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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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Fourth Consultation
on the Fertilizer Industry

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DRAFT DIRECTORY OF TECHNOLOGICAL CAPABILITIES IN DEVELOPING COUNTRIES RELATED TO THE FERTILIZER INDUSTRY *

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Explanatory Notes

Ton refers to metric ton (1,000 kg)

Nm^3 refers to a normal cubic metre of gas

Four dots (....) indicate that data are not available or are not separately reported

A blank in a table indicates that the item is not applicable or not available

Dates divided by a slash (e.g. 1965/66) indicate a crop or a financial year

The following abbreviations are used in this publication:

Abbreviations for Fertiliser, Fertiliser Raw Materials etc.

A	Ammonia
ACl	Ammonium chloride
AN	Ammonium nitrate
APS	Ammonium phosphate sulphate
APSN	Ammonium phosphate sulphate nitrate
AS	Ammonium sulphate
ASN	Ammonium sulphate nitrate
ASP	Ammonium sulphate phosphate
CAN	Calcium ammonium nitrate
DAP	Diammonium phosphate
KCl	Potassium chloride
KS	Potassium sulphate
MAP	Monoammonium phosphate
MOP	Muriate of potash -- fertilizer-grade potassium chloride
N-acid	Nitric acid
NP/NPKs	NP/NPK complex fertilisers of various grades
P-acid	Phosphoric acid
P rock	Phosphate rock
S-acid	Sulphuric acid
SSP	Single superphosphate
TSP	Triple superphosphate
U	Urea
UAN	Urea ammonium nitrate (solution)
UAP	Urea ammonium phosphate

Abbreviations for Process Technology Used

BASF	BASF A.G. (F.R.Germany)
CHEMICO	Chemical Construction Corporation (USA)
CLE	Creusot Loire Enterprises (France)
CNCCC	China National Chemical Construction Corporation
DMCC	Dharamsi Morarji Chemical Co.Ltd. (India)
DSM	Dutch State Mines - Stamicarbon (Netherlands)
EIL	Engineers India Ltd.
FACT	Fertilisers and Chemicals Travancore Ltd. (India)
FCI	Fertiliser Corporation of India Ltd.
FEDO	FACT Engineering and Design Organisation (India)
FPDIL	Fertiliser (Planning and Development) India Ltd.
ICI	Imperial Chemical Industries (UK)
PEC	Société Potasse et Engrais Chimiques (France)
SIAPE	Société Industrielle d'Acide Phosphorique et d'Engrais (Tunisia)
TEC	Toyo Engineering Corporation (Japan)
TVA	Tennessee Valley Authority (USA)

INTRODUCTION

This first draft of the Directory of Technological Capabilities in Developing Countries Related to the Fertilizer Industry has been compiled by UNIDO as part of the programme to strengthen co-operation among developing countries in the fertilizer industry recommended by the Second and Third Consultations on this industry.

The Directory includes information currently available to UNIDO on capabilities existing in developing countries in the following five areas:

1. Training facilities and programmes in plants, fertilizer associations and other institutions;

2. Fertilizer process technologies available for transfer;

3. Fertilizer producing companies, including details as to products, capacity, technology used, construction and equipment as well as major problems and achievements of these companies;

4. Engineering contracting firms which can design and construct fertilizer plants;

5. Manufacturers of equipment, spare parts and catalysts used in the fertilizer industry.

The purpose of the Directory is to facilitate co-operation among developing countries by making up-dated and authoritative information in these areas readily available to countries planning, developing or expanding their fertilizer industries. The necessity for a directory of this kind is demonstrated by the fact that participants at Consultations and other expert group meetings have often expressed their unawareness of existing capabilities in the fertilizer or fertilizer-related industries in other developing countries, which forces them to rely almost solely on developed countries' expertise, equipment and spares at high cost and long lead times although alternative expertise, spares and some equipment may be available nearby.

In order to define the practical scope and content of the Directory, a pilot field survey of the five Andean Group countries was carried out in June 1982 to ascertain the range of capabilities and achievements of the fertilizer industry in these countries. It was found that achievements of their fertilizer industry might be of interest to other developing countries but that most of the existing capabilities in engineering contracting, equipment manufacture, etc. were of a general nature and not fully proven by their fertilizer industry.

The pilot survey showed that the time and cost of undertaking an in-depth coverage of proven fertilizer-related capabilities in a representative number of developing countries was well above budget. Therefore, it was felt that a survey of 30 developing countries coupled with a search of information available in UNIDO would suffice, as this stage, to prepare a draft directory of technological capabilities as well as to show the interest of the surveyed countries in presenting their own capabilities in fertilizers.

The Terms of Reference, which were used as the questionnaire in the survey, and the list of countries surveyed, showing those which replied, are given in Tables I and II respectively.

This draft presents part A of the Directory, namely the country data sheets, which contain the information available on 60 developing countries by country for the five areas listed above. A sixth area will be added later covering raw material reserves; a first country listing of those reserves was included in the study "Mini Fertilizer Plant Projects" (UNIDO/IS.416) which has been presented to the Fourth Consultation on the Fertilizer Industry. Parts B and C of the Directory, cross reference of capabilities by country and region and company addresses, are under preparation.

The format used in presenting part A of the directory is described in the following country data sheet. The numbering of the sections for each country corresponds to the areas of information listed; if there is no information for an area, that section is omitted.

COUNTRY DATA SHEET

1. Training facilities

The companies listed have reported that they have training facilities. Those which have said that they can provide training for outside trainees are indicated. Further details are given under the headings:

(a) description of facilities
(b) types of training provided
(c) areas of emphasis in training
(d) organization: language, fees, etc.

2. Fertilizer process technologies available for transfer

(insofar as these have been made known to UNIDO)

(a) description of technology
(b) companies to which this technology has been transferred
(c) conditions for transfer

3. Fertilizer production

Those fertilizer producing companies that are known to UNIDO are listed. Addresses will be given in part C of the Directory, which is in preparation. First a table is given for each company showing for each product the current capacity, current production, planned expansion of capacity, technology used in production, raw materials used and year production began. Further information, as far as it is available, is included under the following headings:

(a) adaptations of equipment, etc. to suit local needs carried out by the company itself or by domestic firms

(b) major problems encountered

(c) major achievements

(d) use of domestic engineering services

) purchase of domestically produced equipment or spares

4. Domestic engineering contractors

Available information is given about the technical capabilities and services provided. Addresses will be listed in part C of the Directory, which is currently in preparation.

5. Domestic manufacturers of equipment, spare parts and catalysts used in the fertilizer industry

Types of equipment, etc. produced are listed according to the list on the next page and the names of companies that are known to have produced them for fertilizer plants are given. Addresses will be listed in part C of the Directory, which is currently in preparation.

TYPES OF EQUIPMENT

1. Standard equipment

   Such as: water treatment, cooling towers, air separation, air compression, filtration, materials handling, air conditioning/refrigeration

2. Fabricated equipment

   (a) Pressure vessels and reactors including synthesis convertors
   (b) Columns including towers, strippers, separators, etc.
   (c) Heat exchangers
   (d) Furnaces, waste heat boilers
   (e) Storage tanks
   (f) gas holders and bunkers

3. Rotating equipment

   (a) Compressors: centrifugal, reciprocating, axial, etc.
   (b) Fans and blowers
   (c) Pumps: water pumps, chemical pumps, etc.

4. Power generation

   - Boilers
   - Steam turbines
   - Power generators
   - Transformers
   - Motors

5. Instrumentation

   - Electronic
   - Pneumatic

6. Bulk supply materials

   - Pipes and tubes
   - Forgings and pipe fittings
   - Valves
   - Castings

7. Laboratory equipment

8. Workshops equipment

TABLE I

TERMS OF REFERENCE

INVENTORY OF TECHNOLOGICAL CAPABILITIES EXISTING IN THE DEVELOPING COUNTRIES RELATED TO THE FERTILIZER INDUSTRY

Specific information should be provided on the following:

1. Training facilities in: plants, fertilizer associations, other institutions.

   (a) facilities: classroom, audio-visual aids, simulator training, pilot plant

   (b) training programmes for: operators, maintenance, instrumentation, foreman, engineer, management, marketing

   (c) main areas of training: on-the-job, emphasis on training subjects

   (d) organization: language of instruction, training for in-house and/or outside trainees, approximate fee per trainee.

2. Fertilizer process technologies available for transfer

   (a) brief description of the technology

   (b) references: List of companies to which the technology has been transfered

   (c) brief description of the conditions for the transfer.

3. Fertilizer production

   (a) List of fertilizer companies: products, capacity per product, raw materials, year production commenced, planned expansions on capacities and/or products, technology used, reference to purchases of locally produced equipment and/or use of domestic engineering services (engineering contractor, civil engineering)

   (b) main problem areas of the listed companies

   (c) main achievements of the listed companies

4. Engineering contractors for the design, construction and erection of fertilizer plants

(a) List of engineering contractors: brief description of their technical capabilities and services

(b) References: List of companies for which the contractor worked, brief description of the work performed indicating the year and total fees.

5. Equipment manufacturers

(a) List of national equipment manufacturers according to the attached list of types of equipment

(b) References: Brief description of the equipment produced, indicating sales to local fertilizer plants and exports.

(c) Local production of catalysts: List of producers, brief description of catalysts.

(d) Local production of spare parts for fertilizer plants: List of producers, brief description of spare parts produced.

6. Raw material reserves

(a) Location of raw materials including current production and reserves (recoverable and potential). Brief description of their situation/problems.

The raw materials to be covered are the following:

i) nitrogenous: natural gas, petroleum, coal, shale-oil;

ii) phosphates: phosphate rock, elementary sulphur, recovered sulphur;

iii) potash: potassium chloride and potassium sulphate ores.

7. Directory of domestic producers

All the companies listed in the headings above, should be presented in a directory form by alphabetical order.

The directory should contain the full name of the company, its initials, full address including telephone and telex numbers, name of top official, name of person for further contact.

TABLE II

SURVEY OF TECHNOLOGICAL CAPABILITIES IN DEVELOPING COUNTRIES RELATED TO THE FERTILIZER INDUSTRY

COUNTRY	ANSWER TO QUESTIONNAIRE		
	YES	NO	PROMISED REPLY BUT NO ANSWER RECEIVED
ALGERIA			X
ARGENTINA			X
BANGLADESH	X		
BRAZIL		X	
CHILE	X		
CHINA	X		
COSTA RICA		X	
CUBA	X		
EGYPT		X	
GUATEMALA	X		
INDIA	X		
INDONESIA	X		
JAMAICA		X	
JORDAN		X	
KENYA	X		
KOREA, Rep. of	X		
MALAYSIA			X
MEXICO		X	
MOROCCO		X	
NIGERIA		X	
PAKISTAN	X		
PHILIPPINES	X		
SENEGAL		X	
SYRIAN ARAB REPUBLIC	X		
TANZANIA, United Republic of	X		
THAILAND	X		
TRINIDAD AND TOBAGO	X		
TUNISIA	X		
TURKEY	X		
ZIMBABWE		X	

Note: This survey does not include the five Andean Group countries, Colombia, Ecuador, Peru, Venezuela and Bolivia, which were included in the pilot survey.

COUNTRY DATA SHEETS

A F R I C A

ALGERIA

1. Training facilities

Sonatrach

(a) Training centres in both production complexes;

(b) In-house training for all levels of personnel.

3. Fertilizer Production

Sonatrach

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	660,000		+ 330,000 (1984)	Chemico, Kellogg	Natural gas	1969, 1981, 1982
Urea	132,000			Chemico		1969
Nitric Acid	660,000			Chemico, Stamicarbon		1969, 1981, 1982
Ammonium	825,000			Chemico, Stamicarbon		1969, 1981, 1982
Phosphoric Acid	165,000 P_2O_5			Rhône Progil Pechiney-Saint Gobain		1972
TSP	290,000			Rhône Progil		1972
DAP	132,000			Rhône Progil		1972
NPK Mixed fertilizers	225,000			Pechiney-Saint Gobain		1972

ALGERIA (cont'd)

(b) Major problems encountered

4 main causes of production loss
(in per cent of total average production loss)

PRODUCT / CAUSES	Ammonia	Ammonium Nitrate	Phosphate fertilizer
Machines	36	44	37
Material	0	11	11
Work and Know-how	21	21	25
Environment	43	24	27
TOTAL	100	100	100

CAMEROON

3. Fertilizer Production

Société Camérounaise des Engrais (SOCAME)

Product	Capacity tons/year	Current Production tons/year (1981/82)	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
SSP	7,000 P_2O_5	-			imported	1977 (shutdown 1977)
Ammonium Sulphate	10,000 N	8,500 N			imported	1977
NPK mixed fertilizers	33,000				imported	1977

IVORY COAST

3. Fertilizer Production

Société Ivoirienne d'Engrais (SIVENG)

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
		1981/82				
SSP		2,700 P_2O_5				1970
Ammonium Sulfate	4,000 N	2,000 N				1970
NPK mixed fertilizers	45,000					

KENYA

3. Fertilizer Production

National Agricultural Chemicals and Fertilizers, Ltd. (NACAF)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia			175		Naphtha	....
MAP/DAP			390	Stamicarbon		....
CAN			300	Stamicarbon		....

MADAGASCAR

3. Fertilizer Production

Usines d'Engrais Chimiques de Tamatave Ze-ReN

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	55,000			Haldor Topsoe	Natural gas	1983
Urea	99,000					....

MAURITIUS

3. Fertilizer Production

Mauritius Chemical and Fertilizer Industry Ltd.

Product	Capacity tons/year	Current Production tons/year (1982)	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Nitric Acid	53,000					1975
CAN		1,300 N				
NPK mixed fertilizers	120,000	7,000 N				1975

MOROCCO

3. Fertilizer Production

Maroc Chimie S.A. (Office Chérifien des Phosphates)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	330,000 P_2O_5			Rhône-Poulenc	Phosphate rock (domestic)	1965, 1972
TSP	369,000			Rhône-Poulenc		1965
DAP	132,000			Rhône-Poulenc		1972
NPK mixed fertilizers	137,000			Rhône-Poulenc		1973

Maroc-Phosphore I (Office Chérifien des Phosphates)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	660,000 P_2O_5			Nissan, Rhône-Poulenc		1976, 1981
MAP	396,000			Fisons		1976

Maroc - Phosphore II (Office Chérifien des Phosphates)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	495,000			Nissan		1982

MOROCCO (cont'd)

Office Chérifien des Phosphates

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid		12 x 165,000		Rhône-Poulenc		....

MOZAMBIQUE

3. Fertilizer Production

Government of Mozambique, Fertilizer Plant at Maputo

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
		(1982)				
Ammonium Sulphate	62,000	12,000				1967
SSP		4,000				1967
NPK mixed fertilizers	120,000	4,000				1967

SECH (Secretary of State for Coal and Hydrocarbons)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia Urea					Natural gas	Initial feasibility study completed

NIGERIA

3. Fertilizer Production

Federal Superphosphate Fertilizer Co.

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
SSP	100,000	30,000		Haldor Topsoe	phosphate rock (imported from Togo) sulphur (imported)	1976

National Fertilizer Company of Nigeria (NAFCON)

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			330,000	Kellogg	Natural gas	1985
Urea			500,000	Stamicarbon		1985
NPK mixed fertilizers			330,000	Jacobs		1985

Webbs Fertilizers (Nigeria)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP			92,000	Fisons		1985
TSP						
NPK mixed fertilizers			500,000			

SENEGAL

3. Fertilizer Production

Industries Chimiques du Senegal

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid			220,000 P_2O_5	Rhône-Poulene		1984
TSP			300,000	Heurtey/TVA		....
DAP			224,000	Heurtey/TVA		

Société Industrielle d'Engrais au Senegal (SIES)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	23,000 P_2O_5			phosphate rock (domestic) sulphur (imported)		1968
TSP	28,000					1968
SSP						1968
NPK mixed fertilizers	116,000					1968

SOMALIA

3. Fertilizer Production

Ministry of Industry

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			50,000	Haldor Topsoe		1983
Urea			70,000	Snampro-getti		1983

SUDAN

3. Fertilizer Production

Sudan ReN Chemicals and Fertilizers

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			66,000	N-Ren	Naphta (imported)	1983
Urea			100,000	Scientific Design !		1983

SWAZILAND

3. Fertilizer Production

Swaziland Chemical Industries

Product	Capacity tons/year	Current Production tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Nitrate	75,000	10,000				
Mixed Fertilizers	180,000			Fisons		1977

TANZANIA

1. Training facilities

Tanzania Fertilizer Company Ltd.

