PHOSPHATE ROCK

By Stephen M. Jasinski

Phosphorus is an essential element for plant and animal nutrition. Most phosphorus is consumed as a principal component of nitrogen-phosphorus-potassium (NPK) fertilizers used on food crops throughout the world. Phosphate rock minerals are the only significant global resources of phosphorus.

The United States is the world's leading producer and consumer of phosphate rock, which is used to manufacture phosphate fertilizers and industrial products for domestic use and export. In 1997, 10 companies operated 17 phosphate rock mines. Approximately 90% of the phosphate rock mined was used to produce chemical fertilizers, and in 1997, production decreased 5% because of temporary mine closures. Companies in Florida and North Carolina produced 84% of the marketable phosphate rock mined in the United States and processed most of the refined mineral in fertilizer upgrading facilities. The average value of marketable phosphate rock was about the same as that of 1996.

Phosphate rock also was mined in Idaho and Utah where the mineral was upgraded into high-analysis phosphate fertilizers and elemental phosphorus (P_4). Two companies in Idaho produced P_4 for use in downstream industrial products.

In the United States, marketable phosphate rock consumption decreased slightly. U.S. phosphate rock sold or used by producers was 41.8 million metric tons, which was equivalent to 74% of effective industry capacity. *(See tables 1, 2, and 13.)* The U.S. Department of Commerce reported that wet-process phosphoric acid (WPPA) production was 11.7 million tons as available phosphorus pentoxide (P_2O_5), which represented an industry operating rate of nearly 100% (U.S. Department of Commerce, 1998). The United States accounted for 53% of global interregional converted phosphate P_2O_5 trade. Diammonium phosphate (DAP) was the major product exported followed by monoammonium phosphate (MAP), granular triple superphosphate (TSP), and WPPA.

Production

Domestic production data were developed by the U.S. Geological Survey from monthly and semiannual voluntary surveys of producers of phosphate rock. All 10 of the companies to which a survey was sent responded, representing 100% of U.S. production.

Consolidation of the fertilizer industry continued in 1997. IMC Global Inc. merged with Freeport McMoRan, Inc., with IMC Global emerging as the surviving entity. IMC Global and Freeport McMoRan Resource Partners operated IMC-Agrico Crop Nutrients, the world's largest producer of phosphate rock and concentrated phosphate products, under a joint-venture agreement. As a result of the merger, IMC Global now has a controlling interest in IMC-Agrico and in the new partner in the joint venture, Phosphate Resource Partners Ltd. (IMC Global Inc., press release, accessed January 22, 1998, at URL (http://www.imcglobal.com/pressrel/newname.htm). Canadian producer, Agrium, Inc., purchased the Rasmussen Ridge Mine in Idaho from Rhône Poulenc Basic Chemicals Co. Agrium has been processing ore from the mine for use at its WPPA plant in Conda, ID, since 1994 (Green Markets, 1997a). Monsanto Corp. spun off its chemical division into a new company, Solutia, Inc. The two companies operated a mine and an elemental phosphorus plant in Idaho in a joint-venture agreement (Green Markets, 1997b).

Southern States.—In Florida, phosphate rock was mined and processed by five producers, Cargill Fertilizer, Inc.; CF Industries, Inc. (CF); IMC-Agrico Co.; Agrifos, LLC; and PCS Phosphates, Inc. (PCS). Their mines and plants were located in Hamilton, Hardee, Hillsborough, and Polk Counties. In Manatee County, Nu-Gulf Industries' Wingate Creek Mine and the associated Mulberry Phosphates, Inc., Piney Point ammonium phosphate conversion plant were idle. U.S. Agri-Chemicals Corp., Farmland Industries, Inc.-Norsk Hydro, L.P., and Mulberry Phosphates operated WPPA and ammonium phosphate plants at Fort Meade, Green Bay, and Bartow, respectively, using phosphate rock purchased from other producers in the State.

In October, IMC-Agrico temporarily closed the Noralyn and Clear Springs Mines. Both were expected to remain closed for 7 months. The firm also permanently closed its Phosphoria Mine at the same time due to depletion of the ore reserves. IMC-Agrico extended the life of its Payne Creek Mine in Polk County, which was temporarily closed in June, by exchanging reserves with CF. In the swap, IMC-Agrico received 6.5 million tons of developed and permitted reserves near the Payne Creek Mine and CF received over 18 million tons of undeveloped and unpermitted reserves near its Hardee Mine in Hardee County (Green Markets, 1997h). On December 31, IMC-Agrico had four mines in operation, with three mines idle. The company also began permitting procedures for two more mines in Central Florida. The larger site, Pine Level, contains 9,700 hectares located in DeSoto and Manatee Counties. The second property, Ona, is situated on 8,500 hectares in Hardee County. The mines were not expected to start production until late in the next decade (Green Markets, 1997e).

