



2016 Minerals Yearbook

PHOSPHATE ROCK [ADVANCE RELEASE]

PHOSPHATE ROCK

By Stephen M. Jasinski

Domestic survey data and tables were prepared by Joseph J. Kohler, statistical assistant.

In 2016, domestic production of marketable phosphate rock was 27.1 million metric tons (Mt), which was slightly less than that in 2015. Reported domestic use of phosphate rock increased slightly to 26.7 Mt compared with 26.2 Mt in 2015, and U.S. consumption of phosphate rock also increased slightly to 28.2 Mt compared with 28.1 Mt in 2015. Producer stocks of phosphate rock increased to 7.4 Mt, which was 11% more than at yearend 2015 (table 1). World phosphate rock production was estimated to be 255 Mt, a 3% decrease from that of 2015 (table 10).

Phosphorus is an essential element for plant and animal nutrition and is consumed primarily as a principal component of nitrogen-phosphorus-potassium (N-P-K) fertilizers. Phosphate rock minerals are the only significant global resources of phosphorus. In this report (unless otherwise noted), mine production is reported in terms of marketable production, which refers to beneficiated phosphate rock with a phosphorus pentoxide (P_2O_5) content suitable for wet-process phosphoric acid or elemental phosphorus manufacturing. Percentages have been calculated using unrounded data.

In 2016, domestic production of phosphoric acid for agricultural use decreased for the third year in a row to 7.19 Mt of P_2O_5 from 7.42 Mt in 2015 and from 7.57 Mt in 2014. Combined production of diammonium phosphate (DAP) and monoammonium phosphate (MAP), the major fertilizer products manufactured from phosphoric acid, was 4.18 Mt of P_2O_5 , which was 3% lower than that in 2015 (Fertilizer Institute, The, 2017b).

Production

The U.S. Geological Survey obtained domestic phosphate rock production data from monthly and semiannual voluntary canvasses of all five companies that mined phosphate rock. All companies responded to the canvasses, representing 100% of production data. In 2016, phosphate rock was produced at five mines in Florida, three in Idaho, and one each in North Carolina and Utah (table 2).

The U.S. phosphate rock industry is concentrated in central Florida in the counties of Hardee, Hillsborough, Manatee, and Polk. In 2016, the mines in Florida accounted for 63% of domestic annual production capacity. The Mosaic Company operated four mines in the region. PCS Phosphate Co., Inc. (a subsidiary of PotashCorp of Saskatchewan Inc.) operated one mine in Hamilton County in northern Florida (table 2).

In Beaufort County, NC, PCS Phosphate operated a large integrated production facility that included a mine and animal feed, fertilizer, and phosphoric acid plants.

In September, Agrium Inc. (Calgary, Alberta, Canada) and PotashCorp announced plans to merge. The merger would create the world's largest potash producer. Both companies operated phosphate rock mines in the United States, and Agrium had a phosphoric acid and fertilizer plant in Alberta, Canada. The merger required approval of regulatory agencies in Canada, the

United States, and other countries where the two companies had business units (Green Markets, 2016a).

In the Western Phosphate Field of Idaho, Montana, Utah, and Wyoming, four mines were active in 2016—three in Idaho and one in Utah (table 2). Most of the active mining took place on federally owned land in Idaho. The U.S. Department of the Interior, Bureau of Land Management (BLM) administered 86 phosphate leases covering 17,800 hectares in Idaho (U.S. Department of the Interior, Bureau of Land Management, undated). Phosphate rock was mined in Caribou County, ID, by Nu-West Industries, Inc. (a subsidiary of Agrium); P4 Production, LLC (a subsidiary of Monsanto Co.); and J. R. Simplot Co. Simplot also operated the Vernal Mine in Uintah County, UT.

