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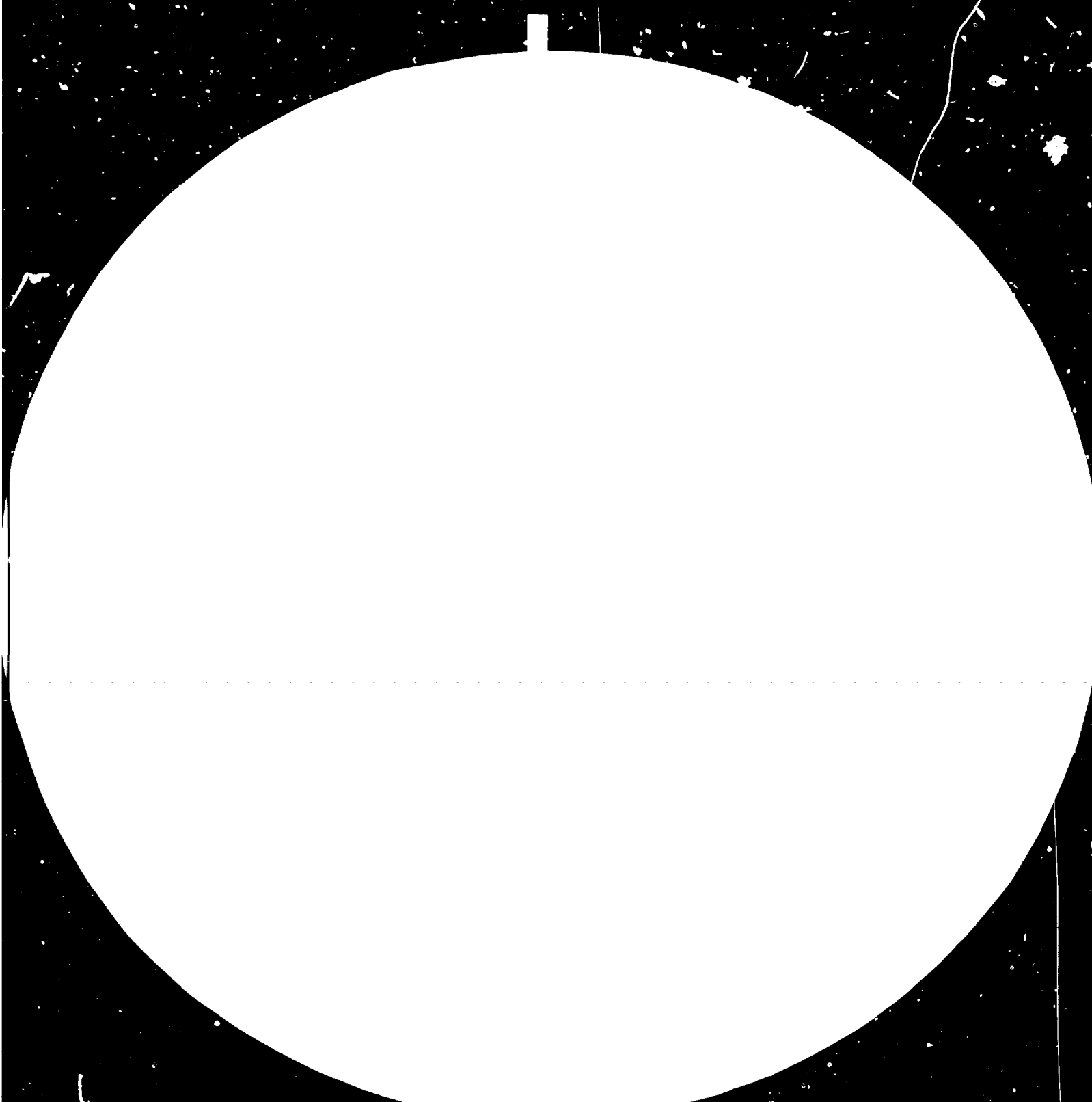

