PHOSPHATE ROCK

By Raymond L. Cantrell

Phosphate rock mineral deposits are the only significant global resource of phosphorus, a chemical element essential to plant and animal life. 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. Florida and North Carolina produce about 85% of the marketable phosphate rock mined in the United States, and process most of the refined mineral in cost effective fertilizer upgrading facilities that are situated to be highly competitive in the global marketplace.

Phosphate rock also is produced in the western States of Idaho and Utah where the mineral is upgraded into high analysis phosphate fertilizers and elemental phosphorus (P_4), which is used to produce downstream industrial products. Phosphate rock supplies from Idaho and Utah are used as inputs to facilities that provide fertilizer to consuming States in a vast region extending from the Midwest to the Pacific Coast and into Canada. The States of Idaho and Montana produce essentially all of the P_4 consumed domestically and exported from the United States.

In 1994, marketable phosphate rock production and consumption in the United States increased markedly because of record diammonium phosphate (DAP) export shipments to China and rising domestic fertilizer demand which was created by a substantial increase in planted feedgrain acreage. Economic recovery led to an additional increase in the production of phosphate rock for a variety of industrial products manufactured principally from P_4, and purified wet-process phosphoric acid. Most mines and finished phosphate materials plants that were temporarily idled during 1993, because of a down cycle in the U.S. phosphate sector, returned to production.

U.S. phosphate rock sold or used by producers was 44 million metric tons, equating to 88% of effective industry capacity, and accounting for more than 30% of total global deliveries. Wet-process phosphoric acid (WPPA) production was 11.2 million tons as available phosphorus pentoxide (P_2O_5), which represented an industry operating rate of nearly 100%. Heavy demand for downstream phosphate fertilizer products produced from WPPA was reflected by rising prices for downstream phosphate fertilizer products as the year progressed. The United States accounted for more than 50% of global interregional converted phosphate P_2O_5 trade in 1994, led by ammonium phosphates—DAP and monoammonium phosphate (MAP)—granular triple superphosphate (GTSP), and WPPA, in order of importance. Value-added byproducts from WPPA manufacture, principally hydrofluosilicic acid for water fluoridation, and uranium oxide yellow cake for electrical power generation continued to be recovered by the industry.

Many positive factors, which provide for an optimistic outlook through the turn of the century, can be traced to major industry consolidation and restructuring in Florida and the western States during the past few years. A protracted period of global phosphate fertilizer oversupply, grain surpluses, and depressed prices between 1981 and 1986 dictated that the U.S. industry should consolidate and incorporate advanced technologies in the WPPA manufacturing process, including wet rock grinding, and the cogeneration of electrical power from byproduct steam. The net result was that by 1994, a few major firms, operating under vastly improved economies of scale, dominated the industry. Added benefits were more effective vertical integration between phosphate rock mining, finished phosphate manufacture, and marketing. *(See tables 1 and 2.)*

Legislation and Government Programs

Section 313 of the Enviromental Protection Agency's Emergency Planning and Community Right-to-Know Act of the Superfund Amendments and Reauthorization Act (SARA) of 1986 (Public Law 99-499) required EPA to establish a national inventory of toxic chemical emissions from certain facilities, called the Toxics Release Inventory (TRI). EPA's 1992 TRI published in April 1994, indicated that phosphoric acid emissions of 94,000 tons ranked fourth among the 1.4 million tons released by the top 50 TRI chemicals, and accounted for about 7% of the total. This amount was only about 0.5% of total U.S. WPPA production.[1] On December 8, 1994, the U.S. President signed the Uruguay Round GATT Agreements Act, H.R. 5110, which was designated as Public Law No. 103-465. This action resulted from several years of global trade negotiations that began in Uruguay, designed to liberalize trade under the auspices of the longstanding General Agreement on Tariffs and Trade (GATT). The new GATT agreement was expected to gradually result in the lowering of tariff barriers, thus improving the prospects for improved access of U.S. agricultural exports to major countries around the globe.[2]

Production

The U.S. Bureau of Mines, Department of the Interior, conducted semiannual Mineral Industry Surveys of all identifiable U.S. phosphate rock producers, to provide the public and private sectors with information and analysis on the situation and outlook for this essential, finite mineral resource.

Florida.—In central Florida, phosphate rock was mined and processed by five producers in Polk, Hillsborough, and Hardee Counties: Cargill Fertilizer, Inc.; CF Industries, Inc.; IMC-Agrico Co., a joint-venture partnership between IMC Fertilizer Group, Inc. and Freeport-McMoRan Resource Partners L.P.; Mobil Mining and Minerals Corp.; and, U.S. Agri-Chemicals Corp., owned by the Chinese subsidiary Sinochem (USA) Inc. Nu-Gulf Industries 1.5-million-ton-per-year Wingate Creek Mine and the associated Mulberry Phosphates, Inc., Piney Point ammonium phosphate conversion plant in Manatee County, FL, were idle.

In northeast Florida, Occidental Chemical Corp. (OxyChem) produced phosphate rock from the 3.5-million-ton-per-year Swift Creek Mine, primarily for upgrading into granular ammonium phosphate fertilizers. OxyChem's 2.3-million-ton-per-year Suwannee River Mine continued to be closed for economic factors associated with the loss of a large superphosphoric acid (SPA) trade contract with the former U.S.S.R. Recoverable phosphate rock reserves at yearend were estimated at about 65 million tons averaging 66.4% bone phosphate of lime (BPL).[3]

Cargill Fertilizer, Inc. operated the 3-million-ton-per-year Fort Meade beneficiation plant in Polk County based on ore mined from its Carlton tract in Hardee County. The firm

also operated the Hookers Prairie Mine, a 2.5-million-ton-per-year operation in Polk County. Marketable phosphate rock from Fort Meade was shipped to Cargill's Tampa Bay, FL, plant where 700,000 tons per year P_2O_5 WPPA, ammonium phosphates, and GTSP fertilizers were produced. The Hookers Prairie Mine supplied Cargill's large WPPA and granular ammonium phosphate facility at Bartow, FL. Current reserves, together with planned acquisitions, should allow Cargill to continue mining phosphate rock in Florida well into the 21st century.[4]