All three companies in Idaho were in the process of developing new mines to replace existing mines when they are exhausted. Agrium continued with planning of the Rasmussen Valley Mine, which is adjacent to its existing Rasmussen Ridge Mine. The company received approval from the BLM and the U.S. Forest Service in early January 2017 to begin operations at the new mine. Production was expected to shift to the new mine in late 2017. In 2016, Monsanto applied for a permit for its new Caldwell Canyon Mine. The company does not expect to exhaust its current Blackfoot Bridge Mine for at least 12 years. Simplot planned to develop the Dairy Syncline Mine, which would be near its currently operating Smoky Canyon Mine. The BLM approved an expansion to Smoky Canyon that would allow Simplot to continue mining in that location until 2024 (Green Markets, 2016c).

Stonegate Agricom Ltd. (Toronto, Ontario, Canada) continued permitting activities at the proposed Paris Hills phosphate project in Bear Lake County in southeastern Idaho (Green Markets, 2016f). The company planned to open a 900,000-metric-ton-per-year (t/yr) underground phosphate rock mine in a 1,010-hectare area where three mines operated intermittently during the 20th century. The Bloomington Canyon Mine operated from 1942 to 1943 and from 1973 to 1975, the Consolidated Mine operated from 1930 to 1932, and the Paris Canyon Mine operated from 1917 to 1926 (Jasinski and others, 2004, p. 62–63).

Consumption

Phosphate rock was used primarily for production of wet-process phosphoric acid for fertilizer applications, which accounted for more than 90% of domestic consumption. The remainder was used for animal feed supplements, direct application to soil, and elemental phosphorus production. Domestic apparent consumption of phosphate rock was 28.2 Mt in 2016 compared with 28.1 Mt in 2015 (table 1).

All U.S. phosphate rock mining companies were vertically integrated, having one or more fertilizer plants, usually located

near the mine. No sales of domestically mined phosphate rock were reported by producers. Mosaic was the leading producer with about 75% of North American phosphoric fertilizer production and 14% of world output. In 2016, the company operated four wet-process phosphoric acid plants and four fertilizer plants in Florida, and one of each in Louisiana. The Louisiana phosphoric acid plant used phosphate rock imported from Peru (Mosaic Company, The, 2017, p. 1).

PCS Phosphate had phosphoric acid and fertilizer production facilities near its mines in Florida and North Carolina. In Idaho, Simplot sent ore from its Smoky Canyon Mine by slurry pipeline to its fertilizer plant in Pocatello, ID. In Utah, Simplot sent ore by pipeline from the Vernal Mine to its plant in Rock Springs, WY.

PCS Nitrogen, Inc. manufactured wet-process phosphoric acid in Geismar, LA, using imported phosphate rock from Morocco. PCS Nitrogen sold some merchant-grade and purified phosphoric wet-process acid (PPA) to Innophos Holdings, Inc., which had a nearby facility, for the production of PPA for use in technical- and food-grade applications (Innophos Holdings, Inc., 2017, p. 7). In June, PCS Nitrogen announced that it would terminate its PPA supply agreement with Innophos at the end of the current contract on July 29, 2018 (Green Markets, 2016e).

Monsanto operated the only elemental phosphorus plant in the United States in Soda Springs, ID. The company used elemental phosphorus to manufacture phosphorus trichloride, which was used as a chemical intermediary to produce glyphosate-base herbicides (Monsanto Co., 2016, p. 7). In other countries, elemental phosphorus was used chiefly to manufacture high-purity phosphoric acid by burning the phosphorus and condensing in water, producing what is known as thermal acid. Worldwide, a gradual shift to manufacturing PPA has taken place because it has lower production costs and none of the hazardous waste disposal issues that are associated with elemental phosphorus. Thermal acid, however, still accounted for about 50% of annual world production capacity of high-purity phosphoric acid, primarily in China. The only other operating elemental phosphorus facilities in the world were in Kazakhstan and Vietnam.

The United States was considered a mature market for phosphate fertilizers, with average annual consumption of slightly more than 4.0 Mt of P_2O_5 from 1990 through 2013. Fertilizer consumption information was collected by the American Association of Plant Food Officials on a crop-year (July 1 to June 30) basis. For crop-year 2013 (July 1, 2012, to June 30, 2013, the last crop-year for which data were available), consumption of P_2O_5 in fertilizers was 4.29 Mt compared with 3.95 Mt in crop-year 2012 (Slater and Kirby, 2016, p. 6).