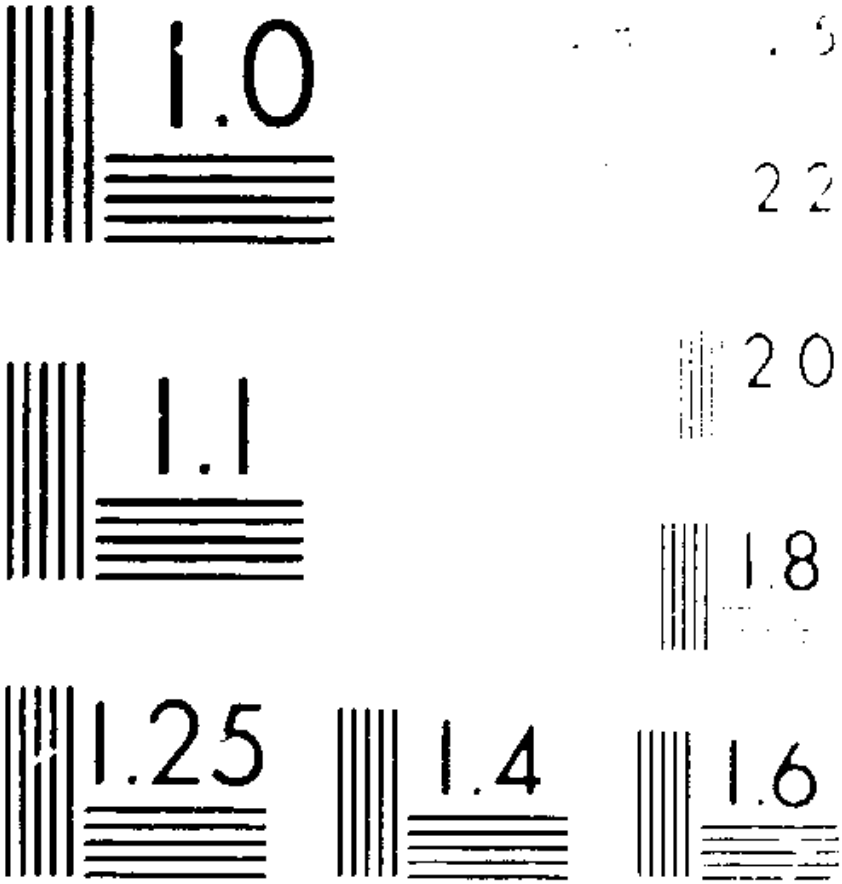
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THE FERTILIZER INDUSTRY IN MEXICO*

by

Adolfo Sisto Velasco**

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MEXICO (the United Mexican States) is a Federal Republic situated in North America between parallels 32°43' and 14°32'; the Tropic of Cancer crosses the center of the country.

The total area of the country is 1,953,128 km^2 and it has a population of 70 million. Approximately 40% of the economically active population is occupied in agriculture and animal husbandry.

Climatic conditions vary, as 60.7% of the country's area lies in the dry zone, 26.27% in the temperate humid zone and 13.1% in the tropical humid zone.

From the agricultural standpoint, there are 24 million hectares of arable land, of which 3,600,000 hectares are irrigated.

The following table lists the country's principal crops in 1981, the land area devoted to each and the harvests obtained in metric tons:

	CROP	HA X 1000	MT X 1000
1.	Rice	180	643
2.	Beans	2,150	1,469
3.	Corn	8,150	14,766
4.	Wheat	861	3,189
5.	Sesame	150	86
6.	Cotton	355	530
7.	Safflower	391	372
8.	Soybeans	378	712
9.	Sorghum	1,767	6,296
10.	Barley	274	559
	Total	14,656	28,622

Apparent consumption of fertilizers in 1981 was 1,558,150 MT of nutrients. This included a total of 1,111,900 MT of N.

