Nitrogen

By Richard W. Lewis [1]

Domestic production capacity of anhydrous ammonia continued to increase, and by yearend it was 20 percent greater, boosting total output capacity to over 11 million short tons. A trend was established toward the construction of large capacity (1,000 tons per day and greater), single-train plants which, it was believed, would eventually replace most of the smaller plants because the operating cost per unit of ammonia produced will be lower.

[1] Commodity specialist, Division of Minerals.

Table 1.—Salient nitrogen statistics
(Thousand short tons of contained nitrogen)

	1956–60 (average)	1961	1962	1963	1964	1965
United States:						
Production as ammonia	3,521	4,429	4,920	r 5,656	r 6,447	7,252
Production as high-purity nitrogen gas	380	1,045	1,683	1,992	r 2,266	2,801
Imports for consumption of nitrogen compounds	276	325	383	401	494	496
Exports of nitrogen compounds	247	173	246	219	337	459
Consumption [1]	3,679	5,130	r 4,862	r 5,454	r 6,031	6,575
World: Production [1]	11,956	15,403	16,320	r 18,864	r 21,213	23,401

r Revised.
[1] Estimated, exclude nitrogen gas.

Table 2.—Nitrogen production in the United States
(Short tons of contained nitrogen)

	1961	1962	1963	1964 r	1965 p
Anhydrous ammonia: Synthetic plants [1]	4,282,160	4,778,106	r 5,504,581	6,278,717	7,079,035
Ammonia compounds, coking plants:					
Ammonia liquor	10,990	11,166	12,059	13,325	12,791
Ammonium sulfate	125,951	124,112	131,385	144,362	150,318
Ammonium phosphates	10,111	6,909	8,234	10,638	10,292
Total	4,429,212	4,920,293	r 5,656,259	6,447,042	7,252,436
Nitrogen gas [1]	1,045,357	1,682,643	1,992,112	2,266,411	2,801,073

p Preliminary. r Revised.
[1] Bureau of the Census Current Industrial Reports.

Table 3.—Major nitrogen compounds produced in the United States
(Thousand short tons, gross weight)

Compounds	1964 r	1965 p
Ammonium nitrate	4,543	4,599
Ammonium sulfate	2,307	2,661
Ammonium phosphate	3,096	3,531
Nitric acid	4,732	4,860
Urea	1,210	1,374

p Preliminary. r Revised.

Source: U.S. Tariff Commission (urea only).

DOMESTIC PRODUCTION

Anhydrous ammonia production in 1965 exceeded that of 1964 by 973,000 tons, or 13 percent. The output of nitrogen (liquid and gas) also increased and was nearly 24 percent greater than in 1964.

The following anhydrous ammonia (NH_3) plants and expanded facilities with engineered capacities were reported completed during the year:

Company	Plant location	Added NH_3 capacity 1,000 short tons per year
Air Products and Chemicals, Inc	New Orleans, La	210
Ammonia, Inc	Bonnie, Fla	50
Apple River Chemical Co	Dubuque, Ill	200
Calumet Nitrogen Products Co	Hammond, Ind	15
Consumers Cooperative Association	Fort Dodge, Iowa	55
El Paso Natural Gas Products Co. [1]	Odessa, Tex	105
Fel-Tex, Inc	Fremont, Nebr	42
Frontier Chemical Co	Wichita, Kans	15
W. R. Grace & Co	Memphis, Tenn	75
Hercules Powder Co	Hercules, Calif	70
Monsanto Co	Luling, La	210
Nipak, Inc	Kerens, Tex	115
Olin Mathieson Chemical Corp	Lake Charles, La	500
Phillips Chemical Co	Beatrice, Nebr	220
Reserve Oil and Gas Corp	Hanford, Calif	22
Shell Oil Co	Ventura, Calif	55
Western Ammonia Corp. [1]	Dimmitt, Tex	27
Wycon Chemical Co	Cheyenne, Wyo	20

[1] Reported as completed in 1964 Minerals Yearbook.

Additional new anhydrous ammonia plants and expansions either planned or under construction were announced as follows:

Company	Plate location	Added NH_3 capacity 1,000 tons per year	Completion date
Allied Chemical Corp	Geismar, La	350	1967
American Cyanamid Co	Fortier, La	350	1966
Borden Chemical Co	Geismar, La	350	1966
Chevron Chemical Co	Pascagoula, La	500	1967
Coastal Chemical Corp	Yazoo City, Miss	350	1966
Collier Carbon & Chemical Corp	Brea, Calif	250	1966
Continental Oil Co	Blytheville, Ark	350	1966
Commercial Solvents Corp	Sterlington, La	350	1967
The Dow Chemical Co	Freeport, Tex	105	1966
E. I. du Pont de Nemors & Co., Inc	Beaumont, Tex	350	1966
Do.	Belle, W. Va. [1]	350	NA
Felmont Oil Corp	Olean, N. Y	70	1966
First Nitrogen Corp	Donaldson, La	350	1966
Green Valley Chemical Corp	Creston, Iowa	35	1966
Mobile Chemical Co	Beaumont, Tex	250	1966
Shamrock Oil & Gas Co	Dumas, Tex	70	1966
Shell Oil Co	St. Helens, Ore	150	1966
Terra Chemicals International, Inc	Port Neal, Iowa	210	1966
Tuloma Gas Products Co	Texas City, Tex	500	1968
United States Steel Corp	Clairton, Pa	400	1966
Valley Nitrogen Producers Co	El Centre, Calif	210	1966

NA Not available.
[1] Upon completion the original plant would be shut down.

Increasing domestic demands for urea, chiefly for fertilizer use, led to heavy expansion of production capabilities in 1965. If all planned projects and plants under construction in 1965 materialize capacity by the end of 1966 will be double that in 1964. Several new plants were completed and functioning in 1965.