Transportation

In Florida and North Carolina, crude phosphate rock ore was sent by slurry pipeline from the mines to the processing plants. All beneficiated phosphate rock was used internally to manufacture wet-process phosphoric acid; the beneficiated phosphate rock was sent by conveyers to acid plants. In central Florida, animal feed products, fertilizers, and phosphoric acid were sent by rail to domestic customers or to the Port of Tampa for export. The Port of Tampa handled the largest volume of fertilizer materials in the United States.

In northern Florida, PCS Phosphate transported its fertilizer products by rail to consumers; some materials, however, were sent by rail to the PCS Phosphate port facility at Morehead City, NC, for export. PCS Phosphate transported products from its Aurora, NC, complex to the Port of Morehead City by barge for export or delivery by rail to domestic consumers. Phosphoric acid producers along the Gulf of Mexico received imported phosphate rock by ship and transported their products by barge on the Mississippi River and its tributaries or by rail to domestic consumers. In Idaho and Utah, phosphate rock was transported to the processing facility from the mine via rail, slurry pipeline, and truck. Phosphate fertilizers were sent by rail or truck to customers.

Prices

Price data were collected through the semiannual canvass of producers and reflected the value of phosphate rock used for production of phosphoric acid and elemental phosphorus. Because phosphate rock produced in the United States is all used internally, this was not a good indicator of actual world price trends. The total value of phosphate rock used in the United States increased by 11% from that of 2015, and the average unit value increased by 9% to \$80.07 per metric ton from \$73.31 per metric ton in 2015 (table 1). No standard domestic or world price for phosphate rock exists. Average ranges of world prices were published in various industry trade journals based on a sample of transactions. In 2016, the average unit value of imported phosphate rock decreased to \$100.79 per metric ton from \$115.16 per metric ton in 2015. The price was calculated using the U.S. Census Bureau customs value and included cost, insurance, and freight (table 1). The import price was within the range of average world prices.

Foreign Trade

U.S. producers reported no exports of phosphate rock in 2016 (table 1). The United States was the leading importer of phosphate rock in the world. In 2016, U.S. imports were 1.59 Mt, down by 19% from 1.96 Mt in 2015. In 2016, 83% of imported phosphate rock was from Peru and 17% from Morocco. All imported phosphate rock was consumed by Mosaic and PCS Nitrogen at their phosphoric acid plants in Louisiana. U.S. import tonnage of other phosphate fertilizers was small compared with exports of the same materials (tables 5–7, 9).

After leading the world in phosphate fertilizer (DAP, MAP, and superphosphates) exports, in terms of tonnage, for about 80 years, the United States ranked second after China for the third consecutive year in 2016 (International Fertilizer Association, 2017). Domestic exports of phosphoric acid and phosphate fertilizers, in terms of P_2O_5 content, decreased by 17% from those of 2015 (Fertilizer Institute, The, 2017a). India was the leading destination for all types of United States phosphate exports combined, in terms of P_2O_5 (tables 5–7).

World Review

World production of phosphate rock decreased by 3% in 2016 to 255 Mt compared with 263 Mt in 2015. China (135 Mt), the United States (27.1 Mt), and Morocco (26.9 Mt) were the

leading producing countries, accounting for 74% of the world total (table 10). Phosphate rock production in China has been reported by several sources to be much lower than the official statistics shown in table 10. Production has been estimated to be between 80 and 85 Mt, based on reported production of phosphate fertilizers, industrial phosphates, and exports of phosphate rock (Zhao, 2015).

In 2016, major projects were under development in Morocco (capacity expansion) and Saudi Arabia (new mining operation). In terms of regional mine development, Africa, the Middle East, and South America accounted for about 90% of new production capacity planned for completion by 2021. Small mine development and expansion projects were in progress in Angola, Egypt, Jordan, Peru, Senegal, Tunisia, and Turkey (Prud'homme, 2017).