(a) In-house training school;

(b) 3-year course for mechanical apprentices.

Kilwa Ammonia Company Ltd. (Kilamco)

(a) Under construction;

(b) Programme of in-house training for all levels of personnel in preparation.

3. Fertilizer Production

Kilwa Ammonia Company (Kilamco)
(c/o Tanzania Petroleum Development Corporation)

Product	Capacity tons/year	Current Production	Planned Expansion tons/day	Technology Used	Raw Materials	Year Production Started
Ammonia			1350	Haldor Topsoe	Natural gas	1987
Urea			1725	Snampro-getti		

TANZANIA (cont'd)

Tanzania Fertilizer Company Ltd.

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	82.5			Pechiney-Saint Gobain	imported	1972
TSP	266			SPIE Batignolles/DSM	imported	1972
Ammonium Sulphate	120			Standard Messo Duisberg	imported	1972
NPK	300			Northwest Engineering BV	imported	1972

(b) Major problems encountered

Lack of raw materials which are all imported and require hard currency for purchase.

Difficulty obtaining spare parts, most of which are imported.

Lack of skilled manpower.

TOGO

3. Fertilizer Production

Société Togolaise des Engrais

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid			165,00 P_2O_5			....
TSP			450,000			....
NPK mixed fertilizers			370,000			....

TUNISIA

1. Training facilities

Training for all fertilizer producing companies in the country is carried out both in the factories themselves and in training centres.

2. Fertilizer process technologies available for transfer

(a) Processes for the production of phosphoric acid and TSP using low-grade phosphates with a high impurity content have been developed by SIAPE (Société Industrielle d'Acide Phosphorique et d'Engrais)

(b) These processes are used by all units of the Tunisian Chemical Group (SIAPE itself, ICM, SAEPE and I.C.G.) as well as by Azot Snayii TAS, in Samsun, Turkey and Phosphoric Fertilizers Industry in Kavala, Greece.

(c) Processes can be transferred under a technology transfer agreement; licensing fee to be determined by capacity; basic engineering can be supplied as well supervision of construction and erection if required.

3. Fertilizer Production

Engrais de Gabès

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
MAP	100,000			S.A.I.		1976
DAP			430,000	Cros		1985
NPK mixed fertilizers			500,000	Cros		1985

Industries Chimiques de Gafsa (ICG)

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid (28%)			160,000 P_2O_5		SIAPE	1984
TSP			400,000		SIAPE	1984

TUNISIA (cont'd)

Industries Chimiques Maghrebiennes (ICM)

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid (28% and 54%)	250,000 P_2O_5			SIAPE	phosphate rock (domestic)	1972, 1974
Phosphoric Acid	160,000 P_2O_5			SIAPE	sulphur (imported)	1982
TSP	100,000			SIAPE		1972

Société Arabe des Engrais Phosphatés et Azotés (SAEPA)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid (28%)	330,000 P_2O_5			SIAPE		1979
Phosphoric Acid (54%)	280,000 P_2O_5			Rhône,Progil		1979
DAP	330,000			TVA/Heurtey		1979
Nitric Acid	280,000			Grande Paroisse		1983
Ammonium Nitrate	330,000			Kaltenbach		1983

TUNISIA (cont'd)

Société de Développement des Industries Chimiques du Sud (SDICS)

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Potassium Sulphate			140,000			1986

Société Industrielle d'Acide Phosphorique et d'Engrais (SIAPE)

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid (28%)	180,000 P_2O_5		+ 360,000 (1985)	SIAPE	phosphate rock (domestic) sulphur (imported)	(1952), 1964, 1973
Phosphoric Acid (70%)			330,000	SIAPE		1985
TSP	600,000			SIAPE		1954, 1964, 1969

TUNISIA (cont'd)

Société Tunisienne d'Engrais Chimiques (STEC)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	50,000					

4. Domestic Engineering Contractors

Tunisie Engineering et Construction Industrielle (TECI):

capabilities cover all phases of project design and implementation; currently engaged to construct a new superphosphoric acid unit for SIAPE

5. Domestic manufacturers of equipment, spare parts and catalysts

(1) Standard equipment

ACMG
COMEC
Le Confort
CSR
SCIN
SGI
SOTECOM

(2) Fabricated equipment

ACMG
COMEC
SAMMI
SCIN
SGI
SOTECOM

(6) Bulk supply materials

Fonderies reunies
SGI
SOFOMECA

ZAMBIA

1. Training facilities

Nitrogen chemicals of Zambia, Ltd.

(b) On-the-job training

(d) Employees were trained abroad when new technologies were introduced

3. Fertilizer Production

Nitrogen Chemicals of Zambia, Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	90,000			coal gasification	coal(domestic)	1970, 1981
Nitric Acid	121,000					1970, 1981
Ammonium Nitrate	139,000					1970, 1981
Ammonium Sulphate	50,000					1981
NPK mixed fertilizers	142,000				imported phosphate and potash intermediates	1981

(b) Major problems encountered

Imported raw materials: necessity of ordering materials up to two years in advance, transportation problems (Zambia is a land-locked country) and storage charges lead to high costs.

Imported equipment and spare parts: necessity of importing all process equipment means that damage to a major item can cause proplonged shutdowns while waiting for delivery. Also lack of foreign exchange can make it difficult to obtain critically needed spare parts at short notice.

Short supply of manpower.

ZIMBABWE

3. Fertilizer Production

Sable Chemical Industries Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	110,000			electrol-ysis of water		1972
Ammonium Nitrate	240,000					1969
Nitric Acid	135,000					1969

Windmill (Private) Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK mixed fertilizers	165,000					1960

Zimbabwe Fertilizer Corporation Ltd. (ZFC)

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
NPK mixed fertilizers						1951, 1956

(a) Equipment adaptation, etc.

ZFC carried out modifications with regard to debottlenecking and increased reliability of equipment in its two granular fertilizer plants resulting in increasing operating rates from 11 t/hr to 18 t/hr at one plant and from 9 t/hr to 15 t/hr at the other. Locally designed and built equipment and modifications improved the raw material intake system (automatic batch weighing system, crushing and mixing processes), the granulation process, the drying equipment, the cooling systems, the screening and oversize crushing equipment, and the bagging amd loading equipment as well as adding a process to coat the product.

ZIMBABWE (cont'd) - 2

Zimbabwe Phosphate Industries (Zimphos)

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	20,000 P_2O_5				phosphate rock (domestic)	1958
TSP						
SSP						

A S I A

BANGLADESH

1. Training facilities

Bangladesh Chemical Industries Corporation (BCIC)

(a) Central Training Institute for all fertilizer industries being built; will include simulator from Simtran; currently training provided in each factory under BCIC;

(b) In-house training; training abroad for operating and maintenance executives.

3. Fertilizer production

The plants at Fenchuganj, Chittacong and Ghorasal are operated or are being built under the Bangladesh Chemical Industries Corporation (BCIC).

Natural Gas Fertilizer Factory (NGFF), Fenchuganj

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	66,000			CHEMICO	Natural Gas	1961
Urea	106,000			CHEMICO		1961
Ammonium Sulphate	12,000			MITSUBISHI	A, raw sulphur (imported)	1969

(b) Major problems encountered

Age of plant: rehabilitation (1978-79) permitted achievement of 100% rated capacity, but capacity again reduced due to frequent breakdown; second rehabilitation of plant should be completed in 1985.

Phosphate Fertilizer Complex I (TSP-I), Patenga, Chittacong

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
TSP	32,000			Dihydrate process		1977 (previously SSP, starting 1969)

Phosphate Fertilizer Complex II, (TSP-II), Patenga, Chittacong

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid				Nissan		1974
TSP	120,000			Nissan		1974

(b) Major problems encountered

- Water supply: plant designed for deep tubewell water - source gradually dries up and becomes too saline leading to use of high salinity water in process and cooling;
- Equipment failure, particularly due to corrosion;
- Shortage of raw materials;
- Power failures;
- Rehabilitation scheme to be completed by end of 1985 should allow plant to reach rated capacity.

Urea Fertilizer Factory Ltd. (UFFL), Ghorasal

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	200,000			ICI	Natural Gas	1970
Urea	340,000			Mitsui Toatsu		1970

UFFL (cont'd)

(b) Major problems encountered

Abnormal downtime due to unwanted tripping of the plant and other mechanical breakdowns;

Overhaul (1978) reduced downtime due to instrumentation problems, but problem of mechanical breakdowns remains;

Maximum output ever achieved was 95% of capacity per stream day; production now averages 85% of rated capacity; maximum stream days per year achieved is 276;

Planned rehabilitation: December 1984 - March 1985.

Urea Fertilizer Factory No. II, Ghorasal

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			60,000	Chinese	Natural Gas	1984/85 (expected)
Urea			100,000	Chinese		

Zia Fertilizer Chemical Co. Ltd. (ZFCL) - Ashuganj Fertilizer and Chemical Complex

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	310,000			UHDE	Natural Gas	1981
Urea	528,000			Stamicarbon		

(b) Major problems encountered

- Severe time and cost overruns in construction and erection;
- Teething problems after commissioning December 1981;
- Damage to equipment and difficulty of replacement leading to lengthy shutdowns;

ZFCL (cont'd)

- Shutdown from October 1982 due to failure of super heater tubes in package boiler and mechanical failure of tube sheet and refractories of process gas cooler.

Polash Urea Fertilizer Factory (PUFF), Ghorasal, Polash, Dhaka

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Urea			95,000	Chinese		1985

Chittacong Urea Fertilizer Factory Ltd. (CUFL)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			330,000			1986-87
Urea			561,000			1986-87

Karnaphuly Fertilizer Ltd. (KFL)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			330,000			....
Urea			561,000			....

3. Fertilizer Production

Petrochemical Industries Group

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	80,000			UHDE, CHEMICO	Natural Gas	1971, 1972
Urea	135,000			Stamicarbon Mitsui Toatsu		1971, 1972
Ammonia			60,000	....		1983
Urea			86,000	Stamicarbon		1983
Ammonia			120,000	UHDE		1984
Urea			200,000	Stamicarbon		1984

CHINA

1. Training facilities

Ministry of Chemical Industry

(b) Training programmes for: operators, repair and maintenance personnel for machinery, electricity and instrumentation, foremen, engineers and management personnel; refresher courses at regular intervals for all personnel;

(c) Both theoretical, classroom training and in-plant practice; usually workers, engineers, technicians and administrative personnel spend more than 6 months practicing in a running plant of the same type before being allowed to operate alone in a newly commissioned plant;

(d) Foreign trainees accepted; English interpreters or English-speaking teachers provided; course fees approximately US$ 400 per person per month, not including cost of accommodation, meals, medical treatment and transport.

2. Fertilizer process technologies available for transfer

(a) Process technologies and all equipment can be supplied for:

Nitrogen fertilizers - ammonia plants with a capacity of 30-200 tpd, using natural gas, refinery gas, coke oven gas, anthracite or heavy oil as raw materials; products such as urea, ammonium bicarbonate, ammonium sulphate, ammonium nitrate, aqueous ammonia, liquid ammonia, etc.

Phosphate fertilizers - superphosphate fertilizer plants with a capacity of 100,000-400,000 t/yr and fused calcium magnesium fertilizers plants with a capacity of 50,000-100,000 t/yr.

(b) Foreign companies to which this technology has been transferred include:

Ammonia/Urea Plants :
Pak-China Urea Fertilizer Plant, Hazara, Pakistan
Polash Urea Fertilizer Factory, Dacca, Bangladesh
Jiang Bei Nitrogen Fertilizer Plant, Viet Nam
New Fee Li Nitrogen Fertilizer Plant, Albania

Ammonia/Ammonium Nitrate :
Fee Li Nitrogen Fertilizer Plant, Albania

Ground phosphate rock :
Jin Zhuan Phosphorous Fertilizer Plant, Democratic Kampuchea

Fused calcium magnesium phosphate :
Wen Di Phosphorous Fertilizer Plant, Viet Nam

Superphosphate :
La Qi Phosphorous Fertilizer Plant, Albania

(c) Conditions for transfer: Plants can be built and all engineering and consultancy services can be provided including personnel training, etc. Also construction can be carried out using foreign technologies.

3. Fertilizer Production

There are more than 2,200 small-, medium- and large-scale fertilizer plants in China, over 1400 producing nitrogenous fertilizers and over 700 producing phosphatic fertilizers. The total output of chemical fertilizer production was about 10 million tons N, 2.3 million tons P_2O_5 and 20,000 tons K_2O in 1980.

The more than 1300 small nitrogenous fertilizer plants each produce 5,000-20,000 t/yr of ammonia; the final products are generally ammonium bicarbonate and aqueous ammonia. Nearly all use anthracite as the raw material; a few use natural gas or heavy oil. As supplies of lump anthracite are inadequate, powdered anthracite is processed into briquettes; carbonated coal briquettes are used as raw material for ammonia synthesis in over 700 small plants. These small plants produced about 8.2 million tons of ammonia in 1980, approximately 55 per cent of the country's total output of ammonia. The advantages of these plants are: a rather short technical process, low investment, fast erection and the full utilization of the country's widely scattered coal resources.

The commercial production of phosphatic fertilizers in the country began only in 1955 with an annual output of 1,400 tons. Now there are small phosphatic fertilizer plants in more than one-third of the country's counties, producing more than 90 per cent of the total. The products are mainly single superphosphate and calcium magnesium phosphate, with small quantities of basic slag, dicalcium phosphates, ammonium phosphates, nitro-phosphates, NPK complex fertilizers, etc.

Except for the large-scale (1000 t/d) ammonia plants that have been imported from abroad (13 plants between 1976 and 1979), all the fertilizer plants have been built using domestic technology, engineering services, plant equipment and catalysts. Complete sets of equipment for more than 30 ammonia installations, each with a capacity of 200 t/d, have been produced. Mass production of equipment is increasing; more than 700 complete sets of equipment for small-sized nitrogenous fertilizer plants were produced by the machinery and electric industries in Shanghai between 1970 and 1982. While spare parts for large-and medium-scale plants, which must meet high standards, are centrally provided by the Ministry of Chemical Industry, those for small plants, which are easier to produce, are furnished by locally-owned enterprises. The industrial chemicals needed are produced under unified planning.

Future plans for the fertilizer industry include giving more weight to the production of phosphate and potash fertilizers as well as developing high-analysis complex or mixed fertilizers.

The following tables give information on the large-scale fertilizer plants, first those built with domestic technology and then those using imported technology.

CHINA (cont'd)

Anda, Heilongjiang Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	240			CNCCC	Associated gas	1970
Nitric Acid	270			CNCCC		1970
Ammonium Nitrate	500			CNCCC		1970

Zibo, Shandong Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	240			CNCCC	Refinery gas	1973
Urea	360			CNCCC		1973

Panjin, Liaoning Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	240			CNCCC	Associated gas	1975
Urea	360			CNCCC		1975

CHINA (cont'd)

Shandong Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	240			CNCCC	Coke or anthracite	1971
Urea	360			CNCCC		1971

Tangshan, Hebei Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	240			CNCCC	Coke or anthracite	1972
Urea	360			CNCCC		1972

Hua County, Shanxi Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	240			CNCCC	Coke or anthracite	1977
Urea	360			CNCCC		1977

Nanchang, Jianxi Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	180			CNCCC	Coke or anthracite	1966
Ammonium bicarbonate	720			CNCCC		1966

CHINA (cont'd)

Jinan, Shandong Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	180			CNCCC	Coke or anthracite	1976
Ammonium bicarbonate	720			CNCCC		1976

Guangzhou, Guangdong Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	240			CNCCC	Heavy oil	1977

Nanjing, Jiangsu Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	240			CNCCC	Heavy oil	1977

Quzhou, Zhejiang Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	240			CNCCC	Heavy oil	1978

CHINA (cont'd)

Congching, Sichuan Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium bicarbonate	120			CNCCC	Natural gas	1970

Sindu, Sichuan Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium bicarbonate	160-200			CNCCC	Natural gas	1974

Lansi, Zhejiang Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium bicarbonate	120			CNCCC	Heavy oil	1968

Tongxiang, Zhejiang Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium bicarbonate	200			CNCCC	Anthracite Coal briquettes	1966

Jiading Shanghai

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium bicarbonate	240			CNCCC	anthracite	1961

CHINA (cont'd)

Taichang, Jiangsu Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium bicarbonate	200			CNCCC	coal briquettes	....