CF Industries announced plans to commission its new 3.2-million-ton-per-year South Pasture Mine in Hardee County in the fall of 1995. The project had an authorized budget of $175 million. In 1994, CF ran a large, 900,000-ton-per-year P_2O_5, WPPA plant and granular ammonium phosphate complex at Plant City, FL, based on phosphate rock purchased domestically. The new mine should provide CF with enough captive phosphate rock tonnage to sustain operations at Plant City for at least another 20 years. Reserves at South Pasture were about 90 million tons as recoverable product.[5]

IMC-Agrico Co. operated seven mines in 1994 having an aggregate annual capacity of about 30 million tons, representing about 55% of total U.S. capacity. Active operations included the Four Corners Mine on the Hillsborough-Manatee County line; the Fort Green and Payne Creek Mines in Polk-Hardee Counties; the Kingsford Mine in Polk-Hillsborough Counties; the Hopewell Mine, in Hillsborough County; together with Noralyn-Phosphoria in Polk County. The firm's Clear Springs Mine in Polk County also was operational. Effective June 30, 1994, IMC-Agrico reported title to an estimated 325 million tons of recoverable phosphate rock reserves in central Florida, averaging 68% BPL.

In June, IMC-Agrico purchased the Fort Lonesome and Haynesworth Mines in Hillsborough and Polk Counties that had been leased from Brewster Phosphates. The aggregate annual capacity of the idle mines was about 5 million tons, according to IMC Fertilizer Group reports.

U.S. Agri-Chemicals' joint-venture Rockland Mine with Freeport-McMoRan in Polk County was closed during the first-half of 1994 following the formation of IMC-Agrico. IMC-Agrico assumed control of the remaining reserves at Rockland and entered into a long-term tolling agreement extending through the year 2004 to supply marketable phosphate rock for Agri-Chemicals' 450,000 ton-per-year P_2O_5 WPPA conversion facility at Fort Meade, FL.

In July 1994, IMC-Agrico entered into an optional agreement with Mississippi Chemical Corp. of Yazoo City, MS, to purchase the remaining reserves on a 4,860 hectare (ha)—12,000 acre—contiguous tract in Hardee County. containing an estimated 80 million tons of phosphate rock reserves. IMC-Agrico reported title and options to a total of approximately 0.5 billion tons of recoverable phosphate rock reserves in Hardee, Manatee, and DeSoto Counties. averaging 65% BPL—described as the South Florida deposits.

IMC-Agrico's annual WPPA production capacity in Florida and Louisiana was about 4 million tons P_2O_5, which represented approximately 32% of total U.S. capacity and 11% of global capacity. WPPA and associated downstream conversion plants were operating at New Wales, Nichols, and South Pierce in Polk County; and, at Faustina and Uncle Sam, LA, along the Mississippi River. The firm shipped WPPA to its Taft, LA, plant for upgrading into granular ammonium phosphates, and produced animal feed-grade phosphate supplements at New Wales, FL, for Mallinckrodt Veterinary, Inc. Uranium oxide was extracted from WPPA produced at the Faustina and Uncle Sam, LA, facilities, while uranium recovery facilities at New Wales and Plant City, FL, were idle in 1994. The firm exported phosphate raw materials and finished products through the Phosphate Rock Export Association (PhosRock) and Phosphate Chemicals Export Association (PhosChem), formed under provisions of the Webb-Pomerene Act with other U.S. producers.[6]

Mobil was building a new mine at South Fort Meade in southeastern Polk County, FL., with a planned annual capacity of 3.5 million tons. The new mine was projected to be capable of sustaining annual design productivity over the next 25 years. The firm planned to close its Big Four Mine in Hillsborough, County , following depletion in mid-1995, and was to place the Nichols Mine in Polk County on standby. In addition to phosphate rock sales on the domestic and export markets, Mobil produced WPPA and ammonium phosphates in a whollyowned conversion facility at Pasadena, TX.[7]

Farmland Industries, Inc.-Norsk Hydro, L.P., and Mulberry Phosphates, operated WPPA and ammonium phosphate plants at Green Bay and Bartow, FL, respectively, based on phosphate rock purchased domestically.

North Carolina.—Texasgulf Chemicals Co., a division of Texasgulf, Inc., operated a large mine and processing plant along the Pamlico River in Beaufort County, NC, near the towns of Aurora and Washington. The mine and beneficiation plants had the capability to produce flotation-grade, calcined-grade, and direct application-grade phosphate rock for domestic use and export. Phosphate rock reserves on three contiguous tracts were estimated at about 1 billion tons, recoverable, according to Texasgulf technical personnel.

Texasgulf produced up to 1.2 million tons P_2O_5 WPPA annually in a chemical complex adjacent to the mine; additional downstream products: SPA, DAP, MAP, liquid ammonium phosphates, GTSP, and calcium phosphate animal feed supplements also were produced at the site. Animal feed phosphate supplements, including defluorinated phosphate rock (DFP), also were produced offsite. Texasgulf operated a purified WPPA industrial grade plant on-site in cooperation with Albright and Wilson, Ltd. of the United Kingdom. Texasgulf was owned principally by Elf Aquitaine S.A. of France, while the Williams Companies, Inc. of the United States held a minority interest.

Western States.—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. In Utah, Simplot-Farmland (SF) Phosphates Ltd. Co.—a joint venture between J. R. Simplot and Farmland Industries, Inc.—operated a major mining and phosphate rock benefication facility at Vernal, UT, used for phosphate fertilizer production at Rock Springs, WY. Cominco Fertilizers, Inc's. Warm Springs underground mine at Garrison, MT, was closed, but small quantities of direct application phosphate rock continued to be shipped from inventories.

Idaho.—Three producers conducted open pit mining from the Phosphoria Formation in Caribou County, ID, producing phosphate rock of about 60% BPL average as feedstock for P_4 furnaces. FMC Corp. operated the Dry Valley Mine on federal and private leases to provide feedstock for P_4 production at Pocatello, ID. The Monsanto Co. produced phosphate rock from the Enoch Valley Mine in the Caribou National Forest for P_4 production at Soda Springs, ID. Rhone-Poulenc Basic Chemicals Co. produced phosphate rock from the Rasmussen Ridge Mine in the Caribou National Forest for P_4 manufacture at Silver Bow, MT, and domestic sales. In 1994, total U.S elemental phosphorus production, in aggregate, was about 230,000 tons P_4, according to the U.S. Department of Commerce, Bureau of the Census.