The fertilizer industry in Mexico may be considered to have begun in 1943, with the creation by the federal government of Guanos y Fertilizantes de México, S. A. (GUANOMEX), now known as Fertilizantes Mexicanos, S. A. (FERTIMEX), for the purpose of producing and marketing fertilizers.

GUANOMEX activities were at first confined to the exploitation of marine bird guano deposits found on small islands in the Pacific Ocean off the coast of the southern portion of the peninsula of Baja California.

The relatively small amounts of guano obtained (a maximum of 15,000 MT per year) decided the firm to focus its activities on the manufacture of chemical fertilizers.

The company's first plant was built in 1947 in San Luis Potosí, S.L.P., and was designed to produce an annual total of 65,000 MT of simple superphosphate. This was followed in 1950 by the construction of a petrochemicals complex in Cuautitlán, Mexico for the production of anhydrous ammonia, sulphuric acid and ammonium sulphate, which was later supplemented by the addition of a simple superphosphate plant.

As GUANOMEX expanded its installations, the success obtained by these plants encouraged private industry to build new factories for the production of solid fertilizers in different localities of the Republic. These plants were acquired by the federal government through FERTIMEX in the late sixties.

Ammonia production began, as noted previously, with the Cuautitlán plant, which manufactured 50 MT/day (later increased to 70) using natural gas as a raw material,and was the first ammonia plant built in Latin America.

Installed capacity for the production of ammonia is now 3,007,100 MT per day and that of solid fertilizers is 4,443,000 MT, equivalent to 1,466,640 MT of nutrients, of which 1,109,500 MT correspond to N, 320,940 to P_2O_5 and 36,200 to K_2O.

Of the total nitrogen, 34.55% corresponds to sulphate, 52.16% to urea and the remainder to ammonium nitrate, DAP and NPK.

By 1986, plants currently under construction or in the engineering stage will increase production to a total of 2,125,000 MT per year of nitrogen in the form of solid fertilizers.

In addition to the above, some 300,000 MT per year (246,000 MT of N)

are currently being applied directly to the soil in the form of anhydrous ammonia, principally in the northwest and central regions of the country and in the Lower Rio Grande valley.

AMMONIA PRODUCTION

The Cuautitlán plant was followed in 1960 by another, built in Monclova, Coahuila by Fertilizantes de Monclova, S. A., with a capacity of 100 MT per day and using coke oven gas produced by a nearby steel plant as a raw material. Meanwhile, a 1956 petrochemicals law had reserved to Petróleos Mexicanos (PEMEX), a government agency engaged in the exploitation of petroleum, the construction and operation of all new anhydrous ammonia plants using natural gas that might be required in the future.

After building three plants with a capacity of 400 MT/day or less, PEMEX went on to construct several plants with a much larger capacity, including three 910 MT/day (1,000 short MT) plants and four 1,360 MT/day (1,500 short MT) plants, for a total installed capacity at the present time of 2,995,000 MT/year.

Most of the country's ammonia (82.2%, or 2,460,000 MT/year) is now being produced in Minatitlán, Veracruz, where one 200 MT/day plant, two 910 and four 1,360 MT plants are located. The rest is produced in Salamanca, Guanajuato by one 275 and another 910 MT/day plant,

and in Ciudad Camargo, Chihuahua, by a 400 MT/day plant.

The Monclova ammonia plant was shut down in 1970, but the Cuautitlan plant is still in operation.

AMMONIUM SULPHATE PRODUCTION

Installed capacity: 1,880,000 MT.

With the exception of 200,000 MT/year obtained as a by-product of a caprolactama plant, and of 12,300 MT produced by steel plants, all ammonium sulphate in Mexico is manufactured by employing a direct reaction of ammonia and sulphuric acid.

Plants built before the seventies used atmospheric crystallizers with a capacity of 150 MT/day each, two of which were installed at each site. The new factory in Querétaro, with a total capacity of 1,800 MT/day, has three recently constructed 600 MT lines using only one vacuum crystallizer apiece.