Columbia Nitrogen Corp. began operating a new 25,000-ton-per-year plant at Augusta, Ga. At New Orleans, La., American Cyanamid Co., built a new plant with an output of about 157,000 tons per year. A new plant with a 35,000-ton-per-year output was completed at Henderson, Ky., for Spencer Chemical Division, Gulf Oil Corp. Mississippi Chemical Co. completed a new urea plant at Yazoo City, Miss., adding 35,000 tons per year to its existing output of 45,000 tons. Nipak Inc. had an 85,000-ton-per-year plant under construction at Kerens, Tex., and Solar Nitrogen Chemicals, Inc., had a plant of equal capacity under construction at Lima, Ohio. Both Allied Chemical Corp. and Mobile Chemical Co. were constructing urea production facilities in connection with their large new ammonia plants under construction at Geismar, La., and Beaumont, Tex., respectively. Borden Cemical Co. was planning a 175,000-ton-per-year plant at Geismar, La., where the firm had a large ammonia plant under construction. Shell Oil Co. was reported to be building a urea plant in conjunction with an anhydrous ammonia plant at Portland, Ore. Collier Carbon & Chemical Corp. expected to have a new urea plant operative in 1966 at the site of its new ammonia plant under construction at Brea, Calif. Terra Chemicals International Inc. announced that it would build a large fertilizer-manufacturing facility at Port Neal, Iowa, which was to include a 350-ton-per-day urea plant. Agway, Inc. expected to produce urea at Olean, N.Y., in a new plant adjacent to the new Felmont Oil Corp. ammonia plant scheduled for completion in 1966.

In 1965, facilities for the production of other nitrogen compounds also were expanded. Several new nitric acid and ammonium nitrate plants were constructed. The New Jersey Zinc Co. started construction on a 270,000-ton-per-year diammonium phosphate unit, said to be the largest in the world. The plant was scheduled for completion in 1966. W. R. Grace & Co. had plans for a 100,000-ton-per-year ammonium phosphate plant to be constructed at Henry, Ill., and in operation in 1967.

The following new air-separation plants to produce nitrogen were reported completed in 1965:

Company [1]	Plant location	Gas capacity (tons per day)
Air Reduction Pacific Co.	Vancouver, Wash.	[2] 160
Air Reduction Co.	Titusville, Fla.	[2] NA
Big Three Industrial Gas & Equipment Co.	Beaumont, Tex.	[3] 800
Chemetron Corp., National Cylinder Gas Division.	Denver, Colo.	[2] 45
Burdett Oxygen Co. of Cleveland, Inc.	Parkersburg, W. Va.	[2] 450
Industrial Air Products Co.	Portland, Ore.	[2] 80

NA Not available.
[1] The list is not necessarily complete.
[2] Argon, nitrogen, and oxygen.
[3] Nitrogen and oxygen.

CONSUMPTION AND USES

Domestic consumption of nitrogen, as compounds, was about 9 percent greater than in 1964. More than 80 percent of all nitrogen consumed, with the exception of nitrogen gas and liquid, went into fertilizer materials.

According to reports by the Department of Agriculture, nitrogen consumed by agriculture as fertilizers for the year ending June 30, 1965, was 4,580,519 tons. This was an increase of 5 percent over the tonnage consumed in the 12-month period ending June 30, 1964.

PRICES

Price increases were noted in August on some fertilizer compounds—$2 per ton on ammonium nitrate and $3 per ton on ammonium phosphate and urea. Prices otherwise held steady. The usual seasonal discounts were given on anhydrous ammonia for delivery in August and September.

Table 4.—Price quotations for major nitrogen compounds in 1965
(Per short ton)

Compound	Jan. 1	Dec. 30	Effective date of change
Ammonium nitrate, fertilizer grade, 33.5 percent N (nitrogen):			
Canadian carlots, bags, f.o.b. shipping point	$67.00	[1] $72.00	Nov. 8
Domestic f.o.b. works, bags	67.00	[2] 69.00–70.00	Nov. 8
Ammonium nitrate, domestic with dolomite, 20.5 percent N bags, carlots, Hopewell, Va	52.00	55.00	Jan. 4
Ammonium sulfate, standard granular, bulk, f.o.b. works	32.00–34.00	32.00–34.00	
Anhydrous ammonia, ferilizer, tanks, works, freight equalized east of Rockies	92.00	92.00	[3]
Sodium nitrate, domestic, commercial, bulk, carlots, works	44.00	44.00	
Sodium nitrate, imported, commercial, bulk, carlots, port warehouse	44.00	44.00	
Urea:			
Industrial, 46 percent N, bags, carlots, delivered, freight equalized	100.00	100.00	
Agricultural, 45 percent N, bags, carlots, delivered	92.00	96.00	Jan. 4

[1] Quoted at $70 from Jan. 4 to Nov. 8.
[2] Quoted at $70 from Jan. 4 to Aug. 2, and $68 from Aug. 2 to Nov. 8.
[3] Quoted at $84 from Aug. 9 to Oct. 4.

FOREIGN TRADE

Gross weight of nitrogenous fertilizer materials exported during the year was nearly 39 percent greater than in 1964. Shipments of ammonium sulfate were nearly double those of 1964, and represented 59 percent of the total quantity of materials exported.

Gross weight of nitrogen compounds imported for consumption was slightly less, but the nitrogen content was slightly more than in 1964. This was due chiefly to a 28-percent increase in incoming shipments of anhydrous ammonia while shipments of most of the other materials decreased. However, the quantity of ammonium phosphate imported increased 81 percent. Although about 17 percent less urea was imported than in 1964, urea remained a major fertilizer import, amounting to 15 percent of the total.