Kinghua, Jiangsu Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium bicarbonate	160			CNCCC	anthracite or coke	1969

Hangzhou, Zhejiang Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia (intermediate)	75			CNCCC	anthracite	1977
Ammonia Chloride	30			CNCCC	A, salt	1977
Soda ash	30			CNCCC		1977

Sianyungang, Jiangsu Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia (intermediate)	150			CNCCC	anthracite	1979
Ammonia chloride	60			CNCCC	A, salt	1979
Soda ash	60			CNCCC		1979

CHINA (cont'd)

Zhanjiang, Guangdong Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Superphos-phate	650			CNCCC	phosphate rock, pyrite	1962

Zhizhong, Sichuan Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Superphos-phate	300			CNCCC	phosphate rock, pyrite	1973

Ninjing, Jiangsu Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium phosphate	140			CNCCC	A, phos-phate rock	1958

Shaoxing, Zhejiang Province

Product	Capacity tons/ day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Calcium-magnesium phosphate	600			CNCCC	Coke, phosphate rock	1965

CHINA (cont'd)

Fertilizer plants constructed in co-operation with foreign companies

Sichuan Chemical Plant, Sichuan Province

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Natural gas	1976
Urea	540,000			Toyo		1976

Qi Luo Petro-chemical Corporation, Shandong Province

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Natural gas	1976
Urea	540,000			Toyo		1976

Ru Zhou Natural Gas Chemical Plant

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Natural gas	1976
Urea	540,000			Stamicarbon		1976

Yunan Natural Gas Chemical Plant, Shuifu, Yunan Province

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Natural gas	1979
Urea	540,000			Stamicarbon		1979

CHINA (cont'd)

Chi Shui Natural Gas Chemical Plant, Guizhou Province

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Natural gas	1979
Urea	540,000			Stamicarbon		1979

Liao He Fertilizer Plant

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Natural gas	1976
Urea	540,000			Stamicarbon		1976

Chenzhou Fertilizer Plant

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Natural gas	1977
Urea	540,000			Stamicarbon		1977

Da Ching Petro-chemical Complex

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Natural gas	1977
Urea	540,000			Stamicarbon		1977

CHINA (cont'd)

Tong Ting Nitrogen Fertilizer Plant, Hunan Province

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Naphtha	1979
Urea	540,000			Stamicarbon		1979

Hubei Fertilizer Plant

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Naphtha	1979
Urea	540,000			Stamicarbon		1979

Qixia Shan Fertilizer Plant, Nanjing, Jiangsu

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Haldor Topsoe	Naphtha	1978
Urea	540,000			Stamicarbon		1978

Guangzhou Petro-chemical Plant

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000				Light oil	1979
Urea	540,000			Stamicarbon		1979

CHINA (cont'd)

An Qing Petro-chemical Complex, Anhui Province

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Haldor Topsoe	Light oil	1979
Urea	540,000			Stamicarbon		1979

Weizhizhin, Shantung Province

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Nitric Acid			595,000	Grande Paroisse		1982
NPK			990,000	Norsk Hydro		1987

4. Domestic engineering contractors

China National Chemical Construction Corporation (CNCCC)

- state-owned enterprise engaged in importing and exporting technology and equipment for chemical and petrochemical plants;
- has constructed dozens of complete plants for producing fertilizers and other chemical products;
- has co-operated with foreign firms in constructing large capacity modern fertilizer and petrochemical plants inside China;
- services offered include feasibility studies, job-site selection, survey, design, equipment and material supply, construction and erection, training technical personnel and technical direction for plant operation.

China National Complete Set Equipment Export Corporation

- co-operates with CNCCC in the construction of fertilizer industry projects for foreign countries.

CHINA (cont'd)

5. Domestic manufacturers of equipment, spare parts and catalysts

All types of equipment from complete plants to spare parts as well as custom fabrication of equipment to customers' specifications:

China National Chemical Construction Corporation (CNCCC)

Mechanical and electrical equipment, tools and instruments:

China National Machinery and Equipment Import and Export Corporation

China National Machinery Import and Export Corporation

Chemical products and catalysts:

China National Chemicals Import and Export Corporation

China National Scientific Apparatus and Materials Company

INDIA

1. Training facilities

Fertilizer Association of India (FAI)

(b) Series of training courses in management and production technology in fertilizer industries covering such aspects as: marketing management, logistics of fertilizer distribution, energy conservation in a fertilizer unit, air pollution control in the fertilizer industry, plant management, fertilizer promotion, instrumentation, maintenance corrosion and water treatment, etc.

(d) Outside trainees accepted; language of instruction: English; course duration: 2-13 days; course fees Rs. 700 - 7,500.

Fertilizer Corporation of India Ltd., Sindri Unit

(b) Training programme in process instrumentation and control in fertilizer industries

(d) Outside trainees accepted; language of instruction: English; fee to be arranged.

Most major manufacturers in the country have extensive training facilities attached to their plants for different categories of employees: skilled technicians, operators and engineers etc. Besides training their own employees they are increasingly providing training for other fertilizer companies in India and in neighbouring countries.

2. Fertilizer process technologies available for transfer

Capabilities for designing and constructing fertilizer plants for a wide variety of products, using many different feedstocks and technologies, are available from design and construction organizations in India. Some of the processes and products are: ammonia from natural gas, naphtha, fuel oil or coal, urea, nitric acid, sulphuric acid up to 1,000 tpd, phosphoric acid up to 400 tpd P_2O_5, complex fertilizers (phosphatic) as well as SSP. Even for those processes where the expertise is to be purchased abroad, Indian companies are capable of providing technical evaluation, basic and detailed engineering, procurement, construction services and commissioning.

Further information is contained in the booklet "Fertiliser Industry Technical Capability in India", available from the Fertiliser Association of India (FAI), Near Jawaharlal Nehru University, New Delhi 110 067, India.

INDIA (cont'd)

3. Fertilizer production

Adarsh Chemicals and Fertilisers, Udhna (Gujarat)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	136,000	58,224				1962, 1980

Agricultural Sales Corpn., Patiala (Punjab)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1982

Andhra Fertilisers, Tadepalle (Andhra Pradesh)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	40,000	37,610				1960

Andhra Sugars, Tanuku (Andhra Pradesh)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	33,530	20,101				1961

INDIA (cont'd)

Anil Starch Products, Bhavnagar (Gujarat)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	33,530	13,412				1947, 1964

Anish Chemicals, Ahmedabad (Gujarat)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	9,000	3,570				1972, 1977

Chemical unit of Associated Industries (Assam) Ltd., Chandrapur (Assam)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	33,530	7,014				1963, 1975

Bharat Alums and Chemicals, Alwar (Rajasthan)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1980

INDIA (cont'd)

Bharat Fertiliser Industries, Bombay (Maharashtra)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	22,500	21,077				1968

Bihar Caustic and Chemicals, Unit: Palamau (Bihar)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Chloride			26,000		Ammonia, Common salt	1982/83

Bihar State Superphosphate Factory, Sindri Institute (Bihar)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	23,470	9,308				1958

Bihara Steel, Bihara (Bihar)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	36,300	22,396			Coke oven gas, S-acid	1972, 1973, 1977

INDIA (cont'd)

Chamundi Chemicals and Fertilisers, Munirabad (Karnataka)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	40,640					1963 (closed since 1971)

Coimbatore Pioneer Fertilisers, Coimbatore (Tamil Nadu)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	40,640	21,729				1966

Coromandel Fertilisers, Visakhapatnam (Andhra Pradesh)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	84,000	67,017		ICI/Kellogg	Naphtha	1967
Urea	132,000	....		CPI Allied		1967
Phosphoric acid	104,000 P_2O_5	69,139		Dorr-Oliver		1968, 1976
NPK/UAP	347,500	244,497		Wellman Lord, TVA		1968, 1976

Dalmia Dairies, Mohindergarh (Haryana)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1982

DCM Chemical Works - Unit: Bhatinda (Punjab)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
SSP			72,000			1983

DCM Chemical Works - Unit: Delhi (Delhi)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	144,000	119,130				1946, 1968

Deepak Fertilizers and Products - Unit: Taloja (Maharashtra)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	100,000			Haldor Topsoe	Associated Gas (from Bombay High)	1983

INDIA (cont'd)

Dharamsi Morarji Chemical Co. - Unit: Ambernath (Maharashtra)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Fxpansion	Technology Used	Raw Materials	Year Production Started
Phosphoric acid	12,150 P_2O_5			Prayon		1968
SSP	146,320	152,209				1924, 1973
TSP	27,000	1,496		DMCC		1968

Dharamsi Morarji Chemical Co. - Unit: Kumhari (Madhya Pradesh)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	161,000	95,383				1961, 1973 1980

Dharuhera Chemicals, Dharhera (Haryana)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1981 (planned)

EID-Parry (India), Ennore (Tamil Nadu)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	16,000	8,095		Casale	Naptha	1963
Phosphoric acid	10,300 P_2O_5	10,118		Prayon		1963
APS	51,480	50,592		Dorr-Oliver		1963
AS	38,610					1968

INDIA (cont'd)

EID - Parry (India), Ranipet (Tamil Nadu)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	40,000	39,830				1906

Fertilisers and Chemicals Travancore, Alwaye (Kerala)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	82,000	49,691		ICI	Naptha	1947, 1960, 1962, 1967. 1971
Phosphoric acid	36,200	22,401		Prayon/ Dorr-Oliver		1960
Ammonium Sulphate	198,000	137,505		Power Gas/ FACT		1947, 1967
Ammonium Phosphate Sulphate:						
20-20-0	49,000	42,673		Dorr-Oliver		1960, 1971
16-20-0	132,000	69,334				
Ammonium Chloride	24,750	6,953		Krebs		1967
SSP	44,700	33,699				1948

Fertilisers and Chemicals Travancore, Ambalamedu - Cochin Phase I (Kerala)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production started
Ammonia	152,000	85,659		Montedison	Naptha	1973
Urea	330,000	186,216		Montedison		1973

Fertilisers and Chemicals, Travancore, Ambalamedu - Cochin-Phase II (Kerala)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric acid	114,000 P_2O_5	43,750		Prayon		1976
NP/NPKs						
17-17-17		2,975	+ 64,000	Wellman-		1976
28-28-0	485,000	48,815	(1984-85)	Lord		
18-46-0	-	64,295				

Fertilizer Corporation of India - Unit: Gorkhpur (Uttar Pradesh)

Product	Capacity tons/year	Current Production (1978-79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	131,000	88,414		CHEMICO, TEC	Naphtha	1969, 1975
Urea	284,920	192,206		Mitsui Toatsu		1969, 1975

Fertilizer Corporation of India - Unit: Korba (Madhya Pradesh)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			228,000	Montedison	Coal	1986
Urea			495,000	Montedison		1986

Fertilizer Corporation of India - Unit: Ramagundam (Andhra Pradesh)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	228,000			Montedison	Coal	1980
Urea	495,000			Montedison		1979

Fertilizer Corporation of India - Unit: Sindri (Bihar)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	219,000			CHEMICO, Montedison, Halder Topsoe	Fuel oil, naphtha	1951, 1979
Urea	330,000			Montedison		1959, 1979
Ammonium Sulphate	320,000			ICI		1951, 1979
Phosphoric acid	119,000 P_2O_5	1,447		Prayon		1977, 1979
TSP	340,000	3,146		FPDIL (Indian)		1977, 1979

Fertilizer Corporation of India - Unit: Talcher (Orissa)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	228,000			Montedison	Coal	1980
Urea	495,000			Montedison		

INDIA (cont'd)

Fertilizer Corporation of India, Trombay

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	297,000			Topsoe		1982

Gammon Fer-Chems, Belagula (Karnataka)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	33,000	39,778				1941, 1976

Girraj Fertilisers and Chemicals, Shikohabad (Uttar Pradesh)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	9,000					1979

Gujarat Narmada Valley Fertilizers Co., Bharuch (Gujarat)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	430,000			Topsoe	Fuel oil	1981
Urea	594,000			Snam-progetti		1981

Gujarat State Fertilisers Co., Baroda (Gujarat)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	236,000	165,174		Casale	natural gas; naphtha	1967, 1969
Urea	364,000	241,944		Mitsui Toatsu		1967, 1969
Ammonium Sulphate	148,000	193,152		ICI		1974
Phosphoric acid	50,000 P_2O_5	36,011		Nissan		1967
DAP	108,000	78,285		CHEMICO		1967

Haryana State Industrial Development Corporation, Panipat (Haryana)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1982
TSP			55,000			1984-85

Hindustan Chemicals, Bhilwara (Rajasthan)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	5,000					1950

INDIA (cont'd)

Hindustan Copper, Khetri (Rajasthan)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric acid	90,000	12,864		Prayon		1976
SSP	n.a.	37,240				1976
TSP	200,000	15,012		FEDO		1976

Hindustan Fertilizer Corporation - Unit: Barauni (Bibar)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	152,000	53,224		Montedison	Naptha	1976
Urea	330,000	115,704		Montedison		1976

Hindustan Fertilizer Corporation - Unit: Durgapur (West Bengal)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	152,000	37,812		Montedison	Naphtha	1974
Urea	330,000	82,200		Montedison		74

Hindustan Fertilizer Corporation - Unit: Haldia (West Bengal)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	152,000			Montedison	Fuel oil	1981
Urea	167,400			Montedison		1981
Phosphoric acid	75,000			Nissan		1982
Nitric acid	160,000			Indian/Ensa, France		1982
Nitro-phosphate 20-20-0	375,000			Indian/ Stamicarbon		1982
Soda Ash	60,000			CLE		1982
Methanol	41,250			Topsoe		1982

Hindustan Fertilizer Corporation - Unit: Namrup (Assam)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	197,000	114,169	+ 152,000 (1984)	CHEMICO, Montedison, Haldor Topsoe	Natural gas	1969, 1976
Urea	385,000	215,511	+ 330,000 (1984)	Selas, Montedison, Haldor Topsoe		1969, 1976
Ammonium Sulphate	100,000	72,983		Indian/ FPDIL		1969

INDIA (cont'd)

Hindustan Fertiliser Industries, Madrij (Rajasthan)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	8,250	5,062				1977

Hindustan Lever Haldia (West Bengal)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric acid	19,500 P_2O_5			Prayon		1979

Hindustan Zinc, Debarj, Udaipur (Rajasthan)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	75,000	31,806				1967
Phosphoric acid	26,000 P_2O_5			Krebs		1979

Hyderabad Chemicals and Fertilisers, Maula Ali (Andhra Pradesh)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	41,900	15,405				1946, 1963

INDIA (cont'd)

Indian Explosives, Panki (Uttar Pradesh)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	307,000	185,347		ICI	Naphtha	1969, 1981
Urea	675,000	402,928		Mitsui Toatsu		1969, 1981

Indian Farmers Fertiliser Cooperative - Unit: Hazira (2 plants)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia			2x445,500	Kellogg	Natural gas	....