IMC-Agrico restarted two concentrated phosphate plants that had been idle for over a year. Production of phosphoric acid and concentrated phosphates resumed at its Nichols, FL, plant in September 1997 and continued until January 1998 to build stocks for seasonal DAP and MAP exports and domestic shipments (Green Markets, 1997d). In December, the Taft, LA DAP plant resumed production to take advantage of its closer location to the Midwest markets during the spring 1998 planting season (Green Markets, 1997f). The company also returned its New Wales, FL, plant to full operating capacity in April (Green Markets, 1997g). IMC-Agrico operated five concentrated phosphate production facilities, two in Louisiana and three in Florida.

The company also recovered 409 tons of uranium oxide (U_3O_8)

from phosphoric acid produced at its plants in Uncle Sam and Faustina, LA. The firm's two U_3O_8 recovery plants in Florida were idle pending improvements in the uranium market (IMC Global, Inc., 1998).

Farmland-Hydro LP began permitting procedures for the Hickory Creek Mine in Hardee County. It was expected to commence operation in late 2004. Farmland current has a supply contract with IMC-Agrico through 2005 (Fertilizer Markets, 1997a).

Mulberry Corp. received permission from the Manatee County commissioners to reopen its Wingate Creek Mine and Piney Point phosphate plant; each has been closed since 1992. The operating permit for the mine, which is operated by its NuGulf Industries subsidiary, was extended to July 21, 2004, and will supply the Piney Point exclusively. Both facilities were scheduled to restart late in 1998. To reopen Piney Point, the company must adhere to a strict sulfur dioxide emission limit of 1.75 kilograms per ton compared with the Environmental Protection Agency (EPA) standard of 2 kilograms per ton. A $17 million upgrade to the existing sulfuric acid plant will be required to meet this standard. Mulberry will purchase sulfuric acid until work on the plant is completed (Fertilizer Markets, 1997c).

In North Carolina, PCS received approval from the U.S. Army Corps of Engineers to expand its Aurora Mine in Beaufort County by 2,000 hectares. Because the new area contains over 500 hectares of wetlands, PCS must mitigate the loss of every 1 hectare of wetland by restoring 2 hectares. Since 1995, the company has restored or created over 800 hectares wetlands for this project. The permit, which runs through 2017, requires that mitigation be completed before mining can begin in the new area. Production was not expected to start until 2004 (Green Markets, 1997m).

Mississippi Chemical Corp. began expansion of its Pascagoula, MS DAP plant. Capacity will be expanded from 653,000 tons per year to 816,000 tons per year and should be completed by the end of June 1998. The company also received permission from the U.S. Army Corps of Engineers to expand its gypsum stack (Green Markets, 1997h).

Idaho and Utah.—In Idaho, five firms mined or processed phosphate rock, either for the production of P_4 in electric furnaces for industrial applications or for conversion to WPPA and finished phosphate fertilizers. Phosphate rock ore was obtained from four open pit mines in the Phosphoria Formation in Caribou County. FMC Corp. operated the Dry Valley Mine on Federal and private leases, to provide feedstock for P_4 production at its Pocatello plant. Solutia, Inc. and Monsanto Co. produced phosphate rock (in a joint-venture agreement) from the Enoch Valley Mine in the Caribou National Forest for P_4 production at their Soda Springs plant. Rhône-Poulenc Basic Chemicals Co. produced phosphate rock ore from the Rasmussen Ridge Mine also in the Caribou National Forest. The ore was processed by Agrium Inc. at its WPPA and DAP plant in Conda. J.R. Simplot Co. operated the Smoky Canyon Mine, which supplied its WPPA plant in Pocatello.

In November, Agrium announced its intention to purchase the Rhône Poulenc Rasmussen Ridge Mine; the sale was completed in January 1998. Agrium will assume responsibility for mining the ore, which it has been processing at its plant in Conda since 1994. Nu-West Industries, which was purchased by Agrium in 1995, had signed a 10-year agreement to process ore from Rasmussen Ridge in 1993 (Green Markets, 1997a).

Monsanto and Solutia submitted a plan for a new phosphate mine on South Rasmussen Ridge near the Agrium mine. The proposed mine is located on 260 hectares of State lease land and 65 hectares of Federal leases. Development was expected to begin in 1999, and commence operation in 2001, when the Solutia Enoch Valley Mine was scheduled to be depleted (Green Markets, 1997k).

In Utah, Simplot-Farmland Phosphates Ltd. Co., a joint venture between J.R. Simplot Corp. and Farmland Industries, Inc., operated a major mining and phosphate rock beneficiation facility near Vernal. The beneficiated phosphate rock was transported 155 kilometers by a slurry pipeline to its phosphate fertilizer production plant at Rock Springs, WY.