Table 5.—U.S. exports and imports for consumption of major nitrogen compounds
(Short tons)

Compounds	1964		1965	
	Gross weight	Nitrogen content	Gross weight	Nitrogen content
Exports:				
Industrial chemicals:				
Ammonium nitrate	1,160	406	(1)	(1)
Anhydrous ammonia and chemical-grade aqua (ammonium content)	46,176	37,957	63,879	53,147
Fertilizer materials:				
Ammonium nitrate	87,077	29,171	103,716	34,745
Ammonium phosphates and other nitrogenous phosphatic-type fertilizer materials	363,116	54,467	319,652	47,948
Ammonium sulfate	483,784	101,595	961,601	201,936
Anhydrous ammonia and aqua (ammonia content)	102,303	84,093	120,324	98,906
Nitrogenous chemical materials, not elsewhere classified	60,427	12,085	34,560	6,912
Sodium nitrate	950	152	466	75
Urea	37,432	16,844	33,554	15,099
Total	1,182,425	336,770	1,637,752	458,768
Imports:				
Industrial chemicals: Ammonium nitrate	160	56	240	84
Fertilizer materials:				
Ammonium nitrate	200,015	66,005	177,232	58,487
Ammonium nitrate-limestone mixtures	37,861	7,951	1,500	315
Ammonium phosphates	96,146	14,422	174,460	26,169
Ammonium sulfate	207,964	43,672	180,869	37,982
Calcium cyanamide or lime nitrogen	23,999	6,000	18,719	4,680
Calcium nitrate	54,740	8,485	33,200	5,146
Nitrogen solutions	82,163	28,757	73,584	25,754
Anhydrous ammonia	158,264	130,093	202,622	166,555
Potassium nitrate or saltpeter, crude	3,163	380	3,545	425
Potassium, nitrate, sodium nitrate mixtures	13,498	2,025	7,409	1,111
Sodium nitrate	363,216	58,115	391,943	62,711
Urea	271,485	123,526	225,785	102,732
Other	23,957	4,791	20,455	4,091
Total	1,536,631	494,278	1,511,563	496,242

[1] No longer separately classified.

WORLD REVIEW

Afghanistan.—The Ministry of Mining and Industry signed a contract with the Soviet trade organization, Neftechimprom-export, for the construction of a nitrogen fertilizer plant at the town of Mazar-Sherif, about 43 miles from the Soviet border. The plant, the first of its type in Afghanistan, was expected to have an annual capacity of 71,000 tons of ammonia, and its completion was scheduled for 1969.

Argentina.—Government approval was granted for Petrosur, a company comprised of both foreign and local interests, to build a fertilizer plant at Campana. The plant was designed for annual production of 55,000 tons of ammonia, 50,000 tons of ammonium sulfate, 30,000 tons of compound fertilizers, 39,000 tons of sulfuric acid, and 55,000 tons of urea. The facility was scheduled for operation in 1967.

Australia.—Imperial Chemical Industries of Australia and New Zealand (ICIA-NZ), with Conzinc Rio Tinto of Australia Ltd. planned to build a nitrogenous fertilizer plant at Newcastle, New South Wales.

Boral Ltd. and Mitsui & Co., a Japanese firm, announced plans to erect a 113,000-ton-per-year nitrogenous fertilizer plant near Sydney.

Table 6.—World production and consumption of nitrogen compounds, years ended June 30, by principal countries

(Thousand short tons of contained nitrogen)

Country	Production [e]			Consumption [e]		
	1962–63	1963–64	1964–65	1962–63	1963–64	1964–65
Australia	22	23	31	55	74	74
Austria	202	202	222	80	91	97
Belgium	321	309	392	148	155	165
Brazil	14	15	8	64	68	77
British West Indies	29	33	33	22	24	26
Bulgaria	109	123	229	82	111	193
Canada	522	516	542	166	209	254
Ceylon	----	----	----	33	44	44
Chile	194	199	214	47	45	66
China	362	497	551	819	1,017	1,085
Cuba	17	17	----	84	88	75
Czechoslovakia	177	179	185	187	214	234
Demark	----	----	23	161	173	191
Finland	50	74	87	73	90	107
France	982	1,200	1,349	905	1,052	1,122
Germany:						
East	418	421	414	328	346	419
West	1,617	1,739	1,809	1,146	1,164	1,253
Greece	----	32	39	120	128	149
Hungary	88	98	109	155	230	234
India	225	254	287	373	482	584
Indonesia	----	17	22	121	106	77
Ireland	----	----	----	36	36	30
Israel	26	29	31	29	30	33
Italy	930	994	1,067	531	532	585
Japan	1,570	1,738	1,874	1,049	1,113	1,182
Korea:						
North	99	99	99	110	110	110
South	44	63	71	248	169	254
Malawi, Southern Rhodesia, Zambia	----	----	----	25	25	49
Mexico	91	133	245	148	244	292
Netherlands	529	546	606	346	341	345
Norway	341	387	408	69	89	95
Pakistan	82	105	90	114	84	91
Peru	19	19	22	45	41	55
Philippines	9	9	10	53	55	55
Poland	394	424	460	407	435	466
Portugal	100	118	129	100	88	106
South Africa, Republic of	131	132	146	144	202	200
Spain	179	205	291	392	413	465
Sweden	61	83	80	142	157	177
Switzerland	28	35	36	31	32	35
Taiwan	94	121	175	130	170	212
U.S.S.R.	1,560	1,932	2,314	1,432	1,771	2,251
United Arab Republic (Egypt)	123	126	166	193	238	288
United Kingdom	820	895	966	850	922	952
United States	4,977	5,634	6,112	5,163	5,746	6,316
Viet-Nam, South	----	----	----	31	75	83
Yugoslavia	14	75	103	138	214	229
World total [1]	17,642	20,086	22,340	17,620	19,916	22,274

[e] Estimate.