Indian Farmers Fertiliser Cooperative, Kandla and Kalol (Gujarat)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	215,000	231,794		Kellogg	Natural Gas	1974
Urea	396,000	360,460		Stamicarbon		1975
NPK	1,000,000	562,960		Dorr-Oliver		1974, 1981
Phosphoric acid			127,000	....		1984

INDIA (cont'd)

Indian Farmers Fertiliser Cooperative - Unit: Phulpur (Uttar Pradesh)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	228,000			Kellogg	Naphtha	1980
Urea	495,000			Snam-progetti		1980

Industrial Supplies and Services, Udajpur (Rajastan)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1982

Jayshree Chemicals and Fertilisers, Khardah (W. Bengal)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	123,360	53,463				1961, 1973, 1982

J.K. Chemical Works, Pandesara (Gujarat)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	3,600					1979

INDIA (cont'd)

Khicha Industries, Udalpur (Rajasthan)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	3,600					1980

Kothari (Madras) Ennore (Tamil Nadu)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Chloride	20,000				Ammonia and common salt	1979
SSP	44,700	34,394				1962

Krishak Bharatiya Coop., (2 plants) - Unit: Hazira (Gujarat)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			345,000x2	Kellogg	Associated gas (from Bombay High)	1985
Urea			3x495,000	Snam-progetti		1985

INDIA (cont'd)

Krishna Industrial Corporation, Nidadavole (Andhra Pradesh)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	50,800	19,746				1964

Liberty Pesticides and Fertilisers - Unit: Madri (Rajastan)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	16,500	3,481				1977, 1978

Liberty Pesticides and Fertilisers - Unit: Visakhapatnam (Andhra Pradesh)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	12,500					1979

Madhuvan Chemicals and Fertilisers, Dabok (Rajasthan)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1977, 1981

Madras Fertilisers, Manali (Tamil Nadu)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	176,000	162,026		ICI	Naphtha	1971
Urea	210,000	144,837		CHEMICO		1971
NPK	362,800	556,120		Dorr-Oliver		1971, 1976

Maharana Khanij Udyog, Madri, (Rajasthan)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	5,000					1979

Maharashtra Agro Industries Development Corporation, Panvel (Maharashtra)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	45,000	23,533				197-

Mangalore Chemicals and Fertilisers, Mangalore Karnataka

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	136,000	121,136	+ 25,000 N (1984)	ICI	Naphtha	1976
Urea	340,000	263,339		Stamicarbon		1976
NPK			64,000 P_2O_5			1984-85

INDIA (cont'd)

Modi Spinning and Weaving Mills, Bareilly (U.P.)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1982

M.P. Agro Morarji Fertilisers, Jhabua (Madhya Pradesh)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric acid			54,000 P_2O_5			1985-86
MAP			94,000			1985-86

Nagarjuna Fertilisers and Chemicals, Kakinada (A.P.)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			228,000	Topsoe	Fuel oil	1984-1985
Urea			437,000	Stamicarbon		1984-1985
NPK			450,000			1986-1987

National Fertilisers - Unit: Bhatinda (Punjab)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	235,000			Topsoe	Fuel oil	1979
Urea	511,500			Mitsui Toatsu		1979

INDIA (cont'd)

National Fertilizers - Unit: Nangal (Punjab)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	232,000	127,364		Grande Paroisse, Topsoe/UHDE	fuel oil (originally electro-lysis of water)	1961, 1978
Urea	330,000	123,343		Grande Paroisse, Montedison		1961, 1978
CAN	320,000	282,505		Saint Gobain		1961

National Fertilisers - Unit: Panipat (Haryana)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	235,000			Topsoe	Fuel oil	1979
Urea	511,500			Mitsui Toatsu		1979

New Central Jute Mills Co., Varanasi (Uttar Pradesh)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Chloride	20,000	17,917		Modified Solvay process	Coke, common salt	1959

INDIA (cont'd)

Neyveli Lignite Corpn., Neyveli (Tamil Nadu)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	70,000	37,934		Montedison	Fuel oil	1966,1979
Urea	154,000	82,465		Montedison		1966, 1979

Noble Chemicals, Ghatkopar (Maharashtra)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	3,000					1980

Orissa Fertilisers and Chemicals, Rourkela (Orissa)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Pelofos	45,000					1973

Paradip Phosphates Ltd., Paradip (Orissa)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric acid			200,000 P_2O_5			1985
DAP			117,000			1986

INDIA (cont'd)

Paushak Baroda, (Gujarat)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	33,530	28,943				1951

Phosphate Co., Rishra (West Bengal)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	61,000	39,079				1950, 1967

Prem Chand Arya, Bulandshahr (U.P.)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1982

Premier Fertilisers, Cuddalore (Tamil Nadu)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	40,640					1963 (closed since 1976)

INDIA (cont'd)

Punjab State Industrial Development Corpn., Hoshiarpur (Punjab)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1982

Rajasthan Project, Udaipur/Chittorgarh (Rajasthan)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
TSP			435,000			1986-1987

Rallis India Magarwara (Uttar Pradesh)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	126,960	50,650				1962, 1981

Rama Krishi Rasayan (formerly West India Chemicals) Loni-Kalbhor (Maharashtra)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	33,530	34,144				1950, 1967

INDIA (cont'd)

Rashtriya Chemicals and Fertilisers - Unit: Thal Vaishet (2 plants), (Maharashtra

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			345,000x2	Haldor Topsoe	Associated gas (from Bombay High)	1984, 1985
Urea			3x495,000	Snam-progetti		1984, 1985

Rashtriya Chemicals and Fertilisers- Unit: Trombay (Maharashtra)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	317,000	110,724		CHEMICO, Topsoe	Natural refinery gas, Naphtha or natural gas	1965, 1983
Urea	429,000	98,253		CHEMICO, Snam-progetti		1965, 1983
Phosphoric acid	120,000	65,528		Nissan		1965, 1975
Nitric acid	346,500			CHEMICO, Davy Power Gas		1965
Nitro-phosphate 20-20-0	555,000	4,279		Pechiney		
15-15-15		265,630		Odda		1965, 1978
APSN 20-20-0		124,139		Stamicarbon		
Methanol	30,000					1966

INDIA (cont'd)

Rourkela Fertilizers Ltd. - Steel Authority of India, Rourkela (Orissa)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	120,000	89,072		UHDE	Coke oven gas; Naphtha	1962, 1969 1979
Nitric acid	270,000			Stamicarbon/ FPDIL		1962
CAN	480,000	276,286		Stamicarbon/ FPDIL		1962

Shaw Wallace and Co., Avadi (Tamil Nadu)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	75,530	60,597				1967

Shivalik Fertilisers, Hoshiarpur (Punjab)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1980

Shriram Fertilisers and Chemicals, Kota (Rajasthan)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	152,000	115,333		Topsoe	Naphtha	1969, 1974
Urea	330,000	250,723		Stamicarbon		1969, 1974

INDIA (cont'd)

Southern Petrochemical Industries Corporation, Tuticorin (Tamil Nadu)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	258,000	144,194		ICI	Naphtha	1975
Urea	512,000	286,216		Mitsui Toatsu		1975
Phosphoric acid	51,000 P_2O_5	32,035		Nissan		1976
DAP	28,000	69,641		Mitsui Toatsu		1977
NPK	160,000			TVA/Hitachi		1976

Steel Authority of India - Unit: Bhilai (Madhya Pradesh)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	32,600	35,515	+ 20,800 (1983-84)		Coke oven gas, S-acid	1955, 1959

Steel Authority of India - (Indian Iron and Steel Co.) - Unit: Burnpur-Kulti (West Bengal)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	23,000	7,301			Coke oven gas, S-acid	1947

INDIA (cont'd)

Steel Authority of India - Unit: Durgapur (West Bengal)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	21,200	10,736			Coke oven gas, S-acid	

Steel Authority of India - Unit: Rourkela (Orissa)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	28,200	15,541			Coke oven gas, S-acid	1967

Tata Iron and Steel Co., Jamshedpur (Bihar)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	23,100	12,541			Coke oven gas, S-acid	1933

Varinder Agro Chemicals, Ludhiana (Punjab)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	66,000					1982

INDIA (cont'd)

Viraj Chemicals, Nandesari (Gujarat)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	2,150	332				1974

Western Chemical Industries, Bombay (Maharashtra)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	3,350	1,689				1948

Zuari Agro Chemicals, San Coale (Goa)

Product	Capacity tons/year	Current Production (1978/79) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	171,000	148,678		TEC	Naphtha	1973
Urea	340,000	259,820		Mitsui Toatsu		1973
NPK/DAP/ UAP	150,000	129,551	+ 150,000 (1984)	TEC		1975

4. Domestic engineering contractors

(For further information about the firms listed see: Fertiliser Industry: Directory of Technical Capability in India published by the Fertiliser Association of India)

Development Consultants Private Ltd.

- captive steam and power generation, and offsite facilities for fertilizer complexes;
- chemical cleaning.

Dharamsi Morarji Chemical Co., Ltd.

- technology for sulphuric acid plants;
- environmental engineering,

Engineers India Ltd. (EIL)

- designs and constructs plants for ammonia synthesis and urea production;
- full range of engineering and consultancy services: feasibility studies, market surveys, process and site selection, basic and detailed engineering, procurement, construction supervision, commissioning, overall project management, etc.

FACT Engineering and Design Organisation (FEDO) - a division of Fertilisers and Chemicals Travancore Ltd.

- designs and constructs plants for ammonia synthesis and production of various nitrogenous fertilizers, nitric acid, phosphoric acid, SSP, TSP, etc., as well as granulated NP and NPK fertilizers;
- services include engineering (design and development), project management, start-up and commissioning assistance.

Fertilizer (Planning and Development) India Ltd. (FPDIL)

- designs and constructs plants for ammonia synthesis and production of urea, AS, CAN, SSP, TSP, DAP, complex fertilizers;
- services include project planning and management, basic design, complete engineering, trouble-shooting and de-bottlenecking as well as technical services for optimising catalyst performance.

Hindustan Dorr-Oliver Ltd. - a member of the Dorr-Oliver worldwide organization

- designs and constructs plants for production of NPK/DAP complex phosphatic fertilizers;
- services include complete engineering, procurement, inspection, erection, commissioning and training;
- also supplies a wide range of equipment.

Humphreys and Glasgow Consultants Private Ltd. - affiliated with Humphreys and Glasgow Ltd., London

- designs and constructs plants for ammonia synthesis and production of urea, nitric acid, phosphoric acid, sulphuric acid, ammonium chloride, ammonium nitrate, ammonium sulphate, nitrophosphate, etc.

- services include process engineering, detailed engineering, procurement, construction supervision, project management and commissioning services.

Simon-Carves India Ltd.

- designs and constructs plants for production of MAP, DAP, nitric acid, phosphoric acid, sulphuric acid, SSP, TSP;
- able to assist in all phases of a chemical project.

SMPS Consultants

- pre-project, project engineering, project management and management consultancy services offered for the processing/chemical industry;
- prepared feasibility study for a fertilizer plant site for Atul Products Ltd.;
- worked for Gujarat State Fertilizer Co., Ltd.

5. Domestic manufacturers of equipment, spare parts and catalysts

(1) Standard equipment: water treatment, cooling towers, materials handling, air conditioning, etc.

Air Conditioning Corporation

The Anup Engineering Ltd.

Best and Crompton Engineering Ltd.

Dynacraft Machine Company Ltd.

Elecon Engg. Co. Ltd.

Ion Exchange (India) Ltd.

Ingersoll-Rand (India) Ltd.

Kirlosker Pneumatic Co. Ltd.

Larsen and Toubro Limited

McNally Bharat Engineering Co.

Paharpur Cooling Tower Ltd.

Richardson and Cruddas (1972) Ltd.
System Projects Pvt. Ltd.

(2) Fabricated equipment: pressure vessels, columns, heat exchangers, tanks, etc.

ACC-Vikers-Babcock Ltd.

The Anup Engineering Ltd.

Bharat Heavy Plant and Vessels Ltd.

Bharat Heavy Electricals

Binny Ltd. Engineering Division

INDIA (cont'd)

Central India Machinery Co.
Cooper Engg. Ltd.
David Brown Gears.
Davy Asmore India Ltd.
Gujarat Machinery and Mfg. Co.
KCP Ltd.
Larsen and Toubro
Richardson and Cruddas (1972) Ltd.
Sarabhai Machinery
Triveni Structures Ltd.
Vijay Tanks and Vessels Pvt. Ltd.
Walchand Nagar Industries Ltd.

(3) Rotating equipment: compressors, fans, pumps, etc.
ACC-Vickers-Babcock Ltd.
Akay Industries
Best and Crompton Engineering Ltd.
Bharat Heavy Electrical Ltd.
Bharat Pumps and Compressors Ltd.
Dorr-Oliver (India) Ltd.
Jyoti Ltd.
Kirloskar Brothers Ltd.
Kirloskar Pneumatic Co. Ltd.
KSB Pumps Ltd.
K.G. Khosla and Co. (P) Ltd.
Kishore Pumps Ltd.

(4) Power generation: boilers, turbines, generators, transformers, motors, etc.
ACC-Vickers-Babcock Ltd.
Best and Crompton Engineering Ltd.
Bharat Heavy Electricals
Jyoti Ltd.
NGEF Ltd.

INDIA (cont'd)

(5) Instrumentation: electronic and pneumatic

Bestobell India Ltd.

Bharat Electronics

Blue Star

Instrumentation Ltd.

Micro Precision Product

Taylor Instrument Co. (India) Ltd.

(6) Bulk supply materials: pipes, tubes, forgings, pipe fittings, valves, castings

Audco India Ltd.

Bharat Heavy Electricals

Bharat Steel Tubes

Bharat Forge

Crawley and Ray

Davy Ashmore India Ltd.

Kirloskar Brother Ltd.

Micro Precision Products

Nitin Castings Ltd.

A.P.V. Engineering Co. Ltd.

Uniabex Alloy Products Ltd.

catalysts

Catalyst (India) Pvt. Ltd.

Catalyst and Chemicals India (West Asia) Pvt. Ltd.

Project and Development India Ltd.

United Catalyst India Ltd.

1. Training facilities

P.T. Pupuk Kujang

(b) In-house training programme for staff at all levels;

(d) Outside trainees accepted; languages of instruction: Indonesian and English; training fees depending upon programme requested.

P.T. Pupuk Sriwidjaja (P.T.PUSRI)

(a) Fully equipped training centre including plant models (ammonia and urea), universal process trainer, Carmody Simulators, Foxboro Simulators;

(b) Training programmes for: operators (ammonia, urea, offsite facility), foremen, plant maintenance (mechanical, instrumentation, electrical), laboratory chemical analysis, upgrading for engineerrs, supervisory management, management development;

(c) Classroom and on-the-job training;

(d) Outside trainees accepted; languages of instruction: Indonesian and English; training fee approximately US$ 1,000 to $ 3,000 per month per trainee, depending on type of training and level of trainee.

3. Fertilizer production

P.T. Asean Aceh Fertilizer

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			330,000	Kellogg	Natural gas	1984
Urea			500,000	Mitsui Toatsu		1984

INDONESIA (cont'd)

P.T. Petrokima Gresik

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	70,000			Haldor Topsoe	Fuel oil	1972
Urea	45,000					1972
Ammonium Sulphate	150,000		+ 250,000 (1984-85)			1972
TSP	390,000		+ 550,000 (1984-85)			1979
DAP	80,000					1979
NPK	50,000					1979
Phosphoric acid			160,000			1984-85

P.T. Pupuk Iskandar Muda

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			330,000	Kellogg		1984
Urea			570,000	Mitsui Toatsu		1984

P.T. Pupuk Kalimantan Timur (KALTIM)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			495,000	Lurgi		....
Urea			560,000	Stamicarbon		1983

P.T. Pupuk Kujang

Product	Capacity tons/year	Current Production (1982) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg	Natural gas	1979
Urea	570,000	514,103		Mitsui Toatsu		1979

P.T. Pupuk Sriwidjaja (PUSRI)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	940,000			Girdler, Kellogg	Natural gas	1963, 1974, 1977, 1978
Urea	1,600,000		+ 570,000 (....)	Toyo Koatsu, Mitsui Toatsu		1963, 1974, 1977, 1978

(d) Use of domestic engineering services

Plant erection: P.T. Barata, P.T. Boma Bisma Indra, P.T. Kelsri and PUSRI Construction Division

4. Domestic engineering contractors

P.T. Rekayasa Industri (PERSERO)

Incorporated in 1981, the company has the task of expanding and developing national capabilities in the fields of engineering and plant construction in order to help promote the country's industrial development. Projects in which the company has participated include: the Iskandar Muda Fertilizer Plant at Aceh, the ammonium nitrate plant at Cilacap and fertilizer bagging plants at several locations in Indonesia.

P.T. Tri-Patra Engineering

Pre-project, project engineering and project management services.

KOREA, Dem. People's Rep.

3. Fertilizer Production

Government (fertilizer plants at a number of locations)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	1,200,000					1961, 1966 1976, 1980
Urea	1,400,000					1961, 1966 1976, 1980

KOREA, Rep. of

1. Training facilities

(b) In-house training for operators, foremen, maintenance engineers; outside training for engineers, management and marketing personnel.