Environment

In June, the Florida Institute of Phosphate Research (FIPR) requested an exemption from the 1989 EPA ban on the use of phosphogypsum to construct a section of a new road in Polk County using the material for the road base. The new road would be built on a deed-restricted property to insure that homes would never be built on the site if the road was abandoned in the future. The EPA had concerns that radon emissions would be higher than normal because of the naturally occurring radioactive minerals in phosphogypsum. A county road that was constructed in 1986 using phosphogypsum was used as an example. Compared with other roads built at the same time with traditional materials, it has not deteriorated, it has radon levels well within allowable ranges, and the cost of construction for the road was less than one-quarter that of the similar roads (Green Markets, 1997c). The EPA also has limited the amount that could be used in research to 318 kilograms in a single laboratory. Petitions filed in 1996 by The Fertilizer Institute requested increasing the amount that could be used for research and changing the methodology used to establish average $Radium^{226}$ concentrations for a stack. The EPA was expected to announce its decisions on these matters in 1998 (Fertilizer Markets, 1997e).

In December, about 190,000 liters of water containing 1% phosphoric acid spilled from a holding pond on a phosphogypsum stack owned by Mulberry Phosphates, near Mulberry, FL. The spill occurred when a pipe used to carry water to the top of the stack was removed and the retaining wall weakened and collapsed, causing a 3-meter wide, 1-meter deep breach in the berm on top of the stack. Emergency pumps were overwhelmed by the volume of water, which spilled into recirculating ditch and then into a small creek. It eventually entered into the Alafia River and flowed into Tampa Bay. The Florida Department of Environmental Protection was expected to assess a fine in 1998 and call for measures to prevent future spills (Green Markets, 1997l).

Consumption

In 1997, U.S. apparent domestic consumption of phosphate rock decreased slightly from that of 1996. About 93% of the total

was consumed in the manufacture of 12.2 million tons P_2O_5 WPPA for downstream fertilizer, animal feed derivatives, and purified WPPA for industrial applications. The balance was used to produce P_4 for industrial applications, including detergent and food additives, water-and metal-treatment chemicals, plasticizers, pesticides, herbicides, vitamins, soft drinks, toothpaste, photographic film, light bulbs, bone china, flame-resistant fabrics, optical glass, and other consumer goods. (*See tables 3 and 4.*)

Stocks

Producers' yearend stocks increased 16% over that of 1996, which was equivalent to more than 2 months of production. The increase was attributed to the rebuilding of inventories after several years of stock reduction.

Transportation

In Florida, rail and truck were used to transport beneficiated phosphate rock to phosphate upgrading facilities. Phosphate rock and finished phosphate materials were sent by rail to ports at Tampa and Jacksonville, and then were shipped for domestic use or exported. In 1997, 21.7 million tons of phosphate-related materials valued at $1.74 billion were shipped from the Port of Tampa, representing over 50% of all shipments (Florida Phosphate Council, 1998). Phosphate fertilizers produced by companies along the Gulf of Mexico were transported by barge on the Mississippi River and other major tributaries for domestic consumption. Producers also sent material to consumers by rail and truck.

FIPR approved $1 million for the construction of an experimental 1-meter diameter pipeline that will use magnetic levitation to move finished phosphate fertilizers in small cylindrical cars. The computer-controlled cars would move individually at 65 kilometers per hour through the pipe to the destination point. Initial tests will be confined to a 0.8-kilometer test track at the IMC-Agrico Kingsford Mine. If the tests are successful, the track will be extended to the company's New Wales processing facility, a distance of between 3 to 5 kilometers. Eventually, the cars could be used to move fertilizer materials to the Port of Tampa. The estimated cost of transport via maglev cars would be 85% less than using truck or rail (FIPR, 1997).

In North Carolina, PCS sent phosphate rock and finished products by barge to the port at Morehead City for export and domestic shipment. Rail facilities also were used extensively for transport.

Western producers moved phosphate rock from mines to plants by rail, truck, and slurry pipeline. Finished product was moved predominately by rail and truck. During the last half of the year, the merger of Union Pacific and Southern Pacific Railroads caused delays in shipments of phosphoric acid from Idaho to California and other western destinations. The problems were attributed to unsettled labor contracts, shortage of locomotives and train cars, and difficulties associated with merging different computer systems. Other regions of the country also were impacted, but to a lesser degree (Fertilizer Markets, 1997d).

Prices

The weighted average value for marketable phosphate rock was $24.60 per ton, f.o.b. mine, a 5% increase from the 1996 value. *(See table 5)*

Foreign Trade

Domestic exports of phosphate rock dropped 80% from that of the 1996 level, as producers have switched to exporting higher value fertilizer materials.

Imports of phosphate rock were estimated at 1.83 million tons. The United States was the second largest importer of phosphate rock from Morocco, with 1.830 million tons in 1997, a slight increase over 1996. PCS and Mississippi Phosphates used phosphate rock from Morocco in phosphate conversion plants at Geismar, LA, on the Mississippi River and at Pascagoula, MS on the Gulf of Mexico, respectively. PCS also used imported ore as feedstock for a purified industrial-grade WPPA plant at Geismar that it operated on behalf of Rhône-Poulenc Basic Chemicals.