[1] Includes quantities for minor producing and consuming countries not listed above.

Source: Nitrogen. No. 39, Jan.–Feb., 1966, pp. 15–16.

Mt. Morgan Grace Ltd., a new company jointly formed by Mount Morgan Ltd. and W. R. Grace & Co., was expected to put a new nitrogenous fertilizer plant on stream in Gladstone, Queensland, by 1967. Ammonia, ammonium sulfate, phosphoric acid, and mixed fertilizers were the planned products.

Ammonia Co. of Queensland Pty. Ltd., announced plans to construct a new anhydrous ammonia plant at Pinkenba, Queensland, for operation early in 1966.

Belgium. — Carbochimique, S.A., contracted to have a 1,000-ton-per-day anhydrous ammonia plant erected at Tertre, the site of the company's existing nitrogenous fertilizer facilities including a 132,000-ton-per-year ammonia plant. The new ammonia unit was scheduled for completion in 1967.

Société Belge de l'Azote et des Produits Chamiques du Marly (SBA) was expanding its facilities at Marly, near Brussels, with new units for producing ammonia,

nitric acid, and calcium ammonium nitrate. The ammonia and nitric acid units were due on stream before the end of the year, while the nitrate plant was scheduled for operation by mid-1966.

Bulgaria.—A large chemical plant was reported under construction near Vraza. Units for producing anhydrous ammonia and 600,000 tons per year of urea were included. Also plans were made to begin construction in 1966 on a new petrochemical complex at Pleven, which would include plants for the production of about 200,000 tons per year of nitrogenous fertilizers. First products were expected from the new plants in 1968. Plans were made to expand nitrogenous fertilizer production to 700,000 tons per year (nitrogen content) by 1980.[2]

Canada.—Brockville Chemicals Ltd. was doubling the capacity of its anhydrous ammonia facility at Maitland, Ontario, to 450 tons per day. The firm also had a new urea plant with a daily capacity of 150 tons and a 250-ton-per-day nitric acid plant under construction at the same site. The new units were expected to produce by early summer of 1966.

Brunswick Mining & Smelting Corp. Ltd., announced plans for building an ammonia plant at Belledune Point, New Brunswick, to produce 1,000 tons daily. The date scheduled for completion was in late 1966 or early 1967.

A $50 million fertilizer complex was under construction at Courtright, Ontario, for Canadian Industries Ltd. In addition to a 1,000-ton-per-day anhydrous ammonia plant, units were being installed to produce nitric acid, ammonium nitrate, ammonium phosphate, urea, and phosphoric acid. The five plants were scheduled for completion by mid-1966.

Consolidated Mining & Smelting Co. of Canada, Ltd. (COMINCO), completed an ammonium phosphate plant near Regina, Saskatchewan, having an annual output capacity of 100,000 tons.

Cyanamid of Canada Ltd. had a $17 million expansion project underway at Welland, Ontario. The project included a new 700-ton-per-day anhydrous ammonia plant, and a urea plant, which will have a daily output capacity of 300 tons. Completion was expected by mid-1966.

Northwest Nitro Chemicals, Ltd. was building a new 600-ton-per-day anhydrous ammonia plant at Medicine Hat, Alberta.

Construction was reported to have started late in the summer on a chemical fertilizer facility near Brandon, Manitoba, for J. R. Simplot Chemical Fertilizer Co. The project, scheduled for completion in 1966, included units for annual production of 100,000 tons of anhydrous ammonia, 70,000 tons of nitric acid, 35,000 tons of urea, nearly 90,000 tons of ammonium nitrate, and about 250,000 tons of ammonium phosphate.

Construction was completed on a major expansion of the Sherritt Gordon Mines Ltd. fertilizer production facilities at Fort Saskatchewan, Alberta. The new installations were reported to have nearly doubled the firm's ammonia output capacity and tripled its urea production.

Western Cooperative Fertilizers, Ltd., put a new fertilizer plant on stream with daily production capacities of the individual units as follows: 200 tons of anhydrous ammonia, 600 tons of sulfuric acid, 190 tons of phosphoric acid, 160 tons of nitric acid, 215 tons of ammonium nitrate and 520 tons of ammonium phosphate.

Table 7.—Chile: Exports of nitrate in 1965, by countries[1]

(Short tons)

Destination	Quantity
Argentina	9,546
Australia	4,864
Belgium	20,097
Brazil	63,632
China	41,189
Denmark	33,841
France	52,154
Germany	2,222
Greece	12,470
India	15,013
Ireland	3,321
Japan	31,746
Lebanon	3,868
Mexico	15,680
Near East[2]	4,850
Netherlands	71,104
Peru	9,144
Spain	131,378
Sweden	4,409
United Kingdom	13,852
United States	439,769
Yugoslavia	3,858
Other Central and South America[3]	1,165
In transit	27,400
Total	1,016,572

[1] Includes 107,766 tons of potassium nitrate.
[2] Includes Jordan and Syria.
[3] Includes Colombia, Ecuador, El Salvador, and Uruguay.

[2] Nitrogen. Bulgaria Plans to Produce 700,000 t.p.a. N by 1980. No. 36, July 1965, pp. 22–23.

China.—The Wuching Chemical Works, in Shanghai, started limited production of urea in a new 40,000-ton-per-year plant. Also, the Chinese news agency reported that initial operation of the Hopei project, a large, modern nitrogenous fertilizer plant, had begun. The Government decreed that a series of new nitrogenous fertilizer plants with annual capacities of 25,000 tons of ammonia must be built. Many existing fertilizer plants were being reconstructed and expanded.