3. Fertilizer production

Chin Hae Chemical Co., Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	100,000			ICI Naphtha Steam Reforming	Naphtha	1967
Urea	125,000			Toyo Koatsu		1967
Phosphoric acid	58,000			Prayon		1967
NPK	165,000			TVA		1967

Chosun Fertilizer Industrial Co. Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK	99,000			blending		1968

Hankook Caprolactam Corporation

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	142,000			Recovered during caprolactam production		1974

Korea Fertilizer Co., Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	195,000			ICI Naphtha Steam Reforming	Naphtha	1967
Urea	330,000			Mitsui Toatsu		1967

Kyunggi Chemical Industrial Co., Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	83,000			Saktting process		1975
Fused Magnesium Phosphate	51,000			Open hearth process		1966
NPK	115,000			High pressure briqueting process		1977
Potassium Sulphate	24.000			Chisso		1982

Namhae Chemical Corporation

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	600,000			Kellogg	Naphtha	1977
Urea	660,000			Mitsui Toatsu		1977, 1980
Phosphoric acid	218,000			Prayon		1977
NPK	713,000			CHEMICO		1977
Nitric acid	180,000			CHEMICO		1977
Ammonium nitrate	30,000			CHEMICO, Sumitomo		1977, 1979

(d) Use of domestic engineering services

Delim Engineering, Korea Engineering

Pung Nong Fertilizer Co. Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Fused Magnesium Phosphate	119,000			Open hearth process		1967
NPK	90,000			High pressure briqueting process		1977

KOREA, Rep. of (cont'd)

Yong-Nam Chemical C., Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	100,000			ICI Naphtha Steam Reforming	Naphtha	1967
Urea	125,000			Toyo Koatsu		1967
Phosphoric acid	115,000			Prayon		1967
NPK	330,000			TVA		

Korea General Chemical Corporation (KGCC)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	300,000			ICI Naphtha Steam Reforming	Naphtha	1973
Urea	231,000			Stamicarbon		1973

5. Domestic manufacturers of equipment, spare parts and catalysts

Korea Fertilizer Co. Ltd. (K.F.C.)

Products: pressure vessels, columns, towers, strippers, separators, heat exchangers, storage tanks, gas holders and bunkers.

3. Fertilizer production

Chemical Company Malaysia Berhad

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
CAN	200,000					1967
NPK	260,000			ICI		1967

Esso Malaysia Berhad

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	50,000			ICI	Refinery gas	1966

Malaysia Acid Works, Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	67,000					1970, 1976

ASEAN Bintulu Fertilizer Plant

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			347,000	UHDE		1985
Urea			500,000	Stamicarbon/ NSM		1985

4. Domestic engineering contractors

Inter Chem Alpha:

Management consultancy, pre-project, project engineering and project management.

PAKISTAN

1. Training facilities

Pakarab Fertilizers Ltd. (PFL) Multan

(b) Training programmes for engineers, plant operators and technicians.

National Fertilizer Corporation (NFC)

(a) NFC Technical Training Centre Multan will be completed by end 1984;

(b) Training programmes for engineers and operators will be available;

(c) Language of instruction: English; training fees will be Rs. 10,000 per person per month for engineers and Rs. 7,000 per person per month for operators.

3. Fertilizer production

Dawood Hercules Chemicals Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	205,000			Kellogg	Natural gas	1971
Urea	345,000			Mitsui Toatsu		1971

EXXON Chemicals Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	107,000				Natural gas	1970
Urea	173,000			Mitsui Toatsu		1970

PAKISTAN (cont'd)

Fauji Fertilizer Company

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Haldor Topsoe	Natural gas	1980
Urea	557,000			Snam-progetti		1982

National Fertilizer Corporation of Pakistan Ltd. (NFC) is the Government-owned fertilizer company with the following six subsidiaries:

Lyallpur Chemicals and Fertilizers Ltd. (LC & FL) Faisalabad

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	20,000				imported	1957

Lyallpur Chemical and Fertilizer Ltd. (LC & FL) Jaranwala

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	80,000				imported	1968, 1975

Pak-American Fertilizers Ltd. (PAFL)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	25,000			Steam reforming	Natural gas (previously coal)	1958, 1968
Ammonium sulphate	90,000				ICI	1958, 1968

PAKISTAN (cont'd)

Pakarab Fertilizers Ltd. (PFL) Multan

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	300,000			Kellogg	Natural gas	1979 (old plant shut down)
Urea	59,000		+ 33,000 (....)	French process		1962
CAN	495,000			UHDE		1979
NP	330,000			UHDE		1979

(b) Major problems encountered

- Heat exchanger in ammonia plant damaged soon after commissioning because cooling water system not adequately designed for protection against corrosion.
- Modifications to NP and CAN units carried out to correct design defects that prevented rated production from being achieved
- Brain drain of professional managers and trained manpower.

(d) Use of domestic engineering services

Civil Contractors:

M/s. Conforce Ltd.
M/s. Macdonald Layton and Co. Ltd.
M/s. Interhom Ltd.
M/s. Hameed Masood Ltd.
M/s. Foundation Engineers Ltd.
M/s. Deep Well Corporation Ltd.
M/s. Boremaster Ltd.
M/s. Highway Contractors
M/s. Builders Associates Ltd.
M/s. Wahid Engineers
M/s. New Construction Co. Ltd.

PAKISTAN (cont'd)

Mechanical, Electrical Instrument and Inspection Contractors:

M/s. Industrial Inspection Consultants

M/s. Industrial Power & Development Organization

M/s. Industrial Power and Development Organization

M/s. Associated Engineering Concern Ltd.

M/s. Industrial Automation Ltd.

M/s. Industrial Goods and Services Ltd.

M/s. King Corporation

M/s. Zelin Ltd.

M/s. Descon Ltd.

M/s. Mechanical Erection and Construction Co.

M/s. Premier Engineer (Pakistan) Ltd.

M/s. Technical Associates

M/s. Potential Engineers Ltd.

M/s. Central Air Conditioning

Pak-China Fertilizers Ltd. (PCFL)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	53,000			Steam reforming	Natural Gas	1982
Urea	96,000			Chinese process		1982

(d) Use of domestic engineering services

Civil Contractors:

M/s. Aurangzeb Khan Khattak

M/s. A. Ghaffor Abdullah Khan and Co.

M/s. Builders Associate Sarhad Ltd.

M/s. Builder Associate Ltd.

M/s. Badi-Uz-Zaman and Co.

M/s. Fida Mohammad Khan andCo.

M/s. Khalid Waheed Associates

M/s. Ghulam Hussain and Co.

M/s. Ghulam Farid Janjua and Co.

M/s. Khurshid and Co. Ltd.

M/s. Jiacco Pak Ltd.

M/s. K.E.D.C. Ltd.

M/s. Mirza Ghulam Qadir

M/s. Izhar Ltd.

Naeem Treading Co. Ltd.

Electrical Contractors:

M/s. Industrial Goods Services Ltd.

M/s. Industrial Power Engg.

M/s. Imperial Electro Company

Instrument Contractors:

M/s. Industrial Goods Service Ltd.

Mechanical Construction and Erection Contractors:

Descon (Design) Engineering Services and Contstruction Ltd.

I.F.C: (Industrial Fabrication Corporation)

Ravi Engineering Ltd.

M/s. Joint Venture

Jiacco Pak Ltd.

Paksaudi Fertilizers Ltd. (PSFL)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Haldor Topsoe	Natural gas	1980
Urea	574,000			Snam-progetti		1980

(b) Major problems encountered

- Emergency feed waterpump inadequate, resulted in damage to one waste heat boiler;
- Refractory failed after two months operation, was replaced;

- Over-designed vent valve at discharge of CO_2 compressor led to complete damage of compressor's high pressure casing;

- High pressure water cooler on ammonia synthesis loop and ammonia cooler on urea plant both failed and had to be replaced by new ones made of a different material;

- Electronic instruments evidently not designed for the local environmental conditions, causing, e.g. unwanted trippings on auxiliary boilers; extensive modifications were necessary to make the system operational; now functioning reliably;

- Cooling water: temperature of 32% too high during hot seasons; cooling towers inadequately designed; treatment with zinc phosphonate and dispersant mixture not effective causing scaling problems in heat exchangers;

- Inert gas generator under-designed;

- Antifoam chemical was unsatisfactory; changed to new one ;

- Frequent stoppages affect the life and activity of catalysts in the ammonia plant; the primary reforming furnace should remain in operation even when auxiliary boilers fail, but it does not do so.

(c) Major achievements

In the third year of production the company achieved 109% of designed capcity.

(d) Use of domestic engineering services

Civil Contractors:

M/s. Builders Associates Ltd.
M/s. Soil Mechanics Ltd.
M/s. Izhar Limited
M/s. Continental Engineers Ltd.
M/s. Mechanised Construction of Pakistan
M/s. Soil Tecknic Limited

Electrical Contractors:

Al-Bario Construction Co.
Imperial Construction Company
Associated Engineering Concern Ltd.
Construction Electric Ltd.

Instrument Contractors:

M/s. Industrial Goods and Services Ltd.

M/s. Zelin Limited

M/s. Industrial Automation Ltd.

Mechanical Contractors:

Mechanical erection and fabrication was carried out by a consortium of Manesmann Inventa and Mann through local manpower.

5. Domestic manufacturers of equipment, spare parts and catalysts

(1) Standard equipment: air compressors, cooling towers, filters, materials handling equipment, etc.

Climax Engineering Company

Haamid Engineering Company
Haseen Habib Corporation Ltd.

(2) Fabricated equipment: pressure vessels and reactors, columns, heat exchangers, furnaces, waste heat boilers, storage tanks, gas holder, etc.

Climax Engineering Company

Haamid Engineering Company

Heavy Mechanical Complex

Karachi Shipyard and Engineering Works, Ltd.,

Nowshera Engineering Company, Ltd.

(3) Rotating equipment: compressors, fans, blowers, pumps, etc.

Bela Engineers, Ltd.

Climax Engineering Company

General Fan Company

K.S.B. Pumps Company, Ltd.

Pakistan Engineering Company Ltd.

Spinning Machinery Company of Pakistan Ltd.

(4) Power generation: boilers, steam turbines, power generators, transformers, motors, etc.

Adamjee Deutz Limited

AEG Telefunken (Pak) Engineering Ltd.

Allwin Engineering Industries

Bela Engineers Limited

Imperial Electric Company Limited

PAKISTAN (cont'd)

Karachi Shipyard and Engineering Works Ltd.

Metropolitan Steel Corporation Ltd.

Nayadaur Motors Limited

Pak Elektron Limited

Pakistan Cable Limited

Pakistan Engineering Co., Ltd.

Ravi Engineering Limited

(5) Instrumentation: electronic and pneumatic

AEG Telefunken (Pak) Engineering, Ltd.

Carrier Telephone Industries

Electric Equipment Manufacturer Co., Ltd.

Telephone Industries of Pakistan

(6) Bulk supply materials: pipes and tubes, forgings, pipe fittings, valves, castings, etc.

K.S.B. Pumps Company Ltd.

Nowshera Engineering Company Limited

Special Steel of Pakistan Limited

Wah Industries Limited

PHILIPPINES

1. Training facilites

Atlas Fertilizer Corporation

(b) In-house training; outside training; observation tours abroad

Planters Products Inc.

(b) In-house training; outside training; training abroad

3. Fertilizer Production

Atlas Fertilizer Corp.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	12,000 P_2O_5					1958, 1964, 1969
Ammonium Sulphate	86,000					1958
SSP/TSP	10,000 P_2O_5					1961
NPK	100,000					1961

Maria Cristina Fertilizer Corp.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	33,000			CHEMICO		1954, 1966
Ammonium Sulphate	50,000					1954

PHILIPPINES (cont'd)

Philippines Phosphate Fertilizer Corp. (PHILPHOS)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid			394,000 P_2O_5	Prayon	phosphate rock (domestic and imported)	1984
Ammonium Sulphate			169,000	Struthers-Wells		1984
NPK/MAP/DAP			935,000	Cros/Bearden Potter		1984

Planters Products Inc.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	100,000			Steam reforming	Refinery gas, Naphtha	1966
Urea	(65,000)			Stamicarbon		1966 currently shut down
Phosphoric Acid	69,000 100% P_2O_5			Dorr-Oliver		1966
NPK	330,000			TVA		1965, 1980

SRI LANKA

1. Training facilities

State Fertilizer Manufacturing Corp.

(b) In-house training; training abroad for plant engineers and plant operators

3. Fertilizer Production

State Fertilizer Manufacturing Corp.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	180,000			Kellogg (Naphtha reforming)	Naphtha	1981
Urea	310,000			Stamicarbon		1981

(b) Major difficulties encountered

Delays in commissioning and start-up owing to equipment failures;

"Brain drain" - departure of skilled technical personnel.

Eppawala Phosphate Ltd.

Product	Capapcity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid			....		phosphate rock (domestic)	....
DAP/TSP			....			....

THAILAND

1. Training facilities

Thai Central Chemical Co., Ltd. (TCCC)

(b) In-house training.

3. Fertilizer Production

Asia Chemical Fertilizer Ind.Co., Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Mixed fertilizers	24,000					

Burapha Fertilizer Co., Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Mixed fertilizers	9,000					

Siam Chemical Co., Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Mixed fertilizers	6,000					

Siam Chemical Fertilizer Industries, Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Mixed fertilizers	6,000					

THAILAND (cont'd)

Thai Central Chemical Co., Ltd.

Product	Capapcity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
NP/NPK mixed fertilizers	350,000		600,000 (1984)	steam granulation	imported	1975

Thai Farmer Chemical Fertilizer Co., Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Mixed fertilizers	12,000					

Ministry of Industry

Product	Capapcity	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			400,000		natural gas	detailed feasibility study being conducted
Urea			578,000			
Phosphoric Acid			210,000			
MAP			...			
NPK			650,000			

VIET NAM

3. Fertilizer Production

Government (fertilizer plants at several locations)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	66,000				Coal	1979
Urea	120,000					1979
SSP	400,000				Phosphate rock (domestic)	
Ammonia			200,000		Coal	....
Urea			270,000			....
Ammonium Nitrate			100,000			....
SSP			...	USSR		....

ARGENTINA

3. Fertilizer production

Dirección General de Fabricaciones Militares

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	8500			Casale	Coke oven gas	1960
Ammonium Nitrate	....					1960

Petrosur S.A.

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	83,000			CHEMICO	Natural Gas	1968
Ammonium Sulphate	76,000					1968
Urea	89,000					1968
NPK Mixed Fertilizers	40,000					
Ammonia			2x700,000	Haldor Topsoe		1982

(d) Use of domestic engineering services

Civil Engineering: Techint S.A.

BOLIVIA

3. Fertilizer production

Yacimientos Petroliferos Fiscales Bolivianos

Product	Capacity	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia			165 t/d	Haldor Topsoe	Natural gas	1986
Urea			250 t/d	.....		1986

BRAZIL

1. Training facilities

Centro de Studos de Fertilizantes do Instituto de Pesquisas Tecnologicas do Estado de Sao Paulo

(a) Facilities include granulating pilot plant as well as chemical analysis, control and bench scan laboratories;

(b) Training programmes for: operators/foremen, and plant maintenance engineers (mechanical, electrical, instrumentation). Specialized training for NPK granulation plants;

(c) In-plant training and plant visits; ratio of theoretical to practical training time 70:30%;

(d) Outside trainees accepted; language of instruction: Portuguese; course duration: 2 weeks for process technology and 1 week for plant maintenance engineers.