J. R. Simplot produced beneficiated phosphate rock for fertilizer manufacture from the Smoky Canyon Mine in the Caribou National Forest. Marketable product was pumped through a 140 kilometer (km)—87 mile—buried slurry pipeline to Simplot's fertilizer conversion facility at Pocatello. The

conversion facility was capable of producing about 400,000 tons P_2O_5 as WPPA annually for downstream SPA, ammonium phosphates, GTSP, and calcium phosphate animal feed-grade product. Ammonia, urea-ammonium nitrate (UAN) solutions, ammonium sulfate, and nitric acid also were produced.

Nu-West Industries, Inc. produced phosphate rock ore from the firm's Mountain Fuel Mine on Dry Ridge through November 1993. In March 1994, Rhone-Poulenc began supplying phosphate rock ore to Nu-West under the terms of a 7-year contract negotiated in November 1993. Rhone-Poulenc was to supply about 1.5 million tons of phosphate ore annually to Nu-West for processing, and upgrading to WPPA, SPA, and ammonium phosphates at Conda, ID. Nu-West reported proven reserves approximating 60 to 70 million tons primarily on leased Federal and State lands. A plan to mine an estimated 6 million tons of phosphate ore from its North Mabie Canyon Extension lease was approved by government agencies. Effective July 1994, all assets of the whollyowned Conda Part-nership—formerly a joint venture with Western Cooperative Fertilizers (United States)—were transferred to Nu-West Mining or Nu-West Industries, and the Conda Partnership was dissolved. Nu-West also announced that it was exploring alternatives for enhancing long-term business prospects, including joint ventures with other fertilizer producers, the sale or merger of the firm, or a continuation of the current internal growth strategy.[8]

Utah.—SF Phosphates produced flotation concentrate from its Vernal, UT, mine, and pumped the material over the Uinta Mountains through a 155 km—96 mile—buried slurry pipeline to a whollyowned conversion plant at Rock Springs, WY. SF's Rock Springs facility produced WPPA, SPA and granular ammonium phosphate fertilizer. Surplus phosphate rock capacity and substantial reserves at Vernal resulted in long-range plans to significantly expand the Rock Springs conversion facility.

Consumption

In 1994, U.S. apparent domestic consumption of phosphate rock increased 13% compared with 1993. About 90% of the total was consumed in the manufacture of 11.2 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, vitamins, soft drinks, toothpaste, film, light bulbs, bone china, flame-resistant fabrics, optical glass, and other consumer goods.*(See tables 3, 4, and 5.)*

Domestic phosphate fertilizer consumption rose 2% to 4.1 million tons P_2O_5, between 1993 and 1994, accounting for about 37% of the total U.S. WPPA supply. The remainder was principally for exports of upgraded phosphate products.

Stocks

Phosphate rock stocks continued the downward trend established in 1993. At yearend, stocks were averaging about 2-month's production equivalent. This was in line with cost effective initiatives adopted by major producers in the industry. *(See table 1.)*

Transportation

In Florida, beneficiated phosphate rock was moved by rail and truck to finished phosphate upgrading facilities. Phosphate rock and finished phosphate materials were railed to ports at Tampa and Jacksonville, FL, for export or domestic use. Finished phosphate fertilizers and phosphate rock were barged up the Mississippi River and other major tributaries for domestic consumption and were also transported inland by rail and truck.

In North Carolina, Texasgulf barged phosphate rock and finished products to the port at Morehead City for export and domestic shipment. Rail facilities also were utilized 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.

Prices

In 1994, marketable phosphate rock was valued at $20.42 per-metric-ton, f.o.b. mine, a decline of about 4.5% from that of 1993. Gross revenues, however, were up by more than 5% owing to heavier volume. Industry consolidation and restructuring resulted in improved operating efficiencies and lower raw materials costs. The price of domestic phosphate rock was more reflective of producer cost because of a higher degree of vertical integration between captive phosphate rock production and upgraded phosphate manufacture. *(See tables 6, 7, and 8.)*

Foreign Trade

U.S. phosphate rock exports continued to trend downwards between 1993 and 1994, falling 13%. Geographically, about 54% of U.S. phosphate rock export shipments were to the Far East—principally, the Republic of Korea and Japan—Western Europe, 24%; Oceania, 11%; Canada, 8%; and Latin America, 3%.

Closures of WPPA plants in Western Europe and Canada, political restructuring in Eastern Europe, together with the popularity of value-added converted phosphate products in international trade, in combination have resulted in a major decline in global phosphate rock trade in recent years. This, in turn, has intensified competitive forces between major offshore phosphate rock producing countries for dwindling raw materials markets and placed downward pressure on U.S. exporters. Additionally, U.S. phosphate rock shipments in North America—Canada and Mexico—have been largely displaced by Togo and Morocco, respectively.

Arcadian Corp. and Mississippi Phosphates Corp. opted to import Moroccan phosphate rock used in phosphate conversion plants at Geismar, LA, on the Mississippi River, and at Pascagoula, MS, on the U.S. Gulf Coast. Arcadian also operated a purified WPPA industrial grade plant at Geismar on behalf of Rhône-Poulenc Chemical Co. The Moroccan Office Cherifien des Phosphates (OCP) reported phosphate rock shipments of 1.8 million tons to the United States in 1994, compared with 900,000 tons in 1993.

