **Shell Agip** process.

4. Cracking & Co shift conversion:

Production of hydrogen from coke oven gas conversion of Co to H_2 and Co_2.

Preparation of the theoritical ratio of H_2: N_2(3:1).

5. Removal of Co_2:

Elemination of Co_2 from synthesis gas by hot K_2Co_3

6. Cu **liquor** wash:

Elemination of Co and traces of Co_2 from synthesis gas mixture through Cu liquor **scrubbing**:

7. NH_3 Synthesis:

Conversion of H_2 & N_2 to NH_3 liquid & gas.

8. Nitric acid:

Production of nitric acid through oxidation of NH_3 on Pt. catalyst.

9. Calcium Ammoniam Nitrate:

Neutralization, mixing, prilling, cooling, coating and screening: bagging & loading.

N.B.:

All gas sections ' processes are carried out through suitable **compression steps.**

1. Air Separation

Air is liquified then pure O_2 is separated and collected in a gas holder and is mixed with air from blower before being compressed in compressors.

The compressed mixture containing approx. 36% O_2 63%,N_2 obtained from this process is blown off into atmosphere.

2. Hydrogenation

Raw C.O. gas is compressed in a 4 stage compressors, then gas enters the hydrogenation reactor containing Co Mo catalyst.

Following reaction take place in reactor.

Organic sulphur ------ H_2S

Unsaturated hydrocarbons ---- saturated hydrocarbon

Gas after hydrogenation reactor is cooled to approximate 40°C then is led to desulpherization.

3. Desulpherization

H_2S is removed by scrubbing using shell a dip wash liquor (Sodium salt of di- isopropanol amine).

Liquor is regenerated and recycled and pure gas is led to cracking plant.

4. Cracking & Co shift conversion

A. Cracking:

The desulpherized gas and the agents necessary for the cracking reaction such as steam and O_2- air mixture are heated up to 450 -500 and then mixed and cracked in the reactor.

The cracking process is effected i a Ni-catalyst at 850 -900°C.

The main reactions during this stage are:

$CH_4 + H_2O$ ------ $Co + 3H_2$ (endothermic)

$CH_4 + 2O_2$ -------- $Co_2 + 2H_2O$ (exothermic)

B. Co-Shift conversion:

The cracking gas is then led into **co-shift converter** for the **conversion** of Co with water vap. to H_2 & Co_2. The **converter** is provided with an appropriated shift conversion catalyst ($FeSo_4$ 90% , Cro 7ù , $Na_2\ Co_3$ 3%).

Conversion takes place according to the exothermic reaction.

$$Co + H_2O \text{ ---------- } Co_2 + H_2$$

5. Co_2 removal

After the gas has passed Co-shift conversion the major portion of Co_2 will be removed from the gas by scrubbing in countercurrent by a hot K_2Co_3 solution 35% at 24 ata and 100°C according to the following reaction.

$$K_2 Co_3 + Co_2 + H_2o \text{ ------- } 2\ KHCo_3$$

The used solution is regenerated by heating with condensing steam in the regeneration tower and then cooled and recycled to Co_2 scrubber. During regeneration Co_2 is removed from solution. The gas after leaving the hot K_2Co_3 scrubbing is cooled to 40°C and streams to the 1 st & 2 nd stage of the synthesis gas compression where it is compressed to about 130 ata in the 1 st & 2 nd stage of the compressor then fed to Cu liquor wash.

6. Cu Liquor Wash

This is the final stage in purification process of the gas which is obtained by a Cu liquor wash that absorbs the Co and the major portion of the Co_2 still contained in the gas , by forming a complex compound according to the following equations:

$$Cu(NH_3)_2 + Co + NH_3 \text{-------} Cu(NH_3)_3 \; Co$$

$$NH_4OH + Co_2 \text{\_\_\_\_\_\_\_\_} (NH_4)_2 \; Co_3$$

The rich **copper liquor solution is regenerated in cold and** hot regenerators and cooled by Ammonia cooler to 5°C and conveyed to the scrubber by high pressure pumps.

The pure synthesis gas is compressed to 310 atm in the 3 rd stage of synthesis gas compressor and then piped to the synthesis loop.