Brazil.—In October, Anglo American plc sold its niobium and phosphate rock operations in Brazil to China Molybdenum Co. Ltd. for \$1.7 billion as part of a corporate restructuring. The phosphate operations included the Chapadao Mine and beneficiation plant in Ouvidor, Goiás State; two phosphate plants at Catalao in Goiás State; and a plant in Cubatao, São Paulo State. The sale also included the Coquieros and Morro Preto phosphate deposits in Goiás State (Green Markets, 2016b).

In December, Mosaic agreed to purchase Vale Fertilizantes S.A., the phosphate rock and potash business of Vale SA. The acquisition of nearly 6 million metric tons per year (Mt/yr) of phosphate rock production capacity included five phosphate rock mines in Brazil and the Vale stake in the Miski Mayo Mine joint venture in Peru, which would give Mosaic 75% of the joint venture, including Mosaic's existing stake. The purchase included four phosphoric acid and fertilizer plants and a potash mine. Mosaic also would acquire the Kronau, Saskatchewan, Canada, potash project and an option to buy the Rio Colorado potash project in Argentina. Approval of the merger was not expected before early 2018 (Green Markets, 2016d).

Morocco.—OCP Group continued with an expansion program to increase its mine capacity from 30.1 Mt/yr to 52.1 Mt/yr during the next decade. In 2016, construction was ongoing at the Khouribga and Gantour mining areas. A 10-Mt/yr expansion at Khouribga was completed in late 2016. A 12-Mt/yr expansion at Gantour was planned for completion by 2023. OCP planned to open new mines at the Meskala deposit in the Essaouira Region after 2023 (Fertilizer International, 2016).

Saudi Arabia.—Ma'aden Phosphate Co. (MPC) continued development of the Umm Wu'al phosphate mine on the Al Khabra deposit. The mine was part of the Wa'ad Al Shamal phosphate project joint venture among MPC (60%), Mosaic (25%), and Saudi Basic Industries Corp. (15%). The project included the phosphate rock mine and beneficiation plant and production facilities for phosphoric acid, animal feed, purified phosphoric acid, sodium tripolyphosphate, and sulfuric acid. The phosphate products would be sent by rail to Ras Al Khair to be processed into fertilizers. Existing fertilizer plants would be expanded at Ras Al Khair as part of the project. Production capacity was planned to be 5.3 Mt/yr of phosphate concentrate, 3.5 Mt/yr of phosphate fertilizers, and 1.5 Mt/yr of phosphoric acid. The project was expected to be completed in 2017 (Ma'aden Phosphate Co., 2017, p. 72–75).

Outlook

According to the International Fertilizer Association (IFA), world phosphate rock production is projected to increase to 249 Mt in 2021 from 226 Mt in 2016. Global production capacity is projected to increase to 270 Mt/yr in 2021 from 246 Mt/yr in 2016 (Prud'homme, 2017). The IFA used lower estimated production and capacity figures for China that were based on processed phosphates production and trade rather than official Government data, which is shown in table 10. The increase likely will be from a combination of new mines and expansions of existing operations. The bulk of the new capacity is expected to be in Morocco and Saudi Arabia (Prud'homme, 2017). U.S. production capacity likely will remain stable through 2017. Three new mines are planned in Idaho, but two would be replacements for existing mines and will not significantly change domestic production capacity. Two mines are under development in Florida, but neither has been permitted.

The projected increases in annual production capacity for phosphate rock will be commensurate with the associated increase in phosphoric acid and fertilizer production. Phosphate fertilizers are necessary to grow crops for food and biofuels to meet the needs of world population growth. According to the IFA, world consumption of P_2O_5 in all uses is projected to increase slightly to 48.8 Mt in 2021 from 44.7 Mt in 2016 (Prud'homme, 2017).