3. Fertilizer production

Araxa S.A. Fertilizantes e Productos Quimicos (ARAFERTIL)
(associated with PETROFERTIL)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
SSP			200,000			1981
TSP			174,000 (1983) +174,000 (1985)			
Phosphoric Acid			110,000 P_2O_5			1985
MAP			.....			1985

BRAZIL (cont'd)

Caraíba Metais, S.A. Indústria e Comércio

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	167,942 P_2O_5					1931

Companhia Brasileira de Fertilizantes

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
SSP/TSP			204,000			1982 (planned)

Companhia Petroquimica Brasileira (COPEBRAS)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion (1979) tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	100,000 P_2O_5			NISSAN		1975
DAP	198,000			MINIFOS (FISONS)		1975
MAP	130,000	100,000				1975
TSP	180,000	207,000				1968
Super-phosphate 30	50,000	30,000				1975
SSP	250,000	135,685				1967
Mixed fertilizers	120,000					1975

BRAZIL (cont'd)

Companhia Riograndense de Adubos (CRA)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
TSP	120,000	95,000	+ 240,000 (1982)			1962
SSP	240,000	18,000				1962
MAP	160,000	46,700	+ 100,000 (1983)			1978
NPK Mixed fertilizers						1968, 1973, 1974, 1978

Companhia Rio-Grandense de Nitrogenados (CRN)
(associated with PETROFERTIL)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			.....		Coal Gas	Pilot phase

Empresa de Produtos Quimicos e Fertilizantes S.A. (PROFERTIL)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
SSP	60,000	12,000				

BRAZIL (cont'd)

Fertilizantes Basicos S.A. (FERTIBASE)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
TSP	50,000	4,000				
SSP	94,000	35,000				

Fertilizantes Beker Ltda. (subsidiary of Beker Comercio e Industría Fertilizantes Ltda.)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
TSP	300,000	98,000				

Fertilizantes Capuava S.A. (FERTICAP)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
MAP	48,000					1980
DAP	25,000					1980
TSP	40,000	10,000				
SSP	160,000	110,000				

BRAZIL (cont'd)

Fertilizantes do Sul S.A. (FERTISUL)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	70,000	43,000				
TSP	300,000	108,000		Heurtey	imported	1973
DAP	85,000	21,600				1974
MAP	216,000	53,000				
Mixed fertilizers	640,000	540,000		Heurtey	imported	1973, 1977

Fertilizantes Fosfatados S.A. (FOSFERTIL)
(associated with PETROFERTIL)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	310,000 P_2O_5		+ 155,000 (1985)			1980
TSP	365,000					1980
MAP	330,000					1980

Fertilizantes Mitsui S.A. Indústria e Comércio

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Thermophos-phate	150,000	143,000	+ 180,000 (1981-1985)			

BRAZIL (cont'd)

Fertilizantes Nitrogenados do Nordeste S.A. (NITROFERTIL)

(controlled by PETROFERTIL)

Product	Capacity tons/year	Current Production (1982) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	665,000	381,742		Steam-reforming process	Natural Gas	1971, 1978, 1982
Urea	710,000	326,592				1971, 1978, 1982
Nitric acid	29,700			Grande Paroisse		1980

Fertilizantes União

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
MAP	50,000					1981
Mixed fertilizers	250,000	80,000				
TSP	110,000	52,000				
SSP	220,000	131,000				

IAP S.A. Indústria de Fertilizantes (Indústria Agro Pecuaria Ltda.)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonium Sulfate	146,400	107,400				
TSP	150,000	72,000				
SSP	320,000	244,000				

BRAZIL (cont'd)

Indústria Carboquímica Catarinense (ICC)
(controlled by PETROFERTIL)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	119,000 P_2O_5			Rhône Progil		1980

Industrias Luchsinger Madorin S.A. (ILM)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	170,000	40,000				
TSP	170,000	96,000		Fisons	imported	1975
Mixed fertilizers	600,000	300,000		Fisons	imported	1975
MAP	330,000	51,200				

Manah S.A.

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
TSP	120,000	118,000	+ 40,000 (1980)			
SSP	77,500	70,000				
Mixed fertilizers	155,500	68,000	+ 122,000 (1980)			

BRAZIL (cont'd)

Nitrocarbono S.A.

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	61,500	35,340	+ 61,500 (1984)			1978

Paskin S.A. - Industrias Petroquimicas

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	25,000	23,800				1972

PETROBRAS Mineracao S.A. (PETROMISA)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Potassium Chloride			80,000 (48,000 K_2O) 500,000			1983/84 (initial production) 1988/89 (final capacity)

BRAZIL (cont'd)

Produtos Químicos Elekeiroz S.A.

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
SSP	90,000	77,000	+ 90,000 (1981 planned)			

Química Indústrial Brasileira S.A. (QUIMBRASIL)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	70,000 P_2O_5			Fisons		1974
MAP	130,000	112,000		Fisons		1974
SSP	370,000	290,000				
TSP	14,000	8,000				
NPK Mixed fertilizers	465,000					1974, 1975
Ammonium Sulphate	4,600					1980

BRAZIL (cont'd)

Sotave Nordeste

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonium Phosphate (MAP/DAP)			300,000			....
SSP	150,000					1980
SSP/TSP			300,000			....

Ultrafertil S.A. - Indústria e Comércio de Fertilizantes
(controlled by PETROFERTIL)

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	576,000			UHDE/Haldor Topsoe	Naptha, Refinery Gas, Asphaltic Residue	1970, 1982
Urea	495,000			Stamicarbon		1970, 1982
Nitric Acid	73,000			Grande Paroisse		1983
Phosphoric Acid	79,000 P_2O_5					
Ammonium Nitrate		216,900	+ 400,000 (1984)	Kaltenbach		1970
Ammonium-Calcium Nitrate		157,800				1970
DAP	253,440	273,800				1970

BRAZIL (cont'd)

4. Domestic engineering contractors

Paulo Abib Engeharia S.A.
Brastechnip
Davy Projetos Industrias Ltd.
Haldor Topsoe S.A.
Internacional de Engenharia
Inter-Uhde Enenharia Quimica Ltda.
Krebs do Brasil Engenharia Ltda.
Lurgi do Brasil, Instalacoes Industriais, Ltda.
Montreal Engenharia S.A.
Natron Consultoria e Projetos S.A.
Nordon Indústrias Metalurgicas S.A.
Dr. C. Otto do Brasil, Instalacoes Industriais
Promon Engenharia S.A.
Setal Instalacoes Industriais S.A.
Snamprojetos EngenhariaS.A.
Technit-Companhia Técnica Internacional
Tenenge - Técnica Nacional de Engenharia S.A.
Themag
. Zanini - Foster Wheeler Ltda. Engenharia e Desenvolvimento

5. Domestic manufacturers of equipment, spare parts and catalysts used in the fertilizer industry

One source of information is:

Annário ABDIB, a directory of companies that build plants and manufacture equipment for basic industries, published annually by:

ABDIB, Associaçao Brasileira para o Desenvolvimento das Indústrias de Base
Rua General Jardin, 645 - 4º andar - Conj. 41
CEP 01223 - Sao Paulo - SP
Brazil

CHILE

3. Fertilizer Production

Sociedad Química y Minera de Chile S.A. (SOQUIMICH)

Product	Capacity tons/year	Current Production tons/year	Planned Expansion	Technology Used	Raw Materials/ Inputs	Year Production Started
Sodium Nitrate	790,000	700,000				
Potassium Nitrate	160,000					

Compañía Sud Americana de Fosfatos S.A. (COSAF)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials/ Inputs	Year Production Started
Triple Superphosphate	100,000				Phosphate Rock (imported)	1968
Normal Superphosphate	40,000					1958
Phosphoric Acid	35,000			Dihidrato		1968

Empresa Nacional de Explosivos

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonium Nitrate			50,000	Kaltenbach-Thuring		1982
Nitric Acid			43,000	Davy McKee		....

COLOMBIA

1. Training facilities

Abonos Colombianos S.A. (ABOCOL)

(b) In-house training; Training abroad for management and technical personnel;

(d) Training provided by company for university students.

Monómeros Colombo Venezolanos S.A.

(a) Carmody simulator (partial)

(b) Training abroad for engineers and supervisors.

2. Fertilizer process technologies available for transfer

Monómeros Colombo Venezolanos S.A. (MONOMEROS)

(a) MONOMEROS carried out some modifications to the original technology acquired from Stamicarbon (Netherlands). The original process was modified to permit the use of MAP as a raw material in order to produce formulas with a higher P_2O_5 content.

A second important modification made it possible to produce formulas with a very low P_2O_5 content, such as 18-6-18-2, used for fertilizing coffee.

Further, MONOMEROS has just completed the erection of a plant for recovering Ammonium Sulfate which it designed on the basis of a pilot plant which it had also constructed.

(b) Although these technologies have not been transferred to any other company, MONOMEROS has provided technical assistance to the firms NITROVEN, PEQUIVEN, PETROPLAS and FERRALCA in Venezuela.

3. Fertilizer Production

Abonos Colombianos S.A. (ABOCOL)

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK complex fertilizers	420			Potasse et engrais chimique	P-acid, MAP, DAP, KCl, KS	1962
Nitric acid	60			Mitsui	ammonia	1962
Ammonia	340			Mitsui	natural gas	1962
Urea			164,000 tons/year			....
bulk blending plant planned			100,000 tons/year			....

(a) Equipment adaptation, etc.

Ammonia plant capacity increased from original 200 t/d to 340 t/d through operations optimization plus equipment modification.

Energy savings achieved by optimizing use and design of heat exchangers and utilizing steam that was formerly lost.

(e) Domestically produced equipment or spares

(Addresses listed in the Company Index)

boilers: DISTRAL S.A.

high-pressure tubing: Union Industrial y Astilleros S.A. (UNIAL)

Fertilizantes Colombianos S.A. (FERTICOL)

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
AN	130			Montecatini	Ammonia, N-acid	1963
Urea	50			C.I.Girdler	Ammonia	1967
Nitric acid	80			Montecatini	Ammonia	1963
Ammonia	65			C.I.Girdler	Natural gas	1967

Monómeros Colombo Venezolanos S.A. (MONOMEROS)

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK complex fertilizers	910			Stamicarbon	N-acid,AS, ammonia, kaolin, P-acid, MAP, DAP P rock, KCl, KS	1973
Nitric acid	226			Stamicarbon	Ammonia	1973
AS	120			Monómeros		1982

(a) Equipment adaptation, etc.

Modification of original process in order to produce formulas with a higher and lower P_2O_5 content. Design of a plant for recovering Ammonium Sulfate.

(d) Use of domestic engineering services

Maximum use was made of the services of local companies such as Foster Wheeler Andina S.A. and Compancol in the construction of the Ammonium Sulfate plant.

(e) Purchase of domestically produced equipment or spares

Equipment was purchased from the following firms (see section 5 for lists of equipment): Distral S.A., Forjas de Colombia, A. Johnson de Colombia S.A., Siemens S.A., Tissot, Unión Industrial y Astilleros S.A. (UNIAL).

4. Domestic engineering contractors

Foster Wheeler Andina S.A.

Compancol

5. Domestic manufacturers of equipment, spare parts, and catalysts

(2) Fabricated equipment: pressure vessels, columns, heat exchangers, furnaces, storage tanks.

Distral S.A.

A. Johnson de Colombia S.A.

Tissot

Union Industrial y Astilleros S.A. (UNIAL)

(4) Power generation

Siemens S.A. (Colombia)

(6) Bulk supply materials: forgings, tubing

Forjas de Colombia

Unión y Astilleros S.A. (UNIAL)

COSTA RICA

1. Training facilities

Fertilizantes de Centro America (Costa Rica) S.A. (FERTICA)

(b) In-house training programme for all categories of staff

3. Fertilizer production

Fertilizantes de Centro America (Costa Rica) S.A. (FERTICA)

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Nitric acid	450				imported A	
Ammonium nitrate	350					
Ammonium sulphate	150					ceased production
Compound fertilizers	700					

CUBA

1. Training facilities

All fertilizer producing companies in the country have training programmes for operators, maintenance, instrumentation, foremen, etc. suited to their own needs.

3. Fertilizer production

Empresa Fertilizantes Completos Cubanitro

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	35,500			Shell partial oxidation of petroleum		1968
Nitric Acid	36,500			Chemical and Industrial International High Pressure		1959
Complex Fertilizers	115,000			PEC Sulphonitric (France)	P Rock KCl N Acid A S Acid	1960
Granular Fertilizers	150,000			TVA (U.S.)	AS SSP TSP KCl N solution S Acid	1966
Mixed Fertilizer	197,000			Bulk Blending	AS TSP SSP KCl	1959 (1914)

(b) Major Problems: Construction of the installation was begun in 1958 but not completed by the original contractors. Completion of construction and erection was difficult due to lack of resources.

CUBA (cont'd)

Empresa de Fertilizantes Nitrogenados de Cienfuegos

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	231,000			Steam reforming of naphtha (COPSOE)		1973
Nitric Acid	223,000			Stamicarbon medium pressure		1973
Ammonium Nitrate	277,000			Stamicarbon		1973
Urea	182,000			Stamicarbon total recycle		1973

(b) Major problems: Design problems made it necessary to carry out changes in the construction of the installation.

Empresa de Fertilizantes "Revolución de Octubre"

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	110,000			steam reforming of naphtha (ONIA process)		1975
Nitric Acid	192,000			GIAP design (USSR)		1975
Ammonium Nitrate	220,000			GIAP design		1975
Urea	35,000			GIAP Project partical recycle		1975

Empresa de Fertilizantes Mezclados Felton

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Mixed Fertilizers	344,500			bulk blending	AS SSP TSP KCl	1973

Fertilizantes Mezclados Habana

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Mixed Fertilizers	766,000 (total for four plants)			bulk blending	AS SSP TSP KCl KS	1914, 1948 and 1972

3. Fertilizer production

Fertilizantes Ecuatorianos S.A.

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK complex fertilizers	120	28,000		TVA	U(imported) A(- " -) KCl (MOP) (imported) AS DAP PAcid	1965/1966
SSP (21% P_2O_5)	80	9,412			S-Acid P-Rock (imported)	1968
Phosphoric Acid (30% P_2O_5)	10-20					1968
TSP			34,000 t/yr			....
Aluminium Sulphate			20,000 t/yr			....
Ammonium Sulphate			15,000 t/yr			....

Corporacion Estatal Petrolera Ecuatoriana (CEPE)

Product	Capacity tons/day	Current Production	Planned Expansion tons/day	Technology Used	Raw Materials	Year Production Started
Ammonia			1,000		Natural Gas	preliminary studies
Urea			1,500			

EL SALVADOR

3. Fertilizer Production

Fertilizantes de Centro America S.A. (FERTICA)

Product	Capacity tons/year	Current Production (1979/80) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate	148,000	15,000 N				1976
SSP	33,000	2,000 P_2O_5				
Complex fertilizers	100,000					1964, 1976

GUATEMALA

1. Training

Productora y Distribuidora de Fertilizantes y Agroquimicos S.A. (DISFERSA)

(b) In-house training

Productora y Distribuidora de Fertilizantes y Agroquimicos del Atlantico S.A. (FERTILASA)

(b) In-house training

Fertilizantes Mexicanos (Tecún Umán) S.A.

(b) In-house training with instructors from parent company in Mexico.

3. Fertilizer production

Productora y Distribuidora de Fertilizantes y Agroquimicos S.A. (DISFERSA)

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK mixed fertilizers	3,600				85% imported 15% domestic	1979

(b) Major problem areas

Shutdowns caused by insufficient raw materials due to lack of foreign exchange

Productora y Distribuidora de Fertilizantes y Agroquimicos del Atlantico S.A. (FERTILASA)

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK mixed fertilizers	1,200			Sackett	imported	1982

(b) Major problem areas

Lack of foreign exchange to import raw materials

(d) Use of domestic engineering services

Civil engineering, plant erection, funnel construction: SEPLACOSA

Productora Guatemalteca de Fertilizantes S.A. (PROFESA)

Product	Capacity	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK mixed fertilizers		95,000 t/yr				

(b) Lack of qualified personnel in the area of production.

Fertilizantes Mexicanos (Tecún Umán) S.A.

Product	Capacity	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK mixed fertilizers		56,000 t/yr		Sackett	A, U P Acid KCl	1980

(b) Major problem areas

Lack of qualified personnel; difficult in procuring inputs, lack of raw materials in the area.

(d) Use of domestic engineering services

Plant erection: A.P.S.A deGuatemala

4. Domestic engineering contractors

A.P.S.A. de Guatemala

SEPLACOSA

MEXICO

1. Training facilities

Fertilizers Mexicanos, S.A. (FERTIMEX)

(a) Training facilties at general offices include simulator equipment; further facilities at 13 industrial units throughout the country;

(b) Training programmes for staff members at all levels include induction courses, technical training and instruction, personal development, executive development and instructor training programmes;

(c) On-the-job and classroom training; ratio of theoretical to practical training time 1:3;

(d) Language of instruction: Spanish.

3. Fertilizer Production

Fertilizantes Mexicanos, S.A. (FERTIMEX)

This Government-owned company has 11 industrial units in Mexico (as well as one in Guatemala, q.v.) that produce fertilizers. The table below gives the total capacity of all 11 domestic units as of April 1983, the production figures for 1982 and planned capacity expansion.