U.S. converted phosphate trade showed an increase in exports of both DAP and MAP, while exports of WPPA and TSP decreased. DAP exports to China and India showed significant growth. DAP exports were believed to be understated for the second consecutive year and were under investigation by the Bureau of Census. According to preliminary data for 1997 from the International Fertilizer Industry Association, U.S. DAP export shipments were 77% of the world total; MAP, 90%; TSP, 37%; and WPPA, 9%. (*See tables 6 through 12*.)

World Review

World production of phosphate rock was the same as in 1996, 135 million tons. The United States accounted for 33% of the world total, followed by Morocco, China, and Russia. Phosphate rock was produced in 37 countries in 1997. (*See tables 13 and 14.)*

Canada.—Agrium began development of a new phosphate rock mine near Kapuskasing, Ontario, which will supply its Redwater, Alberta fertilizer manufacturing facility. The new mine was expected to start production in 1999 and have a life span of 20 years. Currently, Redwater plant uses sedimentary phosphate rock from Togo. However, the ore from the new mine will be of igneous origin, thus it will require modification to allow the processing of either type of rock. The total cost for development of the mine and upgrading the plant will be $70 million over a 2-year period (Green Markets, 1997j).

In Quebec, Norsk Hydro and the Quebec Society of Mining and Exploration (Soquem) completed a feasibility study for a phosphate rock-ilmenite mine at Sept-Iles. According to Soquem, the mine would produce annually 600,000 tons of phosphate rock, averaging 38% P_2O_5 and 400,000 tons of ilmenite. The phosphate would be processed by Hydro at its plant in Porsgrunn, Norway (Fertilizer Markets, 1997b). No date has been given for further activity on the project.

China.—China is the leading consuming country for crop

nutrients, accounting for over 25% of world consumption. The country is also the third largest producer of phosphate rock and the leading producer of low-analysis phosphate fertilizer, but it lacks the capacity to produce high-analysis material. The development of phosphate rock mines has been taking place at a faster pace than downstream processing capacity. As part of a 5-year plan to achieve a more balanced application of fertilizer nutrients, the Ministry of Chemicals and Industry plans to accelerate the development of phosphate fertilizer production over the next 5 years. Plans call for several projects including a 560,000-tons-per-year TSP plant at Dayukou, a 400,000-tons-per-year TSP plant at Yunnan, a 800,000-tons-per-year TSP plant at Wengfu, a 240,000-ton-per-year DAP plant at Luzai, and a 120,000-ton-per-year DAP plant at Jinchang. Four other plants were planned to provide an additional 1 million tons per year of phosphate fertilizer production capacity (Fertilizer International, 1997a). In 1997, the country exported 1.5 million tons of rock while importing over 5 million tons of DAP, primarily from the United States. This represented 55% of U.S. DAP exports and 30% of China's phosphate demand.

Christmas Island.—Christmas Island Phosphate (CIP) signed a 21-year lease with the Australian Government allowing continued mining of phosphate rock on the island. The new lease covers about 20 square kilometers, which is equivalent to 15% of the island. CIP claims it will be able to maintain a production level of over 500,000 tons per year through 2018 (Asiafab, 1997).

Jordan.—Norsk Hydro has set up a joint venture with Jordan Phosphate Mines Co. (JPMC) to build and operate a major NPK complex in Jordan. The new company will be 40% owned by Jordanian companies and the remaining 60% by Hydro. Plans include a 444,000-tons per-year P_2O_5 WPPA plant to feed a new NPK plant that is expected to start up in 2001. The joint venture is dependent upon the approval of the respective companies' boards and the Jordanian government arranging road and rail connections (Fertilizer Week, 1997b). JPMC began a $250-million expansion of its mine at Shidiyah. Production was expected to double to 8 million tons per year by 1998. The mine contains 1 billion tons of Jordan's 1.5 billion tons of reserves (Fertilizer International, 1997b).

Mexico.—Grupo Fertinal S.A. de C.V., the largest producer of phosphate rock in Mexico, reached an agreement with Nisshi Iwai Corp. of Japan to finance the expansion of its San Juan mine in Baja California at a cost of $50 million. Fertinal plans to double the annual production capacity to 1.5 million tons by 2000, which would supply all the requirements at its Lazaro Cardenas fertilizer plants. Currently, the company imports over 1.8 millions tons of phosphate rock annually from Morocco (Fertilizer Week, 1997c).

Morocco.—Office Chérifien des Phosphates (OCP) exported 11.7 million tons of phosphate rock in 1997; Mexico (15.9%), the United States (15.7%), and Spain (15.5%) were the principal destinations. OCP planned add over 900,000 tons per year P_2O_5 to its WPPA capacity by 2000 through improvements and new construction, beginning in 1998. The projects will involve revamping all eight phosacid plants at Jorf Lasfar and some at Safi. Upon completion, production was expected to reach 3.5 million tons per year P_2O_5. OCP also entered into a joint-venture agreement with Chambal Fertilizers of India to build a 330,000 tons per year P_2O_5 WPPA plant at Jorf Lasfar. The plant was expected to be completed by April 1999. Up to two-thirds of the acid produced will be shipped to India; the remained will be used by OCP for downstream production. The company exported 1.83 million tons of phosphate rock to the United States in 1997 (Fertilizer International, 1997c).