However, in 1970, as an emergency measure to provide a rapid increase in the production of sulphates, the old plants were expanded by increasing the number of crystallizers and their additional equipment. This made it possible to increase their capacity by 460,000 MT/year in less than 12 months.

UREA PRODUCTION

Installed capacity: 1,258,000 MT.

All urea plants are located in the vecinity of PEMEX ammonia plants so as to reduce CO^2 transportation needs; the most distant (in Pajaritos, Veracruz) is just 27 kms. away from the ammonia plants.

The first two plants, built in the early sixties, had a capacity of 150 MT/day. (Salamanca N° I and Minatitlán N° I).

These were followed by the construction of a 225 MT plant in Ciudad Camargo and later by that of one 750 MT Plant (Minatitlán II), one 1,000 MT plant (Salamanca II) and one 1,500 MT plant (Pajaritos I).

Another 1,500 MT/day plant (Pajaritos II) is currently under construction, and two more of the same capacity are in the engineering and procurement stage.

DAP AND NPK PRODUCTION

Installed capacity: 500,300 MT.

Production is centered in four relatively small plants, the largest

having a capacity of 450 MT/day. The first two large-capacity (1,300 MT/day) lines are currently under construction at the port of Lázaro Cárdenas on the Pacific Coast.

PLANT LOCATION

A number of different criteria have been employed in selecting plant locations.

The first plant (Cuautitlán, Mexico), which began operations in 1950, was built near Mexico City, at the time the center of all railway and highway communications in the country.

Others (Guadalajara, Torreón, Querétaro) were built to serve local farming needs, and raw materials are transported to the plant sites.

The Monclova plant was built next to a steel mill that provided the coke-oven gas for the production of ammonia, while the urea plants were built near PEMEX ammonia plants (Ciudad Camargo, Salamanca, Minatitlán and Pajaritos).

Another object in selecting the location of the last-mentioned plant, and that of the Lázaro Cárdenas plant currently under construction, was the possibility of building a company wharf at the ports for the ocean transport of their products.

PLANT CAPACITY

Rising demand for fertilizers, the availability of a greater volume of raw materials in certain localities, technological development and considerations of an economic nature have led the firm to move gradually onward from building small-capacity plants to the construction of large-scale lines, as may be seen from the foregoing data.

Furthermore, considerations based on such factors as infrastructure, transport and plant management have made it advisable in recent years to begin concentrating production to a limited number of sites within the country.

TECHNOLOGY

Construction of the first plants built in the country was based on turnkey contracts covering the entire complex involved.

As the country's technical resources increased, the participation of foreign companies was gradually reduced, and today contracts generally cover only the license and basic engineering supplied by a single or different companies for the various plants that make up a complex, with the rest of the work being done in Mexico. In some cases, these companies are asked to provide certain procurament services, but the orders are invariably placed by FERTIMEX.

The standard always followed is to emply the greatest possible amount of nationally manufactured equipment. Necessary exceptions to this rule include: very high-pressure equipment, turbogenerators and turboblowers, electric motors of more than 500 horsepower, centrifuges and specialized equipment.

PROBLEMS ENCOUNTERED IN THE DEVELOPMENT OF THE INDUSTRY

As it was to be expected, the rapid growth of the fertilizer industry produced a number of problems, most of which have now been solved, while others are in the process of being solved. There are still a few, however, for which we have yet to find a definitive solution.

These problems are of all kinds--planning, financing, technological, human resources, etc.--and some of them are not linked exclusively to the fertilizer industry, but are part of the general problems faced by the nation as a whole.

Some stem from the initial development of the industry, which because of the manner in which it first grew when in the hands of a number of different enterprises--all operating with the best of intentions but entirely uncoordinated--was based on no real plan. Everyone decided where to locate their plants, what type of products to manufacture, what technology and distribution systems

were to be employed, etc., solely on the basis of what was most convenient for their own company, something which did not necessarily coincide with our national agricultural needs.