References Cited

- Fertilizer Institute, The, 2017a, Fertilizer record addendum December 2016: Washington, DC, The Fertilizer Institute, February 7, 4 p.
- Fertilizer Institute, The, 2017b, Fertilizer record Oct.–Dec. 2016: Washington, DC, The Fertilizer Institute, February 17, 8 p.
- Fertilizer International, 2016, Morocco's phosphate growth dash: Fertilizer International, no. 472, May–June, p. 57–62.
- Green Markets, 2016a, Agrium, PotashCorp plan merger; Wall Street not so sure: Green Markets, v. 40, no. 38, September 16, p. 1, 17–18.
- Green Markets, 2016b, Anglo closes phosphate/niobium sale: Green Markets, v. 40, no. 41, October 7, p. 16.
- Green Markets, 2016c, Idaho mine expansions under review: Green Markets, v. 40, no. 29, July 15, p. 17–18.
- Green Markets, 2016d, Mosaic to buy Vale fertilizer assets for \$2.5 B: Green Markets, v. 40, no. 52, December 23, p. 1, 14–15.
- Green Markets, 2016e, PCS will not renew acid contract with Innophos: Green Markets, v. 40, no. 27, July 1, p. 14.
- Green Markets, 2016f, Stonegate eyes Paris Hills permits by end of 2017: Green Markets, v. 40, no. 37, September 9, p. 16.
- Innophos Holdings, Inc., 2017, Revitalized for growth—2016 annual report: Cranbury, NJ, Innophos Holdings, Inc., 90 p. (Accessed June 28, 2017, at <http://ir.innophos.com/download-library>.)
- International Fertilizer Association, 2017, Processed phosphates statistics: Paris, France, International Fertilizer Association, October 13, 39 p. (Accessed October 14, 2017, via <https://www.fertilizer.org>.)
- Jasinski, S.M., Lee, W.H., and Causey, J.D., 2004, The history of production of the Western Phosphate Field, in Hein, J.R., ed., Life cycle of the Phosphoria Formation: Amsterdam, The Netherlands, Elsevier B.V., p. 45–71.
- Ma'aden Phosphate Co., 2017, Facing today's challenges preparing for tomorrow's opportunities—2016 Annual Report: Riyadh, Saudi Arabia, Ma'aden Phosphate Co., 192 p. (Accessed June 21, 2017, at <https://www.maaden.com.sa/download/2016-Annual-Report-En.pdf>.)
- Monsanto Co., 2016, Form 10-K—2016: U.S. Securities and Exchange Commission, 152 p. (Accessed October 26, 2016, at <https://otp.investis.com/clients/us/monsanto/SEC/sec-show.aspx?FilingId=11640837&Cik=0001110783&Type=PDF&hasPdf=1>.)
- Mosaic Company, The, 2017, Form 10-K—2016: U.S. Securities and Exchange Commission, 260 p. (Accessed March 8, 2017, at <http://investors.mosaicco.com/doc.aspx?IID=4097833&DID=39490609>.)

Prud'homme, Michel, 2017, Fertilizers and raw materials global supply, 2017–2021: Paris, France, International Fertilizer Association, June 28, 100 p. (Accessed July 12, 2017, via <https://www.fertilizer.org>.)

Slater, J.V., and Kirby, B.J., 2016, Commercial fertilizers 2013: Columbia, MO, Association of American Plant Food Control Officials, Inc., 42 p.

U.S. Department of the Interior, Bureau of Land Management, [undated], BLM Idaho mining and minerals: U.S. Department of the Interior, Bureau of Land Management. (Accessed September 6, 2017, at <https://www.blm.gov/programs/energy-and-minerals/mining-and-minerals/about/idaho>.)

Zhao, Isaac, 2015, Out of the haze, demystifying the Chinese phosphate market: Phosphates 2015, Tampa, FL, presentation, 23 p.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Fertilizers—Sustaining Global Food Supplies. Fact Sheet 155–99, 1999.

Historical Statistics for Mineral and Material Commodities in the United States. Data Series 140.

Marketable Phosphate Rock. Mineral Industry Surveys, crop-year.