Russia.—Apatit JV, the largest producer of phosphate rock, announced plans to build a fertilizer plant at Kirovsk in the Kola Peninsula. A 190,000-tons-per-year P_2O_5 TSP plant will be built initially followed by a MAP/DAP plant. Construction of the TSP plant was expected to begin in 1998. The company's nearby mine will feed the plant. Sulfuric acid will be obtained from nearby nonferrous smelters (Fertilizer Week, 1997a).

A new terminal was opened at the Port of Murmansk in July that will handle larger shipments of fertilizer materials. Annual cargo handling capacity has been increased from 5.8 million tons to 8 million tons and the port can now accommodate ships up to 50,000 dead weight tons. The new terminal is equipped with modern cargo handling equipment and three sets of warehouses with 20,000 tons capacity for three different types of fertilizers (Adamovsky, 1997).

Outlook

U.S. and world annual capacity to mine and beneficed phosphate ore into marketable phosphate rock continued to exceed domestic and world demand by an estimated 20% and 19%, respectively. However, these figures are slightly misleading. U.S. production will be below rated capacity to prolong the life of several mines and certain mines in Russia and Kazakstan cannot produce near capacity owing to poor internal demand, logistical problems with exporting, or poor quality material. U.S. phosphoric acid production was near usable capacity and world phosphoric acid production was 96% of available capacity.

Phosphate rock demand in the United States is driven by the fertilizer sector, which supplies North America markets and is a major supplier to world markets. In 1997, more than 60% of the P_2O_5 in finished fertilizers manufactured in the United States was contained in exported materials. U.S. exports are driven world for demand for DAP, primarily in China and India. China accounts for 55% of U.S. DAP exports, however it does not import any other phosphate materials from the United States. U.S. DAP exports to India and China are predicted to increase slightly over the next 5 years there is uncertainty, however, as to when new fertilizer plants in those countries will be commissioned, decreasing import requirements.

U.S. demand has been fairly steady over the past 2 years despite changes in the U.S. farm policy in 1996 that have given farmers freedom to plant the crop of their choice. It may take several years before any great impact is seen. Since 1996, planting of corn and soybeans, which require more phosphatic fertilizer than other crops, has risen. Total acreage planted for all crops is projected to increase about 2% in 1998. Higher corn acreage also is expected over the next 2 years to increase stocks. Exports of phosphate rock are anticipated to decline further in 1998, as the emphasis has switched to exporting high-analysis fertilizer materials. All of the above factors should lead to phosphate demand increasing by about 2% over the next year.

World-wide, the gap between the production and consumption

phosphate rock has been closing as excess capacity has been reduced because of depletion of reserves, technical problems, and a reduction in exports from United States, Israel, Russia, Senegal, and South Africa. Over the next 5 years mine capacity will probably increase through new mines in Australia, Canada, Sri Lanka and improvements to mines in Africa and the Middle East. Operations in Kola Peninsula of Russia and in other Former Soviet Union (FSU) countries continue below capacity. Exports from Russia are predicted to increase now that improvements have been made to the port at Murmansk, but internal consumption and fertilizer plant capacity utilization are not expected to grow over the period. New fertilizer plants are planned in Africa, China, India, Mexico, and the Middle East. World demand is expected to grow about 2.5% to 3% per year through 2002.

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[1]Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT PHOSPHATE ROCK STATISTICS 1/

(Thousand metric tons and thousand dollars unless otherwise specified)

	1993	1994	1995	1996	1997
United States:					
Mine production (crude ore)	107,000	157,000	165,000	179,000	162,000
Marketable production	35,500	41,100	43,500	45,400	43,300
P2O5 content	10,700	12,100	12,800	13,300	13,200
Value	$759,000	$869,000	$947,000	$1,060,000	$1,060,000
Average per metric ton 2/	$21.38	$21.14	$21.75	$23.40	$24.60
Sold or used by producers 3/	40,100	43,900	43,700	43,500	41,800
P2O5 content	11,900	13,100	13,000	12,900	12,100
Value 4/	$856,000	$929,000	$950,000	$1,020,000	$1,030,000
Average, dollars per metric ton	$21.38	$21.14	$21.75	$23.40	$24.60
Exports 5/	3,200	2,800	2,760	1,570 6/	335 6/
P2O5 content	1,020	886	875	NA	NA
Value	$91,200	$71,700	$78,300	NA	NA
Average, dollars per metric ton	$28.51	$25.60	$28.35	$35.82	$35.25
Imports for consumption	534	1,800 r/ e/ 7/	1,800 r/ e/ 7/	1,800 e/ 7/	1,830 e/ 7/
C.i.f. value	$32,300	$87,800 r/	$91,800 r/ e/	$104,000 e/	$91,800 e/
Average, dollars per metric ton	$60.45	$48.76	$51.01	$57.91	$50.19
Consumption 8/	38,300	42,900 e/	42,700 r/ e/	43,700 e/	43,300 e/
Stocks, Dec. 31: Producers	9,220	5,980	5,710	6,390	7,390
World: Production	119,000	127,000 r/	130,000	135,000 r/	135,000 e/