U.S. converted phosphate trade volume and unit value were up substantially in all major categories compared with 1993, led by record DAP shipments to China. The United States continued to dominate world interregional converted phosphate trade in 1994, accounting for about 53% of the 10.4 million ton P_2O_5 total, according to data reported by the International Fertilizer Industry Association (IFA), Paris, France. U.S. DAP export shipments were 74% of the global total; MAP, 94%; GTSP, 39%; and merchant-grade WPPA, 14%. *(See tables 8, 9, 10, 11, 12, 13, 14, and 15.)*

World Review

World phosphate rock production was about 129 million tons in 1994, an increase of more than 7% compared with 1993, according to data received from IFA subsequent to the preparation of table 17. Phosphate rock shipments for domestic conversion and export rose 6% to a level of 135 million tons, which reflected a drawdown of inventories and improved demand for finished phosphate products and raw materials at the global level. Home deliveries for conversion into upgraded phosphate materials for domestic consumption and export

accounted for about 80% of the total, with phosphate rock exports making up the remainder. WPPA plants in the major export oriented countries of the United States, Morocco, Tunisia, Senegal, South Africa, and Jordan, were pressured to meet demand, and operated at between 90% to 100% of rated capacity in 1994, according to IFA.

The United States continued to lead global phosphate rock output, accounting for about 32% of total production and 33% of total shipments, respectively. About 65% of the total increase in world phosphate rock production and shipments between 1993 and 1994 was attributable to rising domestic and international demand for upgraded U.S. phosphate materials. IFA data for 1994 indicated that production and shipments were also up in the important African countries and in the Middle East. In Socialist Asia, phosphate rock production continued to be dominated by China, with an estimated output of 26 million tons, or 20% of the world total; Vietnamese production at the new Lao Cay Mine expansion was up 40% to 500,000 tons.

***Africa.*—Egypt.—**Egypt's ongoing project to develop a 2-million-ton-per-year mine at Abu Tartur in the Western Desert was further delayed owing to technical problems and an incomplete railway link of 350 km between Abu Tartur and Quena in the Nile Valley; the railway between Safaga on the Red Sea coast and Quena, however, was complete. Only the pilot beneficiation plant was operating at this high temperature underground mine. Consequently, the Sebaya East Mine in the Nile Valley will remain open and continue to produce single superphosphate (SSP). The high iron sulfide content of Abu Tartur phosphate rock inhibits efficient filtration in WPPA manufacture, according to World Bank sources.

Morocco.—A major capacity expansion was planned in Morocco, where OCP was to bring another eight, 165,000-ton-per-year P_2O_5 WPPA units on-stream at Jorf Lasfar, doubling capacity at the facility around the turn of the century. Additional ammonium phosphate and GTSP capacity was also to be built.

During 1994, Morocco had an approximate 20% phosphate rock capacity surplus, i.e., output about 5 million tons below annual production capability of about 25 million tons. In the major mining center at Khouribga, phosphate extraction was to gradually shift from the depleting Sidi Daoui reserves to a large new open pit mine at Sidi Chennane. At Youssoufia, white rock reserves were depleting and being replaced by black rock mined underground and upgraded by calcining. Two mines at Ben Guerir provided lower grade phosphate rock for domestic conversion. Bou Craa in the Western Sahara was producing about 1.2 million tons of high grade 80% BPL material for export.

Senegal.—An approximate two-fold expansion of WPPA capacity to 640,000 tons per year P_2O_5 was planned by the turn of the century. At this time, the Keur Mor Fall deposit should deplete and a new mine would be commissioned at Tobene. Phosphate rock exports were to be largely displaced by upgraded product.

South Africa, Republic of.—Indian Ocean Fertilizer planned to debottleneck its Richards Bay WPPA plant to a rated capacity of 500,000 tons per year P_2O_5 by 1996. Foskor beneficiated phosphate-bearing tailings from ore mined by the Palabora Mining Company Ltd. (PMC), and produced high grade phosphate rock assaying 80% BPL and above for domestic conversion and export, at Phalaborwa.

***Asia.*—**In China, a total of 1 million annual tons P_2O_5 as WPPA was scheduled to come on-stream in seven provinces, primarily during 1996 and 1997. IFA analysts, however, did not believe that China's huge volume of upgraded phosphate imports would be significantly affected owing to the large imbalance in the fertilizer ratio between nitrogen and phosphate, favoring nitrogen. There were also interesting developments in China's phosphate rock supply-demand situation in 1994. Chinese imports ceased altogether, while high grade domestic phosphate rock was present in an increasing number of export markets, including India, Korea, Malaysia, and the Philippines. China's export grade phosphate rock was believed to be from Yunnan province, and was transported over long distances to the ports.

***Former U.S.S.R.*—**Phosphate rock production—principally on the Kola Peninsula in Russia, and at Karatau in Kazakhstan—decreased about 30% between 1993 and 1994, and was down 50% compared with 1992. The region continued to be plagued by rising production costs, inadequate electrical power supplies for elemental phosphorus furnaces in Kazakhstan, logistical problems, and declining domestic phosphate demand.

***Latin America.*—**In 1994, the Peruvian Sechura Desert phosphate rock deposit at Bayovar in the northwestern coastal region was placed in the hands of CEPRI BAYOVAR, a special committee formed to promote outside equity participation through the privatization of the State-owned mining enterprise, GRAU BAYOVAR. Presently, 80,000 to 100,000 tons per year of marketable rock is produced, 80% for single superphosphate production (20% P_2O_5), and the remainder for direct application exports to New Zealand.

Phosphate rock reserves in the two main areas explored total about 380 million tons as 66% BPL concentrate. Beneficiation may be effected by a simple process involving washing and floating with seawater, followed by rinsing with freshwater. A mine and beneficiation plant to produce 2 million tons concentrate annually was envisioned, which would include some production of direct application rock. Additionally, conversion plants to produce WPPA and DAP were being considered. The reserves are 30 km from the Pacific Ocean near Bayovar Bay, where a loading dock would be constructed. Large fresh water aquifers and adequate electrical power was available in the vicinity. Countries in the Pacific Basin and South America were considered to hold strategic market potential. Peru's more favorable economic and political climate have improved the probability for project fruition by the turn of the century.[9]

***Middle East.*—Israel.—**Rotem Fertilizer planned to commission a new 300,000-ton-per-year P_2O_5 WPPA plant at Mishor Rotem in the second half of 1996. Negev Phosphates mined phosphate rock at Arad, Oron and Nahal Zin, with a combined annual capacity of about 5.5 million tons.