Colombia. — Industria Colombiana de Fertilizantes, S.A., 64-percent Government-owned, suspended operation of its chemical fertilizer plant at Barrancabermeja. A reorganization of the corporation and a redesigning and expansion of the plant for more economical operation were planned. Ammonium nitrate was the major product.

France. — Charbonnage de France, a Government-owned coal mining company, planned to invest about $20 million in a nitrogen-products plant with an output of 250,000 tons per year of nitrogen. The plant was to be erected at Nord-Pas-de-Calais.

Etablissement Kuhlman ordered a new ammonia plant built at its LeMadeleine plant near Lille.

A newly organized company, jointly owned by Compagnie Francaise de Raffinage, Office National Industriel de l'Azote, and Société Generale d'Engrais et Produits Chimiques Pierrefitte, was to establish an anhydrous ammonia plant near Le-Havre. Production of 1,000 tons ammonia per day was scheduled to begin in 1967.

Germany, West. — A 1,000-ton-per-day ammonia plant and a 540-ton-per-day concentrated nitric acid plant was being built for Erdölchemie, G.m.b.H. at Dormagen between Cologne and Dusseldorf. The units were expected to be productive in 1966.

Two new urea plants were being constructed; a 165-ton-per-day unit at Luneburg for Salzgitter Chemie G.m.b.H. and a unit, capacity unknown, for Saarbergwerke, A.G. at Perl.

Greece.—It was reported that Government approval was given for a group of Greek companies to build a $45 million fertilizer plant in central Greece to be completed in 1967. Among the products to be produced was 165,000 tons per year of urea.

Hungary.—Projected plans for the new integrated chemical works being built at Szeged, established the following annual production capacities: 550,000 tons of nitrophosphates, 186,000 tons of calcium nitrate, and 212,000 tons of calcium ammonium potassium nitrate. However, construction which was underway indicated that the initial capacities would be about one-half of that ultimately planned.

The fertilizer facilities of Borsod Chemical Combine were being expanded, and it was hoped that by the end of the year the ammonia production capacity of the Borsod plant would be increased by 100,000 tons per year.

India.—Fertilizer Corporation of India commissioned a new nitrogenous fertilizer complex at Trombay. Annual capacities of the units included in the plant were stated as 115,000 tons of ammonia, 105,000 tons of nitric acid, 330,000 tons of nitrophosphate, 99,000 tons of urea, and 33,000 tons of methanol. An expansion project by Fertilizers & Chemicals Travancore, Ltd., at Alwaye, Kerala, to add 40,000-ton-per-year capacity, was to be completed by the end of the year.

The following plants were either under construction or approved for construction:[3]

[3] Bureau of Mines. Mineral Trade Notes. V. 61, No. 5, November 1965, pp. 41–43.
Nitrogen. Present Status of India's Nitrogen Expansion Programme. No. 37, September 1965, pp. 13–17.

Company and plant location	Annual capacity in metric tons of nitrogen	Date expected completion
Public sector: (Government plants)		
Neyveli, Madras	70,000	1966
Gorakhpur, Uttar Pradesh	80,000	1967
Namrup, Assam	45,000	1967
Durgapur, West Bengal	125,000	1968
Cochin, Kerla	165,000	1968
Korba, Madhya Pradesh	100,000	1969
Private sector:		
Coromandel Fertilizer Ltd., Visakhapatnam, Andhra Pradesh	80,000	1967
Gujarat State Fertilizer Co. Ltd., Baroda	96,000	1967
Hindustan Allied Chemicals, Ltd., Kothagudem, Andha Pradesh	100,000	1967
Birha Gwailor, Ltd., Goa	160,000	1968
Rajasthan Fertilizers & Chemicals Corp. Ltd., Kotah, Rajasthan	100,000	1968
Imperial Chemical Industries, Ltd., Kanpur, Uttar Pradesh	100,000	1968

Indonesia.—An Italian firm was contracted by the Government to build a fertilizer plant at Gresik to produce annually 7,000 tons of ammonia, 150,000 tons of ammonium sulfate, and 45,000 tons of urea. Operation of the plant was scheduled for 1966.

Iran. — National Petrochemical Co., a subsidiary of the National Iranian Oil Co., joined with Allied Chemical Corp. (U.S.) in a 50–50 partnership to develop a major petrochemical complex. Ammonia, urea, sulfur, and mixed fertilizers were planned for initial production.

Ireland.—A new ammonia plant at Arklow was put into operation in September by Nitrigin Eireann Teoranta (Irish Nitrogen, Ltd.) a State-owned company. Final products of the plant were said to be sulfate of ammonia and calcium ammonium nitrate with a combined annual capacity estimated at 150,000 tons.

Japan.—The Japanese Ministry of International Trade & Industry approved a general production expansion of 20 percent for existing ammonia plants. Many producers planned to have new, large-capacity single-train units built and scrap their existing facilities. Sumitomo Chemical Co. Ltd. was planning a 248,000-ton-per-year plant at Niihama to be completed near the end of 1966. Nissan Chemical Co. decided late in the year to replace its 85,000-ton ammonia plant with a 120,000-ton-per-year plant at Toyama. Ube Kosan Industry planned a 600-ton-per-day ammonia plant and a 300-ton-yer-day urea plant for building in the Sakai area. Mitsubishi Chemical Co. had an ammonia and a urea plant under construction at Mizushima. Annual capacities were stated as 180,000 and 73,000 tons respectively. At Sakai, Toyo Koatsu Industries Inc. were building a 500-ton-per-day ammonia plant and a 600-ton-per-day urea plant. These two plants, equipped with computer process control systems for complete automation, were due on stream in April 1966. Showa Denko K.K., contracted for a 500-ton-per-day ammonia plant to be built at its Kawasaki works near Tokyo. In addition, it was reported that Kasei Mizushima Co., Nihon Gas Chemical Co., Tokai Gas Co., Kyowa Chemicals Co. were expanding urea production capacities for a total increase of about 620 tons per day.