7. NH_3 Synthesis

Synthesis gas mix is compressed to about 310 ata in the 3 rd stage of synthesis compressors and promotors is used inside the ammonia converter at temp. 500°C.

$$3 H_2 + N_2 \text{----------} 2NH_3$$

The NH_3 formed is condensed after several cooling steps in the deep cooler and condensation column the condensed ammonia is separated and send to the amm. spheres for storage.

The remaining synthesis gas is mixed in the condensation column with the make up synthesis gas (before entering the ammonia converter), then lead to the circulation compressors which **circulates** the gas back to the synthesis column.

The concentration of inerts in synthesis gas should be kept below 10% so gas is purged periodically. NH_3 escaped with purge gas is scrubbed in aq. amm. scrubber with water.

8. Nitric Acid

The production of dilute nitric acid is effected mainly in two sections:

1. Catalytic oxidation of NH_3 with air/ O_2 on a Pt Rh contact according to the equation:

   $4\ NH_3 + 5O_2$ ------- $4\ No + 6H_2O + H_R - 216.6^K$ cal.

2. Oxidation of the nitric oxide with air/ O_2 and absorption in water:

   $2\ No + O_2$ ---------$2NO_2$ + HR - 27.1 K cal.

   $3\ No_2 +$ -------- $2\ HNo_3 + No + H_R$ 17.2 K cal.

The amm. liquid is evaporated with water (this inturn used in cooler I for cooling No gases) then mixed with air (12.5 % NH_3).

The gas mixture is conducted to ovens in which the NH_3 burns at the Pt Rh gauzes at 850°C.

The hot gases cooled and oxidize again i 2 ndry ir then compressed in compressors then cooled in coller II. The cooled nitrous gas is then passed to the oxidation and absorption system which comprise series of 4 towers provided with ceramic rings.

The oxidation of No to No_2 is carried out in the 1 st tower. In other towers No_2 is absorped by water or low conc acid to form HNo_3 54% acid is bleached with air in the bleaching tower. Air from the bleaching tower containing nitric oxide is conducted to inlet compressor.

Exhaust gas grom the towers goes to an expension turbine to decrease the total energy consumption.

9. Calcium Amm. Nitrate

A. Neutralization & Evaporation

Liquid NH_3 from synthesis plant is evaporated and brought together with nitric acid 54% in the 1 st stage neutralizer which is operating undervacuum.

$$NH_3 + HNo_3 \text{--------} NH_4\ NO_3 + H_2O$$

The solution in 1st stage neutralizer is slightly acidic, so NH_3 gas is led to this solution in the 2 nd neutralizer to adjust the correct P.H. (4.65) under normal pressure.

After 2 nd neutralizer, Amm. Nitrate 78% concn passes to 1 st stage evaporator which is working under vacuum of 92% concn is stored in a storage tank & pumped to the 2 nd stage evaporator at the top of the prilling tower (98% - 99%), the uncondensable gases are exhausted by a vacum pump.

B. Mixing & Prilling

The high concn amm. Nitrate solution from 2 nd stage evaporator is led to a cyclone mixer to mix with dust of fertilizer and limestone 2.5% .

The hot solution fed to the top of the prilling tower through spray centrifuge is solidified to prills by means of a draft of air in counter current. A centrally located scraper rotates on the bottom of the prilling tower and discharges the prilled calcium **ammonium nitrate through** a slotted opening and shuted to a belt conveyor where prills are delivered to the cooling drum.

C. Cooling, Coating and Screening

The fertilizer prills leave the prilling tower with a temp. of 80- 90°C. The product has to be cooled to about 28°C to prevent any transformation of the crystals'structure by cooled air in a cooling drum. A bucket elevator conveys the cooled fertilizer product to the screening station where the product is classified product to the screening station where the product is classified into 3 fractions normal size, over size, under size. The over size is crushed to the normal size in a crusher, the under size is returned back to the mixer to protect prills against water absorption and to prevent caking, the product is mixed with powder of limestone in coating drum.

The coated product runs via a bucket elevator and is transfered by a belt conveyor to the bulk product storage.

D. Limestone Grinding

1. Limestone quarry.

   Capacity 244 t/ d $CaCo_3$, max size 30 mm.

2. **Limestone** grinding plant.

   Gross size for mixing.

   Fines for coating.

E. Product Storage

The storage has a capacity of 30,000 ton bulk product.

F. Bagging and Loading

The bagging and loading stage has a capacity of 1900 ton / 14 h.

G. Empty bag storage

A store for 500,000 empty bags.