This does not mean that private industry did not made a valuable contribution, however, as aside from supplying the market with what were at the time important amounts of fertilizers, it also launched the manufacture of new products and thus provided valuable experience in the fields of technology and training of personnel that was very useful in the later stages of the industry's development.

Perhaps the main problem is transportation. Rising national production placed a sudden and very heavy load on our existing transport system, which were unprepared to meet the situation for a number of reasons--one of them being that industry had never bothered to inform the transport authorities in advance of the many expansion programs that were being planned or under way. Close coordination between industrial planners and those in charge of national transport systems is indispensable.

As a first step, we have been making use whenever possible of coastal shipping, but unfortunately only one of our currently operating industrial units is located on a seacoast. At this site the company has built its own wharf, measuring 530 meters

in length by 40 in width and a useful depth of 12.5 meters, at which automatic loading and unloading systems are currently being installed. Another similar wharf was built at the new Lázaro Cárdenas plant now in the process of construction at a Pacific Ocean port; it has the same dimensions as the other, except that in this case the useful depth is 13.3 meters.

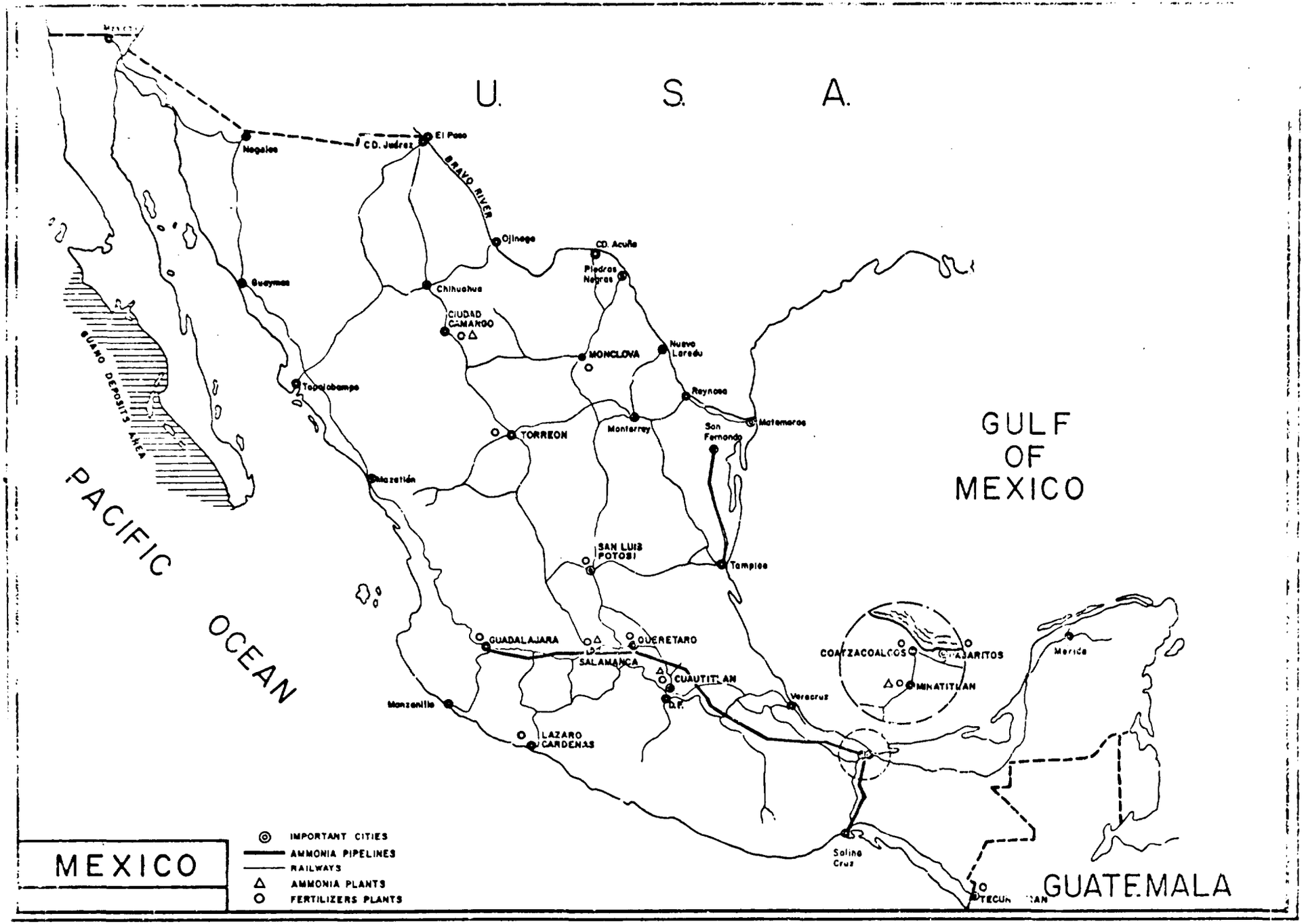
Another step has been the adoption of other, different transportation systems such as the movement of liquids through pipelines, which are currently handling about 30% of our cargo volume, over both short and long distances. The most important of these pipelines, however, is the one now being built from Minatitlán in the Isthmus of Tehuantepec, where the major part of the country's ammonia is produced, to Guadalajara in Western Mexico, covering a distance of some 1,500 kms. and providing a top capacity of 3,000 TM/D for the transportation of ammonia up to the central highlands. It will also supply the needs of industrial plants located along the way, such as those supplying ammonia for direct application to fields in such important agricultural areas as the Bajio and the west coast of Mexico, where the necessary distribution centers for direct sales to the public are under construction.