Korea, South.—Negotiations were completed for the construction of two fertilizer plants, each having an annual capacity of 84,000 tons of urea and 180,000 tons of mixed fertilizers. The new plants at Chinhoe and Ulsan were scheduled for completion early in 1967.[4]

The Japanese Government approved the sale of a $44 million urea plant to be erected by Japanese engineers. The plant, having an annual capacity of 330,000 tons of urea, was to be completed 1 year after the signing of the construction contract.[5]

Kuwait. — A 120,000-ton-per-year ammonia plant was to be completed by the end of the year at Shuaibeh, 20 miles south of the city of Kuwait. The Government expects to export nearly all of the production.

Lebanon.—Esso Fertilizer Co., a new company formed by Esso Mediterranean, Inc., and Elie J. Doumet S.A.L. of Lebanon, contracted with an Italian firm to erect a nitrogenous fertilizer plant having

[4] Bureau of Mines. Mineral Trade Notes. V. 61, No. 4, October 1965, p. 40.

[5] Oil, Paint and Drug Reporter. Urea Plant In Korea To Be Built by Japan. V. 188, No. 2, July 12, 1965, pp. 5, 48.

a capacity of 140,000 tons per year. The facility located at Ras Saalata, near Beirut, was to be completed in 1966.

Mexico. — Petroleos Mexicanos (PEMEX), awarded a contract for the construction of a 1,000-ton-per-day anhydrous ammonia plant at Minatitlan. It was reported that PEMEX also started construction of a 50,000-ton-per-year ammonia and fertilizer plant at Ciudad Camargo, Chihuahua, and planned a similar facility for Frontena, Tabasco.

Netherlands.—Maatschappij tot Exploitatie van Kooksovengassen, N.V. (MEKOG) had a 400-ton-per-day urea plant under construction at Pernis, near Rotterdam. Production was expected in 1966.

A new company, Ammoniak Unie N.V., jointly formed by Badische Anilin-und-Soda Fabrik A.G. and Verenigde Kunstmestfabrieken Mekog-Albatros N.V., started construction on a 300,000-ton-per-year ammonia plant at Pernis. First production was scheduled for October 1966.

Esso Nederland NV was building a 300,000-ton-per-year ammonia plant and associated urea facilities near Rotterdam. The plants were expected to be in operation early in 1968.

Nederlandse Stikstof Maatschappij N.V. was expanding its ammonia production facilities near Terneuzen with a new 160,000-ton-per-year unit scheduled for completion in early 1966.

Norway.—Norsk Hydro-Elektrisk A/S, Norway's principal producer of nitrogenous materials completed a 100,000-ton-per-year ammonia plant early in the summer at its chemical center in Herøya. The firm then started construction of another unit to produce annually 50,000 tons, and scheduled an additional unit for completion in 1967. The capacity of the company's urea plant at the same site was also being expanded from 150,000 tons to 250,000 tons.

Pakistan.—A urea plant with an annual capacity of 173,000 tons was planned for Dharki-Mari, West Pakistan, by Esso Pakistan Fertilizer Co. Ltd. The plant was scheduled for completion in 1967.

A contract was reportedly awarded to a consortium of six Japanese firms to erect a 150,000-ton-per-year urea plant in East Pakistan.

Peru.—A new nitrogenous fertilizer plant went on stream at Cuzco. Anhydrous ammonia capacity was stated to be only 14,000 tons per year, but the plant was designed for future expansion to twice this amount. The ammonia is converted to nitric acid and calcium ammonium nitrate.

Philippines. — Completion of the Esso Standard Fertilizer & Agricultural Chemical Co. fertilizer plant was expected by yearend. Units with production capacities of 300 tons per day of ammonia and 200 tons per day of urea were included in the project.[6]

Poland.—A new ammonia plant was reported in production at the Kedzierzyn nitrogen facilities. A daily output of 165 tons of ammonia was expected to produce 165,000 tons of calcium ammonium nitrate annually as the final product. This was the first ammonia plant in Poland to use methane from coke-oven gas for feedstock.

The first ammonium nitrate plant in Poland started production at Tarnow. The capacity was given as 30,000 tons per year. Most of the output was scheduled for use as a raw material for producing caprolactam.

The first stage of a complete nitrogenous fertilizer plant at Pulawy was to be completed by the end of the year, and the ammonia, nitric acid, and ammonium nitrate plants, with daily capacity of 1,650, 2,975, and 3,680 tons respectively were to be completed by mid-1968.

Rumania.—The ammonia, nitric acid, and ammonium nitrate units of the Cravaiova chemical combine were not completed in 1964 as scheduled, but they were expected to be in operation by the end of 1965.

South Africa, Republic of.—According to reports, Fisons (Pty.) Ltd. signed a contract for the construction of a 100,000-ton-per-year ammonia plant at Milnerton, near Cape Town. The plant, to be completed by the end of 1966, was the first of three included in the project. The other two, a nitric acid unit and an ammonium nitrate unit, were to follow.[10]

African Explosives & Chemical Industries Ltd. was erecting a new 160,000-ton-per-year urea plant near Durban. The completion date was scheduled for 1967.

Spain.—The first ammonium nitrosulfate plant built in Spain was completed for Sociedad Espanola de Fabricaciones Nitrogenadas S.A. The annual capacity was

[6] Nitrogen. New Plants and Projects. No. 37, September 1965, p. 10.