e/ Estimated. r/ Revised. NA Not available.
1/ Data are rounded to three significant digits.
2/ Average value based on the sold or used values.
3/ Includes domestic sales and exports.
4/ Total value of all domestic and export sales.
5/ Exports reported to the U.S. Geological Survey by companies.
6/ Source: Bureau of the Census.
7/ Some phosphate rock import tonnage and value were suppressed by the Bureau of the Census.
8/ Expressed as sold or used plus imports minus exports. Includes some estimated phosphate rock tonnage imported from Morocco not reported by the Bureau of the Census in 1994-97.

TABLE 2
PRODUCTION OF PHOSPHATE ROCK IN THE UNITED STATES, BY REGION 1/

(Thousand metric tons and thousand dollars)

	Mine production (crude ore)		Marketable production			
			Beneficiated			Ending stocks, rock
Period/region	Rock	P2O5 content	Rock	P2O5 content	Value 2/	
1996	179,000	23,800	45,400	13,300	1,060,000	6,390
1997:						
January-June:						
Florida and North Carolina	81,200	9,480	20,200	6,460	476,000	6,200
Idaho and Utah	3,850	1,080	2,500	832	59,600	1,180
Total	85,000	10,600	22,700	7,290	536,000	7,380
July-December:						
Florida and North Carolina	72,100	7,910	17,300	5,030	426,000	5,850
Idaho and Utah	4,790	1,230	3,200	919	102,000	1,540
Total	76,900	9,150	20,500	5,950	528,000	7,390
Grand total	162,000	19,700	43,300	13,200	1,060,000	XX

XX Not applicable.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Average value based on the sold or used values.

TABLE 3
PHOSPHATE ROCK SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY GRADE AND REGION 1/

(Thousand metric tons and thousand dollars)

Period and grade (percent BPL 2/ content)	U.S. total		
	Rock	P2O5 content	Value 3/
January-June 1996	21,200	6,320	$486,000.00
July-December 1996	22,400	6,610	532,000
Total	43,500	12,900	1,020,000
January-June 1997:			
60 to less than 66	17,400	5,060	402,000
Other 4/	3,440	1,010	92,000
Total	20,900	6,070	494,000
July-December 1997:			
60 to less than 66	16,300	4,710	421,000
Other 4/	4,600	1,330	113,000
Total	20,900	6,030	534,000
Grand total	41,800	12,100	1,030,000
Florida and North Carolina	36,300	10,500	894,000
Idaho and Utah	5,450	1,600	134,000

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ 1.0% BPL (bone phosphate of lime or tricalcium phosphate)=0.458% P2O5.
3/ F.o.b. mine.
4/ Includes below 60 and 70 to greater than 74 % BPL content.

TABLE 4
PHOSPHATE ROCK SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY USE 1/

(Thousand metric tons)

Period and use	Rock	P2O5 content
1996	43,500	12,900
1997:		
January-June:		
Domestic:		
Agricultural	19,500	5,240
Industrial	W	W
Subtotal	W	W
Exports 2/	W	W
Total	20,900	6,070
July-December:		
Domestic:		
Agricultural	19,500	5,650
Industrial	W	W
Subtotal	W	W
Exports 2/	W	W
Total	20,900	6,030
Grand total	41,800	12,100

W Withheld to avoid disclosing company proprietary data; included in "Total."
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Exports reported to the U.S. Geological Survey by companies.

TABLE 5
VALUE OF U.S. PHOSPHATE ROCK, BY GRADE

(Dollars per metric ton, f.o.b. mine)

Grade	1996			1997		
(percent BPL 1/ content)	Domestic	Export	Average	Domestic	Export	Average
74 or more	W	--	W	--	--	--
72 to less than 74	W	W	W	--	--	--
70 to less than 72	W	W	W	24.98	W	25.13
66 to less than 70	22.29	30.14	22.62	29.06	W	29.33
60 to less than 66	23.00	W	23.14	18.00	W	18.07
Less than 60	W	--	W	18.27	--	18.27
Weighted average	22.90	35.82	23.40	20.32	35.25	20.41

W Withheld to avoid disclosing company proprietary data.
1/ 1.0% BPL (bone phosphate of lime or tricalcium phosphate)=0.458% P_2O_5.