Where distribution is concerned, the systems used over the years have varied and work is still being done on this point as the distribution and sale of fertilizers is a complicated problem, since

it is affected by such different factors as logistics, prices, loans to farmers, etc.

A current and major effort being made by FERTIMEX to ensure the timely arrival of supplies at the distribution centers and to aid in the mass movement of supplies required during the application period is its "national warehouse construction plan" calling for the construction in each state of a primary warehouse and a series of satellite warehouses, all with capacities based on estimates of probable demand in the state.

Future planning for the industry is based on a development plan established in 1980 as part of the federal government's Global Development Plan, which includes the Mexican Food System (SAM), a program aimed at obtaining the country's self-sufficiency in the production of basic foods by encouraging a technological changeover in agriculture and the intensive use of manpower and fertilizers.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Salina Cruz
GUATEMALA
MEXICO
IMPORTANT CITIES
AMMONIA PIPELINES
RAILWAYS
AMMONIA PLANTS
FERTILIZERS PLANTS

NITROGEN

Installed capacity in Mexico (Jan. 1982)
(thousands of MT of product/year)

		Ammonia	Ammonium Sulphate	Ammonium Nitrate	Urea	DAP	NPK
Cd. Camargo, Chih.	PEMEX	132.000					
	FERTIMEX				75.000		
Coatzacoalcos, Ver.	FERTIMEX		200.000			82.500	
Cuautitlán, Méx.	FERTIMEX	22.000	235.000				
Guadalajara, Jal.	FERTIMEX		278.700				
Minatitlán, Ver.	PEMEX	2,461.800					
	FERTIMEX			100.000	302.000		140.000
Monclova, Coah.	FERTIMEX			68.000			66.000
Pajaritos, Ver.	FERTIMEX				495.000	145.800	
Querétaro, Qro.	FERTIMEX		594.000				
Salamanca	PEMEX	391.300					
	UNIVEX		190.000(*)				
	FERTIMEX		160.000		386.000		
Tecún Uman	FERTIMEX						66.000
Torreón	FERTIMEX		200.000				
	OTHERS		12.300				
		3,007.100	1,880.000	168.000	1,258.000	228.300	272.000

(*) Caprolactam by product