MEXICO (cont'd)

FERTIMEX (cont'd)

Product	Capacity tons/year	Current Production tons/year 1982	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	22,000					1951
Nitric Acid	155,000	155,000	+ 430,000 (1984) + 260,000 (1985)	Dupont, Société Belge de Azote		1959, 1961
Phosphoric Acid	419,600	420,000 P_2O_5	+ 198,000 (1984) + 198,000 (1985)	Dorr-Oliver, Rhône-Poulenc, Pechiney-Saint Gobain, Prayon		1962, 1965, 1969, 1982
Urea	1,258,000	1,137,000	+ 495,000 (1984)	Toyo Koatsu, Lonza Lummus, Snamprogetti, Stamicarbon		1963, 1972 1978, 1982
Ammonium Nitrate	168,000	315,000	+ 400,000 (1984)	Saint Gobain, Canada Development Inc.		1959, 1962
Ammonium nitrate solution			215,000			1985
UAN solution			350,000			1985
Ammonium sulphate	1,673,000	1,443,000		Chemico, Struthers Wells		1951, 1966, 1969, 1973, 1978
DAP	228,300	216,000	+ 275,000 (1984)	Dorr-Oliver		1970, 1975
NPK	206,000	206,000	+ 250,000 (1984)	PEC, TVA		1962, 1968
DAP/NPK			+ 425,000 (1984) + 286,000 (1985)			
SSP	482,500	437,000		Surtenvant, Saint Gobain, Superfloskolet		1947, 1950 1978
TSP	176,500	146,000	+ 150,000 (1985)	Dorr-Oliver		1962, 1965, 1969, 1978

MEXICO (cont'd)

FERTIMEX (cont'd)

(b) Major problems encountered

Transport problems, specifically insufficient availability of railroad cars;

Difficulties with supplies of raw materials, particularly ammonia, carbon dioxide and sulphur;

Difficulties with supplies of machinery and equipment;

Certain difficulties deriving from the imported technology.

(c) Main achievements

In order to improve productivity, the company established more efficient systems of maintenance, acquisition of supplies and equipment, control of raw materials and products, training, security, information and labor relations.

The projected production in 1982 of 4,752 thousand tons of intermediate products represents 87% of installed capacity and of 3,600 tons of final products represents 81.4% of installed capacity.

With the completion of the new industrial complex at Lázaro Cárdenas - Las Truchas, the company will be able to satisfy amply the requirements of the country's agricultural sector.

While many of the existing plants are 15 or more years old and therefore use outdated technology, the company is continuing to use them to produce fertilizer to meet the country's needs while in the process of replacing them by constructing plants using the most advanced technology.

Petroleos Mexicanos, S.A. (PEMEX)

This Government-owned company, which has plants at Camargo, Minatitlán and Salamanca, supplies ammonia to FERTIMEX for the manufacture of fertilizers.

Product	Capacity tons/year	Current Production tons/year 1982	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	2,985,000	2,118,000			Natural gas	1961, 1962, 1968, 1975, 1977

Univex, S.A.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium sulphate	190,000			Stamicarbon		1972

5. Domestic manufacturers of equipment, spare parts and catalysts

(1) Standard equipment: cooling towers, air compression, refrigeration, etc.

Jacuzzi Universal, S.A.
Mayekawa de México, S.A.
Torres Marmex, S.A. de C.V.

(2) Fabricated equipment: pressure vessels and reactors, columns, towers, heat exchangers, furnaces, storage tanks, etc.

Avante, S.A. Ingenieros
Consorcio Industrial, S.A.
C.S.R. de México, S.A.
Ecología, S.A.
Fabricaciones de Acero Inoxidable, S.A.
Inductomex, S.A.de C.V.
Mexicana de Bienes de Capital
Pfauder, S.A.
Swecomex, S.A.
Tanques de Acero Trinity, S.A.
Tecnotanques del Noroeste, S.A.
Trinox Manufacturera, A.S.

(3) Rotating equipment: compressors, fans, pumps, etc.

GEM, S.A.
Industrías Ingersoll Rand, S.A.
Industrias Guillermo Murguía, S.A.
Máquinas de Proceso, S.A.
Worthington de México, S.A.

(4) Power generation: biolgers, steam turbines, power generators, transformers, motors, etc.

Babcock and Wilcox de México, S.A. de C.V.
Ce-rrey, S.A.
Clayton de México, S.A.
Cleaver Broods de México
Industrias IEM, S.A. de C.V.
Industrias Ingersoll Rand, S.A.
Industrias Pesadas, S.A. de C.V.
Manufacturera Fairbanks Morse, S.A. de C.V.

MEXICO (cont'd)

(4) Power generation (cont'd)

Megatek, S.A.
Motores U.S. de México, S.A.
Reliance de México, S.A.
West Instruments de México, S.A.

(6) Bulk supply materials: pipes, forgings, castins, etc.

Ascomática, S.A.
Dezurid de México, S.A. de C.V.
EMCA, S.A. de C.V.
Mibco de México, S.A.
OYM, S.A.
Puriti, S.A.
Senkowski Control Definidos, S.A.

PERU

1. Training facilities

Fertilizantes Sintéticos S.A.

(b) Classroom training; programmed instruction courses (from E.I. Du Pont de Nemours and Co.) translated into Spanish for training supervisors and maintenance personnel; outside training for supervisors and supervising engineers.

Industrial Cachimayo S.A.

(b) Outside training for operators, maintenance personnel, office personnel

Petróleos del Peru S.A.

(b) In-house training; training abroad

2. Fertilizer process technologies available for transfer

Fertilizantes Sintéticas S.A.

(a) The company designed and built a caustic regeneration unit rated at 1.5 t/8 hr 100% sodium hydroxide in which carbonated caustic soda from the absorber (in the ammonia plant elimination of 0.1% to 0.2% CO_2 from the feed synthesis gas is accomplished by sodium hydroxide scrubbing) is treated with slaked lime and the resulting precipitated calcium carbonate is separated. This original design works satisfactorily.

(b) Has not yet been transferred to other companies, but might be available for transfer.

Industrial Cachimayo S.A.

(a) The company designed a siphon draining arrangement for its 300,000 m^3/year water treatment plant. Previously it took 20 men to clean up manually the sludge that accummulated from the process of adding slaked lime to the water to eliminate temporary hardness followed by the addition of ferric chloride to flocculate the resulting solids.

(b) Has not been transferred to other companies, but might be available for transfer to similar plants.

Industrias Químicas S.A.

(a) SSP was produced in a fully lead-coated funnel reactor which frequently plugged up causing considerable down time. The company replaced about 90% of the funnel's inner lead lining with refractory bricks and has not had any plug-ups since then.

(b) Has not been transferred to other companies, but might be available for transfer.

3. Fertilizer production

Fertilizantes Sintéticos S.A.

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonium Sulphate (20,5% N)	50			Montecotini	A S Acid	1960
Ammonium Nitrate (33% N)	140			Montecotini	A N Acid	1960
Nitric Acid (53%)	200			Montecotini	A	1960
Nitric Acid (98%)	4			Montecotini	A	1960
Ammonia	75			Montecotini	H from oil Nitrogen	1960
Nitrogen	2700 Nm^3/h			Linde air separation		1960

(a) Equipment adaptation, etc.

Built caustic regeneration unit described under Section 2.

(b) Major problem areas

Power house condenser tubes corroded by contaminated sea water used for cooling and abraded because the sand level has increased near the intake. Will switch to ground water cooling to avoid this. Modifications were necessary to the cracker and boiler burners.

(d) Use of domestic engineering services

Civil engineering (structural design and construction): Flores y Costa (no longer in existence) and Groña y Montero.
Mechanical and electrical erection: Martínez y Linares and Ingeniería Industrial.

(e) Purchase of domestically produced equipment and spare parts

Spare parts are purchased from the following companies (addresses in the Company Index): AIRTEC, Atlas Copco, Compresoras Andinas, COSAPI, Delcrosa, Hidrostral, IMG, Incomet, MAGENSA, Mecánica Industrial, Metal empresa, Reconsa, SIMA, Talleres Elisa, Talleres Grieve.

Industrial Cachimayo S.A.

Product	Capacity tons/day	Current Production	Planned Expansion (1985) tons/day	Technology Used	Raw Materials	Year Production Started
Ammonium Nitrate	118		220	Uhde	A N Acid	1965
Nitric Acid	140		280	Uhde	A	1965
Ammonia	50		100	Uhde	electro-lytic hydrogen N	1965
Nitrogen	2500Nm^3/h			Uhde	air separation	1965

(b) Major problem areas

Insufficient electric power (hydroelectric) to operate at "full" capacity, often causing shut-downs in summer months.

(d) Use of domestic engineering services

Civil engineering, mechanical and electrical erection: Martínez y Linares.

(e) Purchase of domestically produced equipment and spares

Spare parts are purchased from the following companies (addresses in the Company Index): Hidrostal, Reconsa, SIMA, Talleres Breso, Talleres Elisa.

Industrias Químicas S.A.

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP (18% P_2O_5)	140			Brookfield	conc. P_2O_5 ore Zn ore, S Acid	1964
NPK complex fertilizers	270			TVA	A,AN,SSP, S Acid, KCl, DAP	1964

(a) Equipment adaptation, etc.

Replacing lead lining of funnel reactor bricks as described in Section 2.

(b) Major problem areas

SSP caking due to too short curing time because of sales pressure.

(d) Use of domestic engineering services

Civil engineering, mechanical and electrical erection: Graña y Montero.

(e) Purchase of domestically produced equipment and spares

Spare parts are puchased from the following companies (addresses in the Company Index): APIN, FAMIA, Gilardi Gamarra.

Petróleos del Perú S.A.

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Urea	510	126,609 t/yr		CHEMICO	A	1975
Ammonia	300	76,056 t/yr		Mitsui Toatsu	Natural gas	1975
Urea			600 t/d		Natural gas	prefeasibility studies

(b) Major problem areas

Desalination plant: corrosion (solved by replacing spray nozzle with one made of titanium).

Urea and ammonia plants: corrosion, maintenance, insufficient electric energy, insufficient gas (a greater problem in the years 1979-1980 than in 1981-1982).

(d) Use of domestic engineering services

Mechanical and electrical erection: COSAPI,, Martinez y Linares

(e) Purchase of domestically produced equipment and spares

Spare parts are purchased from the following companies (addresses in the Company Index): FAMESA, MAGENSA, Martinez y Linares, Metal Empresa.

PERU (cont'd)

4. Domestic engineering contractors

COSAPI
Graña y Montero
Ingenería Industrial
Martínez y Linares

5. Domestic manufacturers of equipment, spare parts and catalysts

1. Standard equipment: air compressors
   Atlas Copco
   Compresoras Andinas

2. Fabricated equipment: columns, heat exchangers, storage tanks
   COSAPI
   INCOMET
   MAGENSA
   Martínez y Linares
   Metal Empresa
   Talleres Grieve

3. Rotating equipment: compressors, fans, blowers, pumps
   AIRTEC
   FAMESA
   Hidrostal
   IMG
   MAGENSA
   Mecánica Industrial
   Reconsa
   SIMA
   Talleres Brero
   Talleres Elisa

4. Power generation: boilers, motors
   APIN
   COSAPI
   Delcrosa
   Metal Empresa

5. Instrumentation
   Talleres Elisa

Other: spare parts for bucket elevators and screw conveyors:
   Gilardi Gamarra
   FAMIA

1. Training facilities

Fertilizers of Trinidad and Tobago Limited (FERTRIN)

(b) In-house training (program designed by an outside firm); training in similar plants abroad.

(d) Company also provides training to university students.

3. Fertilizer production

Federation Chemicals Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	610,000			Stamicarbon	Natural gas	1960,1966, 1977
Urea	90,000			Stamicarbon		
Ammonium sulphate	88,000			Stamicarbon		

Fertilizer of Trinidad and Tobago Ltd. (FERTRIN)

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	2000			Kellog	Natural gas	1981

National Energy Corporation of Trinidad and Tobago

Product	Capacity	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Urea			1620 t/d	Snamprogetti		1983

National Agro Chemicals Ltd.

Product	Capacity	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK mixed fertilizers				domestic and imported		

4. Domestic engineering contractors

Brisco Ltd.

Damus

George S. Williams and Co. Ltd.

George Wimpey Caribbean Ltd.

3. Fertilizer production

Fosfatos Tomás

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK	95,000					1972, 1974

VENEZUELA

1. Training facilities

Petroquímica de Venezuela S.A. (PEQUIVEN)
(also includes NITROVEN fertilizer complex at El Tablazo)

(b) In-house training; outside training; training abroad for upper echelon engineers, management and marketing personnel.

3. Fertilizer Production

Petroquímica de Venezuela S.A. (PEQUIVEN) - fertilizer complex at Morón

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
DAP	800			Dorr Oliver	A P Acid (imported)	1976
NPK complex fertilizers	920			- " -	A, U, AS, S Acid, P Acid, KCl, KS	1976
Urea	750			Snam-progetti	A	1963, 1974
Ammonium Sulfate	240			Montecatini	A S Acid	1963
Ammonia	600			CHEMICO/ Mitsubishi	Natural Gas	1963, 1974
Nitric acid (53%)	185			Montecatini	A	1963
Phosphoric acid	290			Dorr Oliver		not operating
TSP			400 t/d	Dorr Oliver		on standby
Urea prilling unit			750 t/d			1985
bulk blending plant			1,000 t/d			1985

(a) Equipment adaptation, etc.

The company enlarged the diameters of the lines in the medium pressure section of the urea plants to solve the problem of ammonium carbamate plugging up the lines.

(b) Major problem areas

Ammonia plant: higher than design temperatures in reformer; too long transfer lines causing fires and line ruptures; insufficient ammonia condensing capacity; necessity of using 40 t/hr boiler to supply additional steam.

Urea plant: centrifuges not operating properly.

NPK plant: excessive dust penetrating into motors and mechanically driven parts and causing them to stop frequently.

(d) Use of domestic engineering services

Civil engineering: Guinand and Brillembourg C.A,, Ratio C.A.
Mechanical erection: Fromiconi and Lei C.A., Van Dam Industrias Metalúrgicas, S.V.E.C.A.-S.A.E., Sade S.A.
Electrical erection: S.V.E.C.A.-S.A.E., Sade S.A.

(e) Purchase of domestically produced equipment or spares

Equipment and spare parts have been purchased from the following firms (see section 5 for lists of equipment): Eleazar Gómez, Formiconi and Lei, IMOSA, Indein, Siemens, Talleres Hispania, Van Dam, Westinghouse.

Petroquímica de Venezuela S.A. - NITROVEN fertilizer complex at El Tablazo

Product	Capacity tons/day	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Urea	2400			Toyo Toatsu	A	1972
Ammonia	1800			C.I.Girdler	Natural Gas	1972

(b) Major problem areas

Design and equipment problems

(d) Use of domestic engineering services

Civil engineering: Guinand and Brillembourg C.A.
Mechanical and electrical erection: Formiconi and Lei C.A.

(e) Purchase of domestically produced equipment or spares

Equipment and spare parts have been purchased from the following firms (see section 5 for listsof equipment): Formiconi and Lei, Indein, Siemens S.A., Westinghouse de Venezuela S.A.

4. Domestic engineering contractors

Formiconi and Lei C.A.

Guinand and Brillenbourg C.A.

Industrias Metalúrgicas Van Dam C.A.

Ratio C.A.

Sade S.A.

S.V.E.C.A.-S.A.E.

5. Domestic manufacturers of equipment, spare parts, catalysts

1. Standard equipment: cooling towers

   Indein Venezuela S.A.

2. Fabricated equipment: columns, heat exchangers, boilers, liquid and refrigerated storage tanks

   C.M. Eleazar Gómez Sucursales C.A.

   Formiconi and Lei C.A.

   Industria Mecánica Orión S.A. (IMOSA)

   Talleres Hispánia C.A.

   Industrias Metalúrgicas Van Dam C.A.

4. Power generation: small transformers

   Siemens S.A.

   Westinghouse de Venezuela S.A.