A store has a capacity of 100,000 bags of 100 kg each.

The Appropriateness of the Technologies
Applied in Egypt
For Producing Ammonia
And Nitrogen Fertinizers

Kima - Aswan :

The Hydrogen is produced by water electrolysis using the surplus power from Aswan Dam Power Station. Nitrogen is produced by air liquefaction. This is the most expensive way of producing hydrogen for ammonia synthesis gas and there is feasibility study to change the process to natural gas steam reforming. The final production is ammonium nitrate 31.5% N.

Suez Fertilizer Plant:

The NH_3 synthesis gas is produced by an atmospheric [illegible] reforming unit,Co shift conversion, compression, water [illegible] for CO_2 removal and Cu liquor wash. The plant is of [illegible] design still working till now with maximum capacity. The refermed gas and natural gas are used as raw materials and production is calcium nitrate 15.5% N.

Talkaha I :

Hydrogen is produced by atmospheric partial oxidation of natural gas with pure O_2. The hot potassium carbonate and C_4 liquor wash are used for CO and CO_2 removal. This process leads to huge amount of carbon black formation. The final prodction is ammonium nitrate 31.5% N.

Talkha II and Abu Kier:-

Pressure steam reforming of natural gas & Co_2 removal by hot potassium carbonate and MEA wash followed by high temperature and low temperature shift conversion and methanation. The final product is urea.

Revamping Anddebopelnecking in Helwan Fertilizer Plant

1. Air Separation:

New cold box to increase the O_2 production & compensate the high O_2 consumption due to this high CH_4 content in coke oven gas.

2. Compression House:

Injection steam & Air in the coke oven Gas to oxidise NO to NO_2 & thus reducing the polymer formation & if any polymer formed steam will prevent its solidification.

3. Hydrogen generation:

A. Changing the pipes made of 15 Mo_3 TO.ST.St. 14541 & thus no corrosion will occur.

B. Injecting steam to gas at the reactor inlet to reduce the quantity of carbon black fromation.

4. Partial oxidation

A- using catalyst with high alumina content (ceramic type). The alpha alumina do not change their chemical structure under physical or chemical influence. Also the side crush strength is not changed too much in the reduced form like that of refractory type catalyst.

B - Emergency steam injection in case of shutdown will be changed to N_2 flush.

5- Cu-liquor-wash

A- The refrigeration capacity was insufficient. Two more refrigeration compressors & two condensers are installed.

B- Bad fouling at the heat exchangers of Cu liquor wash system: new heat exchangers were installed.

6. Nitric acid plant:

a. Bad pollution leading to quick blocking of the candle filters, the suction line was distorted (10 M). A spare set of candle filters was installed as standby unit.

b. Leakages from gaskets at compressor: Teflon gaskets are used.

c. Special weaved aspestos gaskets are used for the combusion furnaces.

d. Corrosion of economizer due to law temp. of boiller feed water (90 - 100°C) and increasing the temperature to 120°C.

e. Study is done to mix air with O_2 to increase the plant efficieny.

7. Fertiliser Unit

The plant was designed to produce CAN with 20.5 per cent N_2 and then we changed to CAN with 33.5 per cent N_2. This leads to: -

A. Failure of the whole dust recovery system (system used to separate fine particles by tillers to be returned again to prilling tower, as the system was made from normal steal.

B. Blockage of screw conveyors due to high dust content and also high humidity.

C. Caking of the product due to high dust content & increase of glazing of the prills surface. Now the dust recovery system is refabricated in stainless steel, so that we can avoid the A.M. hazards.

8. Cooling water sections:-

We suffered from high temp. of cooling water due to algae formation and dust from steel factory, thus leading to bad fouling of all plant equipment. affecting their main function of heat transfer. After using chemical additives (anti algae, anti corrosion) and filtering the cooling water, the situation is now improved,

CONCLUSION

1. The natural gas is the best raw material for ammonia-synthesis.
2. The electrolysis is the most expensive way of producing ammonia.
3. The coke oven gas needs many purification steps to produce the ammonia synthesis gas.
4. The most suitable capacity for ammonia units for the developing countries is the moderate capacity units (500 -600 T/Y).
5. In Egypt the Ammonium nitrate 31.5 -33.5% N_2 is the most suitable fertilizer according to the ways of irrigation & soil specifications.