Jordan.—Jordan Phosphate Mines (JPMC) had new projects underway at Aqaba and near the new mining operation at Es Shidiya. At Aqaba, JPMC planned to complete a debottlenecking project designed to raise WPPA capacity 10% to 450,000 tons per year P_2O_5 by 1996, while an 80,000-ton-per-year P_2O_5 joint venture with Nippon of Japan was under construction and scheduled operational in 1997. In addition, a 200,000- ton-per-year P_2O_5 joint venture WPPA project was planned with Fauji Fertilizer of Pakistan (FFC) for completion in 1997 or 1998. This material was to be exported to supply the FFC-JPMC joint venture DAP facility planned at Port Qasim near Karachi, Pakistan.

At Es Shidiya, a 200,000-ton-per-year P_2O_5 WPPA joint-venture project between JPMC and India's Southern Petrochemical Industries Corp. (SPIC)—Indo Jordan Chemicals —was under construction and scheduled operational in 1997. WPPA will be shipped to SPIC's phosphate fertilizer plant at Tuticorin, Tamil Nadu in southern India. JPMC planned to gradually expand the new 3-million-ton-per-year mine at Es Shidiya, given its logistical advantages to the port at Aqaba over existing mines at El Hassa and El Abiad in central Jordan.

Saudi Arabia.—Applications were solicited from established companies with mining and processing experience to prequalify for the exploitation of the Al Jalamid Phosphate rock deposit, 120 km from the town of Turayf in northern Saudi Arabia near the border of Iraq.

The proposed $1.7 billion project was to include an open pit mine and beneficiation plant with an annual production capacity of 4.5 million tons of high quality 71% BPL phosphate rock, a slurry pipeline for the transport of flotation concentrate to Al Jubail on the Persian Gulf, and, an attendant 2.9- million-ton-per-year DAP fertilizer facility.

A feasibility study was completed for the Directorate General of Mineral Resources (DGMR) by Jacobs International, Inc. under the direction of the U.S. Geological Survey (USGS). The study indicated that the Al Jalamid deposit contained proven reserves of 213 million tons of crude ore averaging 46% BPL. In view of the size, costs and technical difficulties, the project will probably not be fully implemented until after the turn of the century.

Oceania.—Sulfur dioxide pollution abatement measures from smelters in Queensland, Australia, dictated that an imminent decision be made to promote a phosphate project based on acidulated phosphate rock from the idle Duchess phosphate rock mine, near Mount Isa.

Western Europe.—The tight phosphate supply-demand situation in 1994 resulted in a 42% increase in Spanish WPPA production, and a decision to operate the last French WPPA plant originally slated for closure in 1996, beyond the turn of the century.

Current Research and Technology

The Florida Institute of Phosphate Research (FIPR) in Bartow, FL, was actively engaged in funding about $3 million for several autonomous and contract projects involving chemical processing, mining and beneficiation, reclamation, and environmental services. FIPR's priority projects in order of importance were phosphogypsum, reclamation, public health, industry efficiency, and waste clay ponds. U.S. Patent No. 5262064—Dewatering Instantaneously with Pulp Recycle—was issued to FIPR on November 16, 1993. FIPR's 1993-94 Annual Report indicated that the process was useful for rapidly consolidating phosphatic waste clays. An interested party signed a licensing agreement designed to potentially utilize the process to remove and consolidate organic muck from a fresh water lake.

In the chemical processing area, FIPR contracted Jacobs Engineering of Lakeland, FL, to explore ways of significantly reducing the quantity of phosphogypsum produced in WPPA manufacture by removing some or all of the free calcite and dolomite from ground rock feed for a WPPA plant, by flotation. The obvious advantages would be a lowering of sulfuric acid consumption per ton of P_2O_5 produced, lower carbon dioxide production and a concomitant decrease in defoamer usage, together with higher throughput. Related projects involving phosphogypsum were centered about more efficient filtration and recovery of phosphate values in WPPA production and environmental remediation.

The U.S. Bureau of Mines Research Center at Tuscaloosa, AL, received additional FIPR funding for an ongoing project designed to delineate the migration of metal and nonmetal ions through active and inactive commercial phosphogypsum stacks. The Research Center was to initiate a new project in the fall of 1994—The Characterization and Utilization of Phosphate Processing Wastes (FIPR 93-01-108R)—designed to demonstrate that previous findings of uniform liquid ionic movement through phosphogypsum stacks may lead to the possible removal of all water soluble elements from a closed phosphogypsum stack by the natural leaching action of rainwater. The recovery of low pH acidic rainwater leachate effluent from the stack would serve to neutralize the stack and possibly prevent the costly necessity of "capping" inactive stacks.

Outlook

Regional supply-demand balances presented at the IFA Annual Conference in Singapore during May 1995 indicated that global phosphate rock supplies would be adequate during the 5-year forecast period 1995-99, with the surplus gradually declining from 15% of supply capability in 1995 to 12% by 1999. Global phosphate rock supply capability was forecast to increase about 7% or 11 million tons during the period, principally to cover new converted phosphate capacity additions. In the United States, surplus phosphate rock availability was expected to be maintained at 6 to 8 million tons per year (12% to 15% of supply capability on average) throughout the remainder of the decade.

The global WPPA P_2O_5 outlook was less certain, however, given variables in the projected outlook for supply capability in the former U.S.S.R. For example, the global P_2O_5 surplus availability narrowed from 6% of supply capability (1.5 million tons) in 1995 to an extremely tight 1% (300,000 tons) by 1999, under the assumption that operating capability in the former U.S.S.R. would not improve beyond the current 38%. Conversely, if operating capability in the former U.S.S.R. were to gradually improve to 65% of capacity by 1999, the global surplus availability could increase to 7% of supply capability (2.0 million tons P_2O_5). It is likely that the region would be required to import phosphate rock under this high-side scenario.

There were relatively small increases in net surplus WPPA P_2O_5 supply availability forecast for the principal exporting regions of Africa, the Middle East and North America—The United States and Canada—between 1995 and 1999. In North America, the WPPA P_2O_5 surplus availability was projected to remain constant at about 5.3 million tons, as the change in demand was approximately equal to that of supply. In the United States, there was no new WPPA capacity forecast on-stream through 1999 except for minor debottlenecking and the possible startup of an idle plant in Florida. There is an outside possibility that major expansions could be partially implemented in North Carolina and out West during the forecast period.