[10] European Chemical News (London). Progress on Cape Town Fertilizer Complex. V. 7, No. 170, Apr. 16, 1965, p. 24.

stated to be 130,000 tons. Spanish firms in the nitrogen fertilizer sector were reportedly discussing the formation of a trade organization.[7] Fertilizantes de Iberia S.A. planned to build a 50,000-ton-per-year ammonia plant at La Coruna, a 75,000-ton-per-year ammonium sulfate plant at Huelva, and a complex fertilizer plant at Castellon. The firm was reported to be completing at Castellon a nitric acid plant with an annual capacity of 82,500 tons and a 120,000-ton-per-year ammonium nitrate plant.

It was reported that Fertilizantes Valencia S.A., a newly formed company, planned to build an ammonia plant at Valencia,[8] and Cros S. A. had plans for a new nitric acid and ammonium nitrate plants with annual capacities of 85,000 tons and 100,000 tons respectively to be erected at its Badalona facility.[9]

Sweden.—The first urea plant in Sweden was put on stream by Svenska Saltpeterverken A.B. at Koeping. The annual output capacity was stated to be 55,000 tons. The firm also began operating a newly constructed 50,000-ton-per-year ammonia plant at Kvarntorp.

Syria.—A fertilizer complex including a 150-ton-per-day ammonia plant at Homs was scheduled for completion by the end of 1967.

Taiwan. — Taiwan Fertilizer Corp. planned to build new urea and ammonium sulfate plants with annual output capacities of 100,000 and 150,000 tons respectively. Both plants were expected to be on stream by 1968.[10]

Trinidad.—Federation Chemicals Ltd., expected to have its second 200,000-ton-per-year anhydrous ammonia plant completed by the end of 1965.

Tunisia.—A fertilizer complex was being built at Gabès, which will include facilities for the production of anhydrous ammonia, nitric acid, ammonium nitrate, and ammonium phosphate. An annual output of about 200,000 tons of ammonium phosphate and 85,000 tons of nitrate was expected, most of which would be exported.

U.S.S.R.—The Navoi Works in central Asia, one of the largest chemical complexes in the U.S.S.R., started initial ammonia production. When in full production, the ammonia plant in the Ukraine.[11]
be 500,000 tons.

A contract was signed with a French firm to construct a 400,000-ton-per-year ammonia plant in the Ukraine.[12]

United Kingdom.—Shellstar Ltd., jointly formed by Shell Chemical Corp. (U.K.) and Armour & Co. (U.S.), became fully operational in November and announced plans for erecting a 1,000-ton-per-day ammonia plant and related fertilizer units at Ince Marshes, Ellesmere Port, Cheshire. The new plant was scheduled for operation in 1968.

The largest ammonia-producing project in the world was under construction at the Imperial Chemical Industries, Ltd., (ICI) Billingham Works on the Tees estuary. The project includes three identical single-train units, each having an annual capacity of 300,000 tons and was scheduled for operation in 1966. ICI began producing ammonium nitrate fertilizer at its new 300,000-ton-per-year plant at Severnside near Bristol, and it expected to have a second plant with an annual capacity of 360,000 tons in production by 1967. Also at Severnside, ICI put a new 190,000-ton-per-year ammonium plant on stream early in the year.

Yugoslavia.—Construction was started on a highly automated nitrogenous fertilizer plant at Kutina. The project, scheduled for completion in 1967, included a 100,000-ton-per-year urea unit, a 250,000-ton-per-year ammonium nitrate unit, and a complex fertilizer unit with an annual output of 45,000 tons.

TECHNOLOGY

James E. Carnahan and Leonard E. Mortenson discovered an electron carrier, ferredoxin, which enables bacteria to fix atmospheric nitrogen. Harold J. Evans found that a minute amount of cobalt is essential for bacterial nitrogen fixation. The addition of 0.1 part per billion of cobalt gave a 12-fold increase in the growth of soybean plants. These three

[7] Chemical Age (London). Spanish Producers May Set Up Nitrogen "Cartel." V. 94, No. 2415, Oct. 23, 1965, p. 620.
[8] Nitrogen. New Plants and Projects. No. 38, November 1965, p. 8.
[9] European Chemical News (London). Nitrogen Fertilizer Plant for S. A. Cros. V. 8, No. 186, Aug. 6, 1965, p. 32.
[10] E&MJ Metal and Mineral Markets. V. 36, No. 37, Sept. 13, 1965, p. 5.
[11] European Chemical News (London). Ensa To Build Fertilizer Complex in Ukraine. V. 8, No. 185, July 30, 1965, p. 8.

scientists shared in winning the 1965 Hoblitzelle National Award in Agricultural Sciences. It was said that the ability to regulate this process will be of inestimable value in the efficient production of food and fiber.[12]

Large capacity, 600- to 1,000-ton-per-day, ammonia plants were being engineered and built. The plants are based on a new integrated design that was said to appreciably lower the production cost. Gas preparation, purification, and ammonia synthesis, previously operated as separate units, were combined into a single-train plant. The use of multistage centrifugal compressors was responsible for much of the cost reduction. A single centrifugal compressor was said to replace several banks of reciprocating compressors, thus reducing equipment costs, floor space, and supporting foundations.[13] Operating cost per ton of ammonia produced in a 1,000-ton-per-day plant using naphtha feed, centrifugal compressors, and steam turbines was estimated at $28.97 compared with $37.06 per ton by three 330-ton-per-day plants using motor-driven reciprocating compressors.[14] Using natural gas as the raw material the cost per ton was $25.58 for the 1,000-ton-per-day plant.

An article was published which discussed basic questions that confront a company about to build a new ammonia plant.[15] The latest improvements in plant design and operation were considered in discussing steam reforming, CO conversion, CO_2 removal, ammonia-synthesis, and costs.