6. Bulk supply materials: pipes and tubes

   Siderúrgica Occidental C.A. (SIDEROCA)

M I D D L E E A S T

AFGHANISTAN

3. Fertilizer production

Government of Afghanistan

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	70,000				Natural Gas	1975
Urea	104,000					

BAHRAIN

3. Fertilizer production

Gulf Petrochemical Industry (GPIC)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia			330,000	UHDE		1985

EGYPT

1. Training facilities

Abu Qir Company for Fertilizers and Chemical Industries

(b) Training programmes for: ammonia/urea plant managers, supervisors, operators/foremen, and maintenance engineers (mechanical, electrical, instrumentation);

(c) In-plant training and plant visits; ratio of theoretical to practical training time 1:4;

(d) Outside trainees accepted; language of instruction: English; course duration: 2 weeks for plant managers/supervisors, process technology, 4 weeks for plant maintenance engineers.

Abu Zaabal Fertilizer and Chemical Company

(b) Training programmes for: phosphoric acid and TSP plant supervisors, operators/foremen, and maintenance engineers (mechanical and instrumentation)

(c) In-plant training and plant visits; ratio of theoretical to practical training time 1:1.5;

(d) Outside trainees accepted; languages of instruction: English and Arabic; course duration: 3 weeks for plant managers/supervisors, process technology, 4 weeks for maintenance engineers

Al Nasr Company for Manufacturing Coke and Chemicals

(b) Training programmes for plant supervisors, operators/foremen, and maintenance engineers (mechanical, electrical and instrumentation)

(c) In-plant training only

(d) Course duration: 2 weeks for plant managers/supervisors, process technology and 3 weeks for plant maintenance engineers.

Semadco Training Centre for Chemical Industries at Talkha

(a) Fully equipped training centre with process simulator and model projects for a variety of manufacturing processes;

(b) Training programmes for plant operators/foremen and maintenance engineers (instrumentation); Specialized training for ammonia/urea, phosphate/phosphoric acid/TSP and Nitro-phosphate/NPK plants;

(c) In-plant training and plant visits; ratio of theoretical to practical training time 1:1;

(d) Outside trainees accepted; languages of instruction: Arabic and English; course duration: 20 weeks for process technology and 25 weeks for plant maintenance engineers.

3. Fertilizer production

Abu Qir Company for Fertilizers and Chemical Industries

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			UHDE	Natural Gas	1979
Urea	495,000	104,657		Stamicarbon		1979
Calcium Ammonium Nitrate	120,000					1982

Abu Zaabal Fertilizer and Chemical Company

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	250,000					1946,1978
Phosphoric Acid	65,000 P_2O_5			Fisons		1983
TSP	150,000			Fisons		1982

Al Nasr Company for Manufacturing Coke and Chemicals, Helwan, Cairo

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	56,000			Haber Bosch	Coke-oven gas	1970
Nitric Acid	172,000		+ 16,500 (1985)			1964
Calcium Ammonium Nitrate	120,000	66,022		BASF		1971

(b) Major problems encountered

Continuous decrease in real productive capacity until it reached 55% in 1979 made a revamping and de-bottlenecking necessary.

Al Nasr Company for Fertilizers and Chemical Industries, Suez, Talkha

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	600,000			Haber Bosch, ICI	Refinery waste gas and natural gas	1952, 1975 1981
Urea	578,000			Stamicarbon		1981
Nitric Acid	460,000			CHEMICO, UHDE		1952 1975
Ammonium Nitrate/CAN	380,000			Stamicarbon		1975
Ammonium Sulphate	10,000					1964

EGYPT (cont'd)

The Egyptian Chemical Industries Company (KIMA), Aswan

Product	Capacity tons/year	Current Production (1979) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	150,000			electro-lysis of water		1960
Nitric Acid	510,000					1960
Ammonium Nitrate/CAN	380,000	298,290		UHDE		1960

(b) Major problems encountered

Production of hydrogen by electrolysis very expensive; feasibility study underway for converting to natural gas steam reforming process

Egyptian Financial and Industrial Company

Product	Capacity tons/year	Current Producti	Planned Expansion	Technology Used	Raw Materials	Year Production Started
SSP	35,000 P_2O_5					1950, 1954, 1964, 1967

IRAN

3. Fertilizer production

Government of Iran - Shiraz Fertilizer Complex

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	46,000		+ 396,000 (1989)	Ammonia Casale ICI	Natural Gas	1963
Urea	54,000		+ 500,000 (1989)	Stamicarbon		1963
Ammonium Nitrate	30,000		+ 250,000 (1989)	Kaltenbach		
Nitric Acid			+ 196,000 (1989)	Grande Paroisse		

IRAQ

3. Fertilizer production

State Enterprise of Fertilizers

(under the State Organization for Chemical Industries)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	995,000			CHEMICO, Haldor Topsoe		1971, 1977, 1979
Urea	1,480,000			CHEMICO; Snamprogetti		1971, 1977, 1979
Ammonium Sulphate	140,000			CHEMICO		1971

State Enterprise for Phosphates

(under the State Organization for Minerals)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid			400,000	Prayon		1983
TSP			600,000	Fisons		1983
MAP			250,000	Fisons		1983
NPK Mixed fertilizers			272,000	Fisons		1983
Ammonia			50,000	Howe Baker		1983

3. Fertilizer production

The Arab Potash Co. Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Potash	1,200,000					1982
Potassium Chloride			720,000			1988
Potassium Sulphate			.....			1988

Jordan Fertilizer Industry Company Ltd.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	410,000 P_2O_5			Rhône-Poulenc	phosphate rock (domestic)	1983
DAP/MAP	726,000				P acid, Ammonia (imported)	1983

KUWAIT

1. Training facilities

Petrochemical Industries Co. (PIC)

(b) Training and retraining employees commensurate with technical background including training courses abroad;

(c) Summer training courses held at the company for students from science and commerce colleges.

3. Fertilizer production

Petrochemical Industries Co. (PIC)

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	660,000		330,000 (1984)	Ammonia Casale, Haldor Topsoe		1966, 1971
Urea	792,000					1966, 1971
Ammonium Sulphate	165,000					

3. Fertilizer production

Lebanon Chemical Co.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	100,000 P_2O_5					1972
TSP	300,000					1972
Nitric Acid	18,000					1966
Ammonium Nitrate	22,000					1966
Mixed fertilizers						

LIBYA

3. Fertilizer Production

NAPETCO - Secretariat of Heavy Industries

Product	Capacity tons/year	Current Production	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	660,000		+ 891,000 (....)	UHDE/ICI, Haldor Topsoe		1977, 1982
Urea	330,000		+ 578,000 (1984) + 574,000 (....)	Stamicarbon		1982

3. Fertilizer production

Qatar Fertilizer Co. (QAFCO)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	590,000			ICI, Haldor Topsoe	Natural Gas	1973, 1979
Urea	660,000			Mitsui Toatsu, Stamicarbon		1973, 1979

SAUDI ARABIA

3. Fertilizer production

Al Jubail Fertilizer Co. (Joint Venture of SABIC - Saudi Arabian Basic Industries Corporation)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			Kellogg		1983
Urea	545,000			Stamicarbon		1983

Saudi Arabian Fertilizer Co. (SAFCO)

Product	Capacity tons/year	Current Production (1981) tons/year	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	198,000			CHEMICO	Natural Gas	1970
Urea	300,000	342,289		CHEMICO		1970

1. Training facilities

General Fertilizer Company (GFC)

(a) Vocational school, simulator training equipment;

(b) 2-year training programme for operators, technical personnel, manintenance personnel.

Intermediate Institute for Chemical Industries of the Ministry of Industry

(b) 24-month intermediate level course in fertilizer manufacturing technology to prepare operators, shift foremen and technical assistants;

(d) Language of instruction: Arabic; outside trainees accepted.

3. Fertilizer production

General Fertilizer Company (GFC)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	380,000			Ammonia Casale	Naphtha (domestic)	1972, 1981
Urea	315,000			Stamicarbon		1981
Nitric Acid	87,500			Neft Chempron		1971
CAN	148,000			Technology from USSR		1971
Phosphoric Acid	160,000 P_2O_5			Prayon	Phosphate rock (domestic)	1981
TSP	450,000			Romanian process		1981

(b) Major problems encountered

- High cost of naphtha - plan to convert to natural gas in 1985
- Surplus ammonia - only 60% ofproduced ammonia consumed in urea production, difficult to operate ammonia unit at less than 77% of name plate capacity - studying plans to produce Ammonium phosphate with surplus ammonia and locally produced phosphoric acid
- Power failures ;
- Water balance for phosphoric acid unit not in order ;
- Heavy corrosion in some pumps and rubber coating, particularly in the phosphoric acid unit.

TURKEY

1. Training facilities

Azot Sanayii T.A.Ş.

(a) Laboratories (chemistry, electricity, mechanics, instrumentation); pilot plant with control panel

(b) Training programmes for all technical disciplines: process operators, maintenance and instrumentation technicians, foremen, engineers

(d) Language of instruction: Turkish; courses in English can be arranged; training fees not yet determined

3. Fertilizer Production

Akdeniz Gübre Sanayii A.Ş.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	71,000 P_2O_5			Prayon	imported	1972
DAP	148,500			Pechiney-Saint Gobain		1972
Nitric Acid						1972
Ammonium Nitrate/CAN	594,000			Stamicarbon		1972

(d) Use of domestic engineering contractors

Tümaş

TURKEY (cont'd)

Azot Sanayii T.A.Ş.

Product	Capacity tons/year	Current Production tons/year	Planned Expansion tons/year	Technology Used	Raw Materials	Year Production Started
Ammonia	150,000				Coal	1961, 1968
Ammonium Sulphate	60,000			BASF	Ammonia, Gypsum (domestic)	1961
Nitric Acid	....			....		1961, 1968
Ammonium Nitrate (20.5%N)	50,000			BASF		1961
Ammonium Nitrate (26% N)	338,500			Kaltenbach		1968
CAN (26% N)	594,000			Stamicarbon		1979
Phosphoric Acid	178,000 P_2O_5					
TSP	220,000			SIAPE-Chemiebau		1971
SSP	220,000			Moritz		1970
DAP	227,000			Olin-Mathieson		1973

(b) Major problems encountered

Equipment:Coal screening and conveyor sustems, coal grinding and drying units, steam boilers, gasifiers and gas purification system, graphite pipes of exchangers in phosphoric acid unit

Caking of CAN - studies are under way to find solution

Dusting problems in fertilizer storage - already solved

(d) Use of domestic engineering contractors

Eti Ltd.
Şirketi
TOKAR
Vural Kollektiv

TURKEY (cont'd)

Bandirma Gübre Fabrikalari A.S. (BAGFAS)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
TSP	160,000			Stamicarbon		1973
Ammonium Sulphate	200,000			Stamicarbon		1979
DAP	300,000			Stamicarbon		1979
NPK	165,000			Stamicarbon		1979

Ege Gübre Sanayii A.Ş.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK	306,500			Minifos-Fisons		1978

(d) Use of domestic engineering services

Alarco
Opak
Tekfen
Tümaş

TURKEY (cont'd)

Gübre Fabrikalari T.A.Ş.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Phosphoric Acid	150,000 P_2O_5					1974, 1976
TSP	370,000			Broadfield-Den		1954, 1974
NPK	200,000			ICI		1978

(d) Use of domestic engineering services

Teksel

Istanbul Gübre Sanayii A.Ş. (IGSAŞ)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia	330,000			UHDE	Naphtha	1977
Urea	511,500			UHDE		1977

(d) Use of domestic engineering services

Etmaş
Terzibaşioglu

Toros Gübre ve Kimya Endüstrisi A.Ş.

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
NPK	330,000			Fisons		1981

(d) Use of domestic engineering services

Tekfen

TURKEY (cont'd)

4. Domestic engineering contractors

The engineering firms listed can design and erect a fertilizer plant according to given process data. They can also be responsible for the construction and commissioning of the plants.

- TOKAR Yapi ve Endüstri Tesisleri Imalat ve Montaj A.Ş.
- TEKFEN Endüstri Tesisleri Imalat ve Montaj A.Ş.
- KUTLUTAŞ HOLDING A.Ş.
- TÜMAŞ Türk Mühendislik Müsavirlik ve Müteahhitlik A.Ş.
- ENTE Endüstri ve Tesisat A.Ş.
- ENTES Endüstri Tesisleri Imalat ve Montaj A.Ş.

5. Domestic manufacturers of equipment, spare parts and catalysts

(1) Standard equipment

(a) Cooling towers

Almüt-Alarko
Gama Endüstri Tesisleri Imalat ve Montaj A.Ş.
Sungurlar Isi Sanayii A.Ş.
Tokar Yapi ve Endüstri Tesisleri ve Montaj A.Ş.

(b) Water treatment

Alarko
Gama Endüstri Tesisleri A.Ş.
Sungurlar Isi Sanayii A.Ş.
Tekfen Endüstri Tesisleri Imalat ve Montaj A.Ş.

(c) Filtration

Alarko
Apex Makina Endüstrisi
Form A.Ş.
Gürmal
Klinger-Yakacik Mak.Fab.
Yönat Teknik Endüstriyel ve Termik Cihazlar

(d) Air conditioning

Alfa
Emak
Ente Endüstri ve Tesisat
Gürmak

TURKEY (cont'd)

(e) Separators

Enternasyonal Tic.Müh.Bürosu
VMI Vibro Magnet-Izolasyon Imalat, Ihracat ve Mühendislik Yüksek Erkoc ve Orgagi Adi Kom.Sti.

(2) Fabricated equipment: heat exchangers, boilers, tanks

Alamsaş-Alarko Agir Makina Sanayii A.Ş.
Demir-Çelik Iş Fabrikasi
Desa, Demir, Kazan ve Mak. San. A.Ş.
Ece Endüstri Tesisleri Isitma-Sogutma Cihazlari Sanayi ve Tic. A.Ş.
Erna Kollektif Şti.
Gama Endüstri Tesisleri Imalat ve Montaj A.Ş.
Habas Endüstri Tesisleri
Karma San.
Sungurlar Isi Sanayii A.Ş.
Teba Isitma Sogutma Klima Cihazlari San. ve Tic. A.Ş.
Tekfen Imalat ve Mühendislik A.Ş.
Türkiye Seker Fabrikalari A.Ş. Ankara Mak.Fab.

(3) Rotating equipment: fans, pumps

Alarko
Alpom Pompa ve Motor Imalat Müessesesi
Genel Makina Sanayi LTD. Şti.
Layne-Bowler Dik. Türbin Pom. San. ve Tic. A.Ş.
Samsun Makina Sanayii
Sungurlar Isi San. A.Ş.
Tekfen Imalat ve Mühendislik A.Ş.
Türbo San, Türbo Mak. San. ve Tic. A.Ş.
Türkiye Seker Fabrikalari A.Ş. Eskisehir Mak.Fab.

(4) Power generation: generators, motors

AEG Telefunken Genel Elektrik Türk A.Ş.
Brown-Boweri
Cengiz Elektrik Motorlari Fabrikasi
Etaş
Gamak Makina Sanayii A.Ş.
Simko

(6) Bulk supply materials: pipes, pipe fittings, valves

Apex Makina Endüstrisi
Borusan Boru Sanayi A.Ş.
Ergat
Fer-Döküm Sanayii
Gürmal Valf ve Fitting Sanayii A.Ş.
Haymak Döküm ve Fitting Sanayii A.Ş.
Izsal Döküm Sanayii A.Ş.

TURKEY (cont'd)

Klinger Yakacik Makina Fabrikasi Döküm Valf San. ve Tic. A.Ş.
Manesman-Sümerbank Bory Endüstrisi T.A.Ş.
M.K.E. Çelik Boru Çekme Fabrikasi
Ümran Boru Fab.
Vastaş

UNITED ARAB EMIRATES

3. Fertilizer production

Abu Dhabi National Oil Co. (ADNOC) - Ruwais Fertilizer Industries (FERTIL)

Product	Capacity tons/year	Current Production	Planned Expansion	Technology Used	Raw Materials	Year Production Started
Ammonia			330,000	Haldor Topsoe	Natural gas	1983
Urea			495,000	Stamicarbon		1983

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INDUSTRIAL DEVELOPMENT ORGANIZATION

Fourth Consultation
on the Fertilizer Industry

New Delhi, India, 23-27 January 1984

DRAFT DIRECTORY OF TECHNOLOGICAL CAPABILITIES IN DEVELOPING COUNTRIES RELATED TO THE FERTILIZER INDUSTRY

Errata

Page 79

Page 79 should read page 69. The following pages should be changed accordingly.

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