The major P_2O_5 deficit regions were Asia, Western Europe, Latin America, and Oceania, in order of importance.

Current WPPA P_2O_5 balances, while encouraging, also demonstrate the risks associated with implementing new capital intensive phosphate projects, and the prudence on the part of major exporting countries and financial institutions of proceeding with cautious optimism. The industry, however, will undoubtedly face major technological challenges to mine and process adequate supplies of finite phosphate rock resources needed to satisfy global demand for food and fiber during the 21st century.

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[1]U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. Toxics Release Inventory 1992. Public Data Release, EPA 745-R-94-001, Washington, DC, Apr. 1994, 288 pp.

[2]U.S. President. Presidential Documents. V. 30, No. 49, Dec. 12, 1994. Office of the Federal Register, Washington, DC, 1994. Dec. 12, 1994. pp. 2478-2480.

[3]Annual Report 1994. Occidental Petroleum Corp., Dallas, TX.

[4]Cargill Fertilizer. Fertilizer Applications Minneapolis, MN, 1994-95.

[5]Annual Report 1994. CF Industries, Inc., Long Grove, IL.

[6]Securities and Exchange Commission. IMC Fertilizer Group, Inc., Form 10-K Report, fiscal year ended June 30, 1994.

[7]Annual Report 1994. Mobil Corp., Fairfax, VA.

[8]———. Nu-West Industries, Inc., Englewood, CO.

[9]Bayovar Phosphate Deposits, CEPRI BAYOVAR, Lima, Peru, 1994, 32 pp.

OTHER SOURCES OF INFORMATION

U.S. Bureau of Mines Publications

Phosphate Rock Ch. in Mineral Commodity Summaries, annual, Jan. 1995.

Phosphate Rock Ch. in Minerals Facts and Problems, 1985.
Phosphate Rock Ch. in Chemical Industry Applications of Industrial Minerals and Metals, Sept. 1993.
Phosphate Rock Annual Report, 1991-93.

Other Sources

Chesson, M. W. and J. Spalding, Phosphate Rock Reserves, The Fertilizer Institute Outlook Conference, Washington, DC, Oct. 17-18, 1994.
The Fertilizer Institute, Washington, DC.
FMC Corp., Phosphorus Chemicals Division, Pocatello, ID.
Freeport-McMoRan Resource Partners, L.P., New Orleans, LA.
Green Markets, Fertilizer Market Intelligence Weekly, Pike & Fischer, Inc., Bethesda, MD.
International Fertilizer Development Center (IFDC), Muscle Shoals, AL.
J. R. Simplot , Minerals and Chemical Group, Pocatello, ID.
Louis, P. L. Fertilizers and Raw Materials Supply and Supply/Demand Balances. Proceedings of the 63rd. International Fertilizer Industry (IFA) Conference, Singapore, May 22-25, 1995, 51pp.
Mining Engineering, The Society for Mining, Metallurgy, and Exploration, Inc., Littleton CO, monthly.
Mississippi Chemical Corp., Pascagoula, MS.
Monsanto Co., Elemental Phosphorus Division, Soda Springs, ID.
Office Cherifien des Phosphates (OCP), Casablanca, Morocco.
Phosphate News. Phosphate Facts. V. 2, No. 10, Florida Phosphate Council, Lakeland/Tallahassee, FL, spring 1995.
Phosphorus and Potassium, British Sulphur Pub., London, England, bimonthly.
Stanford Research Institute (SRI), Menlo Park, CA.
U.S. Army Corps of Engineers, Wilmington, NC.
U.S. Department of Agriculture, Economic Research Service, Washington, DC.

TABLE 1
SALIENT PHOSPHATE ROCK STATISTICS 1/

(Thousand metric tons and thousand dollars unless otherwise specified)

	1990	1991	1992	1993	1994
United States:					
Mine production (crude ore)	151,000	154,000	155,000	107,000	157,000
Marketable production	46,300	48,100	47,000	35,500	41,100
P2O5 content	14,200	14,500	14,100	10,800	12,100
Value 2/	$1,080,000	$1,110,000	$1,060,000	$759,000	$839,000
Average per metric ton 3/	$23.20	$23.06	$22.53	$21.38	$20.42
Sold or used by producers 4/	49,800	44,700	45,100	40,100	44,100
P2O5 content	15,100	13,500	13,500	11,900	13,100
Value 2/	$1,150,000	$1,030,000	$1,020,000	$856,000	$901,000
Average per metric ton 3/ 5/	$23.20	$23.06	$22.53	$21.38	$20.42
Exports 6/	6,240	5,080	3,720	3,200	2,800
P2O5 content	2,020	1,640	1,200	1,020	886
Value 2/	$191,000	$163,000	$120,000	$91,200	$71,700
Average per metric ton 3/	$30.66	$32.00	$32.29	$28.51	$25.60
Imports for consumption	451	552	1,530	534 7/	620 7/
C.i.f. value	$21,900	$28,000	$56,200	$32,300	$30,200
Average per metric ton 8/	$48.57	$50.73	$36.71	$60.45	$48.76
Consumption 9/	44,000	40,200	42,900	38,300	43,100 e/
Stocks, Dec. 31: Producers	8,910	10,200	12,600	9,220	5,980
World: Production	162,000	150,000 r/	141,000 r/	121,000 r/	124,000 e/

e/ Estimated. r/ Revised.
1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits.
2/ The total value is based on a weighted value.
3/ Computer-calculated average value based on the weighted sold or used values.
4/ Includes domestic sales and exports.
5/ Weighted average of sold or used values.
6/ Exports reported to the U.S. Bureau of Mines by companies.
7/ Some phosphate rock import tonnage and value were supressed by the Bureau of the Census.
8/ Average unit value obtained from unrounded data.
9/ Expressed as sold or used plus imports minus exports. Includes an estimated 900,000 tons of phosphate rock imported from Morocco not reported by the Bureau of the Census in 1993 and 1,800,000 tons in 1994.