TABLE 6
U.S. EXPORTS OF GROUND AND
UNGROUND PHOSPHATE ROCK 1/

(Thousand metric tons)

Country	1996	1997
Australia	132	7
Canada	12	24
India	223	--
Japan	269	29
Korea, Republic of	724	186
Netherlands	57	29
New Zealand	71	24
Other	81	36
Total	1,570	335

1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 7
U.S. EXPORTS OF SUPERPHOSPHATES
(CONCENTRATED)

(Thousand metric tons)

Country	1996	1997
Argentina	1	5
Australia	267	231
Bangladesh	--	20
Brazil	76	161
Canada	19	12
Chile	141	92
Japan	38	41
Peru	18	17
Uruguay	13	9
Other	109	46
Total	681	634

Source: Bureau of the Census.

TABLE 8
U.S. EXPORTS
OF DIAMMONIUM PHOSPHATE 1/

(Thousand metric tons)

Country	1996 2/	1997 2/
Argentina	402	252
Australia	599	493
Brazil	29	36
Canada	119	119
Chile	51	46
China	3,880	4,690
Colombia	68	76
Dominican Republic	37	31
Ecuador	32	47
Germany	32	--
Guatemala	24	18
India	245	1,090
Japan	421	366
Kenya	54	82
Mexico	149	234
New Zealand	181	14
Pakistan	569	213
Thailand	244	131
Turkey	17	124
Uruguay	107	42
Other	660	393
Total	7,920	8,500

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Data under review by Bureau of the Census.

Source: Bureau of the Census.

TABLE 9
U.S. EXPORTS OF
MONOAMMONIUM PHOSPHATE 1/

(Thousand metric tons)

Country	1996	1997
Australia	318	282
Brazil	166	339
Canada	542	493
Chile	59	51
Colombia	69	98
Guatemala	24	17
Japan	104	135
Mexico	101	85
Thailand	44	26
Other	84	107
Total	1,510	1,630

1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 10
U.S. EXPORTS OF
PHOSPHORIC ACID 1/

(Thousand metric tons)

Country	Quantity	
	1996	1997
Australia	122	88
Canada	73	64
India	130	174
Venezuela	60	58
Other	185	86
Total	570	470

1/ Excludes superphosphoric acid tonnage.

Source: Bureau of the Census as adjusted by the U.S. Geological Survey.

TABLE 11
U.S. EXPORTS OF ELEMENTAL PHOSPHORUS 1/

Country	1996		1997	
	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)
Brazil	3	$5	67	$104
Canada	1,250	2,370	1,260	2,450
Japan	4,760	9,570	3,540	7,170
Korea, Republic of	30	57	317	601
Mexico	6,250	12,500	3,480	7,270
Netherlands	40	108	12	23
Other	281	948	130	368
Total	12,600	25,500	8,800	18,000

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ F.a.s. values.

Source: Bureau of the Census.

TABLE 12
U.S. IMPORTS FOR CONSUMPTION OF PHOSPHATE ROCK AND
PHOSPHATIC MATERIALS 1/

(Thousand metric tons and thousand dollars)

Phosphatic materials	1996		1997	
	Quantity	Value 2/	Quantity	Value 2/
Natural calcium phosphates, unground	575	33,100	809	40,600
Natural calcium phosphates, ground	(3/)	117	62	3,830
Dicalcium phosphate	4	5,530	6	7,800
Elemental phosphorus	1	3,280	2	4,410
Normal superphosphate	(3/)	33	(3/)	90
Triple superphosphate	83	7,650	39	6,910
Diammonium phosphate	77	18,300	57	14,500
Fertilizer containing nitrates and phosphates	69	12,300	146	11,900
Phosphoric acid	32	7,010	6	2,940

1/ Data are rounded to three significant digits.
2/ Declared c.i.f values.
3/ Less than 1/2 unit.

Source: Bureau of the Census as adjusted by the U.S. Geological Survey.

TABLE 13
PHOSPHATE ROCK ANNUAL
WORLD PRODUCTION CAPACITY,
DECEMBER 31, 1997

(Thousand metric tons)

Region/country	Capacity	Percent
United States	56,000	33
Africa	45,700	27
Asia	28,800	17
Western Europe and the former U.S.S.R.	21,000	12
Middle East	12,400	7
Latin America	5,300	3
Oceania	1,300	1
World total 1/	170,000	100

1/ Data may not add to totals shown because of independent rounding.

Sources: International Fertilizer Industry Association and the U.S. Geological Survey.