A new process[16] to prepare coke-oven gas for cryogenic processing and ammonia production was being built into the United States Steel Corp. chemical complex at Clairton, Pa. The total ammonia recovery was claimed to reach 99.5 percent. The new process produces a clean gas ready for compression for hydrogen recovery and avoids the production of ammonium sulfate which is currently in over capacity.[17]

A new process for making urea, called the Thermo-Urea hot-gas recycle process, was patented.[18] Because the process requires the use of centrifugal compressors, as in the new large capacity ammonia plants, it cannot be pilot-planted. A huge volume of gas is required for the efficient operation of centrifugal compressors. The proof of the technical and economic advantages of the process will have to wait until someone builds a 1,500-ton-per-day or larger plant using it.[19] Chemical Construction Corp. found that single-train urea plants with capacities up to 2,000 tons per day are technically feasible and more economical both in operating and capital costs per ton of urea produced. It was reported that urea can be made with the new process in a 1,500-ton-per-day or more plant for about $27 per ton using $18-per-ton ammonia.[20]

Dutch State Mines developed an improvement in its well-known recycle urea process. After tests in a 50-ton-per-day pilot plant, construction was started on a 220-ton commercial unit to use the process. The process was expected to lower utilities consumption, decrease capital cost requirements, and result in a simpler, more trouble-free operation.[21]

A paper was published which described the Stengel process for the manufacture of concentrated solutions of ammonium nitrate.[22] The authors stated that the process has two advantages in capital costs. The plants are small in comparison to those required by other processes of the same production rates and the reaction and concentration steps are in one stage, thus saving the cost of separate concentrator.

A new process was developed by Oesterreichische Stickstoffwerke A.G. (OSW) Linz, Austria, whereby melamine can be produced continuously from urea at atmospheric pressures. It was claimed that the product is 99.9 percent pure and does

[12] Farm Chemicals. "Fixing" Nitrogen Fixation. V. 128, No. 8, August 1965, p. 45.
[13] Chemical Engineering. The New Look in Ammonia Plants. V. 72, No. 24, Nov. 22, 1965, pp. 124–126.
[14] European Chemical News Large Plant Supplement. The Design and Economics of Large, Single-Train Ammonia Plants. V. 8, No. 191, Sept. 10, 1965, pp. 34, 36.
[15] Chemical Engineering. Questions and Answers on Today's Ammonia Plants. V. 72, No. 13, June 21, 1965, pp. 109–118.
[16] Rice, Robert D. Method of Recovering Ammonia From Coke-Oven Gasses. U.S. Pat. 3,024,090, Mar. 6, 1962.
[17] Chemical Week. Cool Gain for Ammonia Recovery. V. 96, No. 9, Feb. 27, 1965, p. 39.
[18] Cook, Lucien H., and Ivo Mavrovic (Chemical Construction Corp.). Urea Synthesis Process. U.S. Pat. 3,200,148, Aug. 29, 1962.
[19] Chemical & Engineering News. Big Urea Plants Make New Process Possible. V. 43, No. 36, Sept. 6, 1965, pp. 120–121.
[20] Chemical & Engineering News. Urea Follows Ammonia in Trend to Huge Plants. V. 43, No. 35, Aug. 30, 1965, pp. 32–33.
[21] European Chemical News (London). Improved DSM Process Reduces Urea Costs. V. 8, No. 194, Oct. 1, 1965, pp. 32–34.
[22] Chemical Trade Journal and Chemical Engineer. The Stengel Process for Ammonium Nitrate. V. 156, No. 4053, Feb. 11, 1965, p. 178.

not require recrystallization. Melamine is an important chemical in the plastics industry and has been relatively expensive because production costs are high using the conventional dicyandiamide route. The new process [23] may lead to much lower production cost.

Several new uses were developed for nitrogen and nitrogen compounds. The Army modified a Chevrolet pickup truck to operate using ammonia as fuel. And research studies were completed in General Motors Corp. laboratories showing that ammonia-fueled engines can be developed to perform as well as the present gasoline-fueled auto engines.[24] A liquid ammonia battery was developed which can operate within a temperature range of minus 65° to plus 165° F for extended periods.[25] The Chowchilla Water District repaired a 75-mile stretch of leaky concrete pipe by a simple method of filling the pipe with ammonia solution. The solution precipitated calcium carbonate which set in the cracks and stopped the leaks. After the ammonia water was drained and the pipe was allowed to dry for several days, it was ready for use.[26] A paper was published suggesting the use of ammonia in the reduction or "poling" process in copper refining. Test data obtained in pilot plant studies showed an average ammonia consumption of 1 kilogram per ton of copper produced. Several advantages in using ammonia instead of the old method of copper poling with wood were cited.[27] Research engineers of Illinois Institute of Technology in Chicago developed a new device for freezing food with nitrogen. Liquid nitrogen is sprayed on the food in a horizontal cylindrical chamber. The new method is more efficient and is capable of processing several times as much food in a unit equal in size to one using the old method of immersion freezing.[28]

[23] Chemical Engineering. A New Route to Melamine From Urea. V. 72, No. 21, Oct. 11, 1965, pp. 180–182.

[24] Steel. Army Discloses Energy Fuel Depot Concept. V. 158, No. 2, Jan. 11, 1965, p. 76.

[25] Missiles and Rockets. Honeywell Building Ammonia Batteries. V. 16, No. 18, May 3, 1965, p. 21.

[26] Chemical Engineering. Treatment With Ammonia Solution Stops Leak in Concrete Pipes. V. 72, No. 2, Jan. 18, 1965, p. 85.

[27] Journal of Metals. Copper Refining by Gaseous Ammonia. V. 17, No. 4, April 1965, pp. 386–388.

[28] Chemical Week. V. 96, No. 8, Feb. 20, 1965, p. 92.