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

(Thousand metric tons and thousand dollars)

Region	Mine production		Marketable production			Stocks
			Beneficiated			
	Rock	P2O5 content	Rock	P2O5 content	Value 2/	Rock
1993	107,000	18,400	35,500	10,800	759,000	9,220
1994:						
January-June:						
Florida and North Carolina	70,100	9,660	16,500	4,950	335,000	5,500
Idaho, Montana, and Utah	5,320	1,330	3,610	997	61,300	2,060
Total	75,400	11,000	20,100	5,950	396,000	7,560
July-December:						
Florida and North Carolina	76,600	11,500	17,500	5,240	385,000	3,940
Idaho, Montana, and Utah	4,620	1,150	3,450	965	58,300	2,040
Total	81,200	12,700	21,000	6,200	443,000	5,980
Grand total	157,000	23,700	41,100	12,100	839,000	XX

XX Not applicable.
1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.
2/ Computer-calculated value based on the weighted sold or used value.

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

(Thousand metric tons and thousand dollars)

Period and Grade (percent BPL 2/ content)	Florida and North Carolina			Idaho, Montana, and Utah			Total		
	Rock	P2O5 content	Value 3/	Rock	P2O5 content	Value 3/	Rock	P2O5 content	Value 3/
January-June 1993	17,000	5,130	378,000	2,900	813	49,700	19,900	5,940	428,000
July-December 1993	17,200	5,170	370,000	2,980	834	58,700	20,100	6,000	428,000
January-June 1994:									
72 to less than 74	890	299	24,100	434	146	16,200	1,320	445	40,300
70 to less than 72	147	48	4,300	--	--	--	147	48	4,300
66 to less than 70	13,900	4,250	245,000	436	137	8,190	14,400	4,390	253,000
60 to less than 66	3,760	1,050	105,000	596	166	5,790	4,360	1,210	111,000
Below 60	--	--	--	1,650	423	21,100	1,650	423	21,100
Total	18,700	5,650	379,000	3,110	872	51,300	21,800	6,520	430,000
July-December 1994:									
72 to less than 74	855	285	23,200	415	141	14,500	1,270	426	37,700
70 to less than 72	105	34	2,750	--	--	--	105	34	2,750
66 to less than 70	14,600	4,420	290,000	371	116	6,950	15,000	4,540	297,000
60 to less than 66	3,150	870	94,200	470	128	5,720	3,620	998	99,900
Below 60	--	--	--	2,310	604	33,200	2,310	604	33,200
Total	18,700	5,610	411,000	3,570	989	60,300	22,300	6,600	471,000

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines 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.

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

(Thousand metric tons)

Use	1993 total		1994					
			January-June		July-December		Total	
	Rock	P2O5 content	Rock	P2O5 content	Rock	P2O5 content	Rock	P2O5 content
Domestic: 2/								
Wet-process phosphoric acid	32,400	9,720	18,700	5,600	19,600	5,830	38,300	11,400
Normal superphosphate	19	6	7	3	8	3	15	6
Triple superphosphate	193	64	4	1	26	8	30	9
Deflourinated rock	85	28	--	--	65	21	65	21
Direct applications	28	8	(3/)	(3/)	--	--	--	--
Elemental phosphorus	4,150	1,090	1,660	445	1,210	323	2,880	768
Ferrophosphorus	--	--	--	--	--	--	--	--
Total	36,900	10,900	20,300	6,050	21,000	6,180	41,300	12,200
Exports: 4/	3,200	1,020	1,480	469	1,320	417	2,800	886
Grand total	40,100	11,900	21,800	6,520	22,300	6,600	44,100	13,100

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.
2/ Includes rock converted to products and exported.
3/ Less than 1/2 unit.
4/ Exports reported to the U.S. Bureau of Mines by companies.

TABLE 5
PHOSPHATE ROCK SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY USE AND REGION 1/

(Thousand metric tons)

Period and Use	Florida and North Carolina		Idaho, Montana, and Utah		Total	
	Rock	P2O5 content	Rock	P2O5 content	Rock	P2O5 content
1993	34,200	10,300	5,880	1,650	40,100	11,900
1994:						
January-June:						
Domestic: 2/						
Agricultural: 3/	17,200	5,170	870	283	18,100	5,460
Industrial	11	4	2,240	589	2,260	593
Subtotal	17,300	5,180	3,110	872	20,300	6,050
Exports: 4/	1,480	469	--	--	1,480	469
Total	18,700	5,650	3,110	872	21,800	6,520
July-December:						
Domestic: 2/						
Agricultural: 3/	17,300	5,160	1,980	550	19,300	5,710
Industrial	99	32	1,590	439	1,680	471
Subtotal	17,400	5,190	3,570	989	21,000	6,180
Exports: 4/	1,320	417	--	--	1,320	417
Total	18,700	5,610	3,570	989	22,300	6,600
Grand total	37,400	11,300	6,680	1,860	44,100	13,100

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.
2/ Includes rock converted to products and exported.
3/ Primarily sales/use of wet-process phosphoric acid.
4/ Exports reported to the U.S. Bureau of Mines by companies.

TABLE 6
VALUE OF FLORIDA AND NORTH CAROLINA PHOSPHATE ROCK, BY GRADE

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

Grade (percent BPL 1/ content)	1993			1994		
	Domestic	Export	Average	Domestic	Export	Average
74 or more	--	--	--	--	--	--
72 to less than 74	26.93	29.20	28.04	26.78	27.46	27.13
70 to less than 72	20.31	31.57	30.43	20.85	35.27	26.09
66 to less than 70	19.33	25.80	19.83	19.67	23.54	19.90
60 to less than 66	24.11	26.45	24.11	29.90	--	29.90
Less than 60	24.03	--	24.03	--	--	--
Weighted average	21.26	28.11	21.89	21.79	25.60	22.08

1/ 1.0% BPL (bone phosphate of lime or tricalcium phosphate)=0.458% P2O5.