TABLE 14
PHOSPHATE ROCK, BASIC SLAG, AND GUANO: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons)

Commodity and country	Gross weight					P_2O_5 content				
	1993	1994	1995	1996	1997 e/	1993	1994	1995	1996	1997 e/
Phosphate rock:										
Albania e/	2	2	2	2	1	(3/)	(3/)	(3/)	(3/)	(3/)
Algeria	718	738	757	1,051 r/	1,068 4/	220 e/	226	232	320 r/	325
Australia	2	21 r/	5 r/	1 r/	1	(3/)	5 r/	1 r/	(3/)	(3/)
Brazil	3,419	3,937	3,888 r/	3,823 r/	3,850	882 r/	1,387 r/	1,364 r/	1,353 r/	1,350
Chile	15	10	12 r/	17 r/	15	4	3	1 r/ e/	5 r/ e/	4
China e/	21,200	24,100	19,300	21,000	20,000	6,350	7,430	5,790	6,300	6,000
Christmas Island	298	260	430	600 e/	600	100	87	145	198 e/	198
Colombia e/	45 4/	48 4/	50	50	50	9	10	11	11	11
Egypt 5/	1,585	632 r/	765 r/	808 r/	800	390	178 r/	207 r/	222 r/	200
Finland	628	647	671	667 r/	650	227	236	244	246 r/	240
India	969	1,237 r/	1,332 r/	1,432 r/	1,500	262	334 r/	360 r/	387 r/	405
Indonesia e/	7	7	8	8	8	2	2	2	2	2
Iraq e/ 5/	800	1,000	1,000	1,000	1,000	240	300	300	300	300
Israel 5/	3,680	3,961	4,063	3,839 r/	4,047 4/	1,148	1,232	1,264	1,201 r/	1,270
Jordan	4,129	4,217	4,984	5,355 r/	5,896 4/	1,367	1,399	1,655	1,765 r/	1,900
Kazakstan e/	4,000	1,700 r/ 4/	1,700 r/	1,700 r/	1,700	1,000	500	500 r/	500 r/	500
Korea, North e/	510	510	520	520	520	163	163	164	164	164
Mexico 6/	237	547 r/	622	682 r/	700	72	164 r/	180	205 r/	210
Morocco 7/	18,193	19,764	20,200	20,855 r/	23,367 4/	5,778	6,274	6,381	6,560 r/	7,430
Nauru	634	613	496	510	500	244	233	190	194	190
Netherlands Antilles e/	10	15	--	--	--	3	5	--	--	--
Pakistan e/	14 4/	15 4/	10 4/	10	8	4	3	2	2	1
Peru	37	37	30 r/	103 r/	104	12	12	9 r/	32 r/ e/	32
Philippines e/	92 4/	20	20	20	20	31	7	7	7	7
Russia e/	9,400	8,000	8,800	8,500	7,500	3,300	2,800	3,000	2,900	2,500
Senegal	1,667	1,587	1,502 r/	1,427 r/	1,535 4/	606	576	545	518 r/	520
South Africa	2,466	2,545	2,787 r/	3,077 r/	3,000	962	995	1,087	1,200 r/ e/	1,170
Sri Lanka e/	36 4/	32 4/	30 r/ 4/	34 r/	34	12	11	10 r/	12 r/	12
Syria	931	1,203	1,551	2,189 r/	2,392 4/	286	371	477	670 r/	730
Tanzania	4	--	21 r/	3 r/ e/	4	1 e/	--	7 r/	1 r/ e/	1
Thailand	11	8	9	9 e/	9	3	2	3	3 e/	3
Togo	1,794	2,149	2,570 r/	2,731 r/	2,631 4/	540	780 r/	933 r/	991 r/	950
Tunisia	5,500	5,699	7,241	7,167 r/	7,068 4/	1,647	1,712	2,182	2,150 r/	2,120
Turkey	78	--	--	-- e/	--	24	--	--	-- e/	--
United States	35,500	41,100	43,500	45,400	43,300 4/	10,700	12,100	12,800	13,300	13,200
Venezuela	--	99	169 r/	203	200	--	27	46 r/	55	55
Vietnam e/	363 4/	470 4/	480	480	490	116	144	145	145	146
Zimbabwe, concentrate	153	151	154	123	120	45	45	45 e/	39 e/	39
Total	119,000	127,000 r/	130,000	135,000 r/	135,000	36,800 r/	39,800 r/	40,300 r/	42,000 r/	42,200

See footnotes at end of table.

TABLE 14--Continued
PHOSPHATE ROCK, BASIC SLAG, AND GUANO: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons)

Commodity and country	Gross weight					P_2O_5 content				
	1993	1994	1995	1996	1997 e/	1993	1994	1995	1996	1997 e/
Basic (Thomas converter) slag: e/										
Egypt	8	8	8	8	8	2	2	2	2	2
France	253 4/	155 4/	140	150	150	46 4/	28 4/	18	27	27
Germany	110 4/	134 4/	125	125	125	16 4/	20 4/	19	19	19
Luxembourg	555 4/	472 4/	500	500	500	100	85	75	75	75
Total	926 4/	769 4/	773	783	783	164 4/	135 4/	114	123	123
Guano: Philippines e/	5 4/	5	5	5	5	2	2	2	2	2

e/ Estimated. r/ Revised.

1/ Table includes data available through May 8, 1998. Data for major phosphate rock-producing countries derived in part from the International Fertilizer Industry Association; other figures are from official country sources where available.

2/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

3/ Less than 1/2 unit.

4/ Reported figure.

5/ Beneficiated.

6/ Includes only output used to manufacture fertilizers.

7/ Includes production from Western Sahara.