TABLE 7
VALUE OF IDAHO, MONTANA, AND UTAH PHOSPHATE ROCK, BY GRADE

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

Grade (percent BPL 1/ content)	1993			1994		
	Domestic	Export	Average	Domestic	Export	Average
72 to less than 74	--	--	--	34.84	--	34.84
70 to less than 72	37.48	--	37.48	--	--	--
66 to less than 70	18.90	--	18.90	18.71	--	18.71
60 to less than 66	8.04	45.23	10.24	12.17	--	12.17
Less than 60	16.32	--	16.32	14.37	--	14.37
Weighted average	18.09	45.23	18.43	16.91	--	16.91

1/ 1.0% BPL (bone phosphate of lime or tricalcium phosphate)=0.458% P2O5.

TABLE 8
VALUE OF U.S. PHOSPHATE ROCK, BY GRADE

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

Grade	1993			1994		
(percent BPL 1/ content)	Domestic	Export	Average	Domestic	Export	Average
74 or more	--	--	--	34.84	--	34.84
72 to less than 74	30.51	29.20	30.00	30.79	27.46	29.65
70 to less than 72	34.51	31.57	32.73	20.85	35.27	26.09
66 to less than 70	19.31	25.80	19.79	19.18	23.54	19.87
60 to less than 66	22.48	45.02	22.62	27.60	--	27.60
Less than 60	17.91	--	17.91	14.37	--	14.37
Weighted average	20.76	28.51	21.38	20.89	25.18	21.14

1/ 1.0% BPL (bone phosphate of lime or tricalcium phosphate)=0.458% P_2O_5.

TABLE 9
U.S. EXPORTS OF GROUND AND UNGROUND PHOSPHATE ROCK 1/ 2/

(Thousand metric tons)
(HTS Nos. 2510.10.0000 and 2510.20.0000)

Country	Quantity	
	1993	1994
Australia	188	183
Belgium	206	197
Brazil	20	30
Canada	263	309
France	14	(3/)
Germany	194	139
India	272	255
Japan	554	471
Korea, Republic of	1,050	1,010
Mexico	3	9
Netherlands	315	350
New Zealand	204	186
Romania	31	--
Other	254	171
Total	3,570	3,310

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.
2/ Dollar values suppressed by the Bureau of the Census.
3/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 10
U.S. EXPORTS OF SUPERPHOSPHATES 1/ 2/

(Thousand metric tons)
(HTS No. 3103.10.0020)

Country	Quantity	
	1993	1994
Argentina	14	14
Australia	228	225
Bangladesh	16	52
Brazil	99	209
Canada	53	25
Chile	148	151
Colombia	13	8
Costa Rica	2	2
Japan	50	31
Peru	14	6
Uruguay	4	5
Other	121	73
Total	762	801

1/ Previously published and 1994 data are rounded by the U. Bureau of Mines to three significant digits; may not add to to shown.
2/ Dollar values suppressed by the Bureau of the Census.

Source: Bureau of the Census.

TABLE 11
U.S. EXPORTS
OF DIAMMONIUM PHOSPHATES 1/ 2/ 3/

(Thousand metric tons)
(HTS No. 3105.30.0000)

Country	Quantity	
	1993	1994
Argentina	190	205
Australia	436	415
Belgium	--	98
Brazil	77	134
Canada	175	78
Chile	108	53
China	2,110	5,410
Colombia	135	108
Costa Rica	10	11
Dominican Republic	33	45
Ecuador	38	22
France	34	49
Germany	91	123
Guatemala	5	12
India	1,190	435
Iran	32	190
Ireland	37	27
Italy	--	14
Japan	512	504
Kenya	62	78
Mexico	247	116
New Zealand	159	165
Pakistan	732	503
Peru	24	35
Spain	11	10
Thailand	87	68
Turkey	131	40
Uruguay	40	42
Venezuela	10	--
Other	652	205
Total	7,370	9,190

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.
2/ Chemical analysis: Nitrogen (18%); P2O5 (46%).
3/ Dollar values suppressed by the Bureau of the Census.

Source: Bureau of the Census.

TABLE 12
U.S. EXPORTS OF
MONOAMMONIUM PHOSPHATE 1/ 2/ 3/

(Thousand metric tons)
(HTS No. 3105.40.0000)

Country	Quantity	
	1993	1994
Argentina	2	--
Australia	188	197
Brazil	132	301
Canada	395	417
Chile	34	58
China	2	--
Colombia	91	68
Costa Rica	20	26
Ecuador	5	2
Guatemala	22	8
Japan	111	131
Mexico	38	115
New Zealand	20	14
Peru	(4/)	5
Saudi Arabia	10	--
Thailand	(4/)	35
Uruguay	--	8
Venezuela	(4/)	(4/)
Other	23	93
Total	1,090	1,480

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.
2/ Chemical analysis: Nitrogen (11%); P2O5 (52%).
3/ Dollar values suppressed by the Bureau of the Census.
4/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 13
U.S. EXPORTS OF
PHOSPHORIC ACID 1/2/3/

(Thousand metric tons)
(HTS No. 2809.20.0010)

Country	Quantity	
	1993	1994
Australia	46	17
Canada	13	61
Colombia	6	9
India	138	190
Indonesia	61	18
Japan	(4/)	--
Venezuela	37	74
Other	197	147
Total	498	516

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.
2/ Principally, "Merchant Grade" (54% - P2O5) product. Excludes superphosphoric acid tonnage reported under HTS No. 2809.20.0020, amounting to 101,000 tons in 1993 and 298,000 tons in 1994. The majority of these tonnages is believed to be Merchant phosphoric acid instead of superphosphoric acid.
3/ Dollar values suppressed by the Bureau of the Census.
4/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 14
U.S. EXPORTS OF ELEMENTAL PHOSPHORUS 1/

(HTS No. 2804.70.0000)

Country	1993		1994	
	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	**Value 2/** (thousands)
Brazil	748	$1,500	663	$1,380
Canada	1,490	2,510	519	936
Japan	9,380	17,600	7,460	14,100
Korea, Republic of	24	101	54	82
Mexico	6,360	9,700	6,220	9,170
Netherlands	23	60	--	--
Other	333	691	320	688
Total	18,400	32,200	15,200	26,400

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits may not add to totlals shown.
2/ F.a.s. values.

Source: Bureau of the Census.