Phosphate. International Strategic Minerals Inventory Summary Report, Circular 930–C, 1984.

Phosphate Deposits. Ch. in United States Mineral Resources, Professional Paper 820, 1973.

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

Phosphate Rock. Mineral Industry Surveys, monthly.

Phosphate Rock Resources of the United States. Circular 888, 1984.

Sedimentary Phosphate Resource Classification System of the U.S. Bureau of Mines and the U.S. Geological Survey. Circular 882, 1982.

Other

Fertilizer Institute, The.

International Fertilizer Development Center.

International Fertilizer Association.

International Plant Nutrition Institute.

Phosphate Availability and Supply—A Minerals Availability Appraisal: U.S. Bureau of Mines Information Circular 9187, 1988.

Phosphate Rock. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.

U.S. Department of Agriculture, Economic Research Service.

TABLE 1
SALIENT PHOSPHATE ROCK STATISTICS¹

(Thousand metric tons and thousand dollars unless otherwise specified)

	2012	2013	2014	2015	2016	
United States:						
Mine production (crude ore)	150,000	139,000	112,000	127,000	130,000	
Marketable production:						
Quantity:						
Gross weight	30,100	31,200	25,300	27,400	27,100	
P ₂ O ₅ content	8,590	8,930	7,110	7,710	7,660	
Value	3,080,000	2,850,000	1,990,000	1,980,000	2,090,000	
Value, average ²	dollars per metric ton	102.54	91.11	78.59	72.41	76.90
Used by producers:						
Quantity:						
Gross weight	27,300	28,800	26,700	26,200	26,700	
P ₂ O ₅ content	7,720	8,200	7,540	7,390	7,550	
Value	2,620,000	2,610,000	2,150,000	1,920,000	2,130,000	
Value, average	dollars per metric ton	96.12	90.72	80.31	73.31	80.07
Imports for consumption:³						
Quantity, gross weight	3,570	3,170	2,380 ^r	1,960	1,590	
Value, cost, insurance, and freight	481,000	375,000 ^r	238,000	226,000	160,000	
Value, average	dollars per metric ton	134.67	118.36 ^r	99.75	115.16	100.79
Consumption, gross weight ⁴	30,900	31,900	29,100	28,100	28,200	
Stocks, producers, December 31	6,700	9,000	5,880	6,730	7,450	
World, production, gross weight	216,000	232,000	237,000	263,000 ^r	255,000	

^rRevised.

¹Table includes data available through June 21, 2018. Data are rounded to no more than three significant digits, except average values.

²Average value based on the used by producer values.

³Source: U.S. Census Bureau.

⁴Expressed as used by producers plus imports.

TABLE 2
ACTIVE PHOSPHATE ROCK MINES IN THE UNITED STATES IN 2016¹

Owner	Mine	County and State
Mosaic Company, The	Four Corners	Hillsborough and Manatee, FL.
Do.	South Fort Meade	Hardee, FL.
Do.	South Pasture	Do.
Do.	Wingate	Manatee, FL.
Nu-West Industries, Inc. (Agrium Inc.)	Rasmussen Ridge	Caribou, ID.
P4 Production, LLC (Monsanto Co.)	Blackfoot Bridge	Do.
PCS Phosphate Co., Inc.	Aurora	Beaufort, NC.
Do.	Swift Creek	Hamilton, FL.
Simplot, J. R., Co.	Smoky Canyon	Caribou, ID.
Do.	Vernal	Uintah, UT.

Do. Ditto.

¹Table includes data available through June 21, 2018.

TABLE 3
PRODUCTION OF PHOSPHATE ROCK IN THE UNITED STATES, BY PERIOD¹

(Thousand metric tons and thousand dollars)

Period	Mine production, crude ore		Marketable production, beneficiated			Ending stocks, rock
	Rock	P ₂ O ₅ content	Rock	P ₂ O ₅ content	Value ²	
2015:						
January–June	64,300	8,030	13,800	3,880	842,000	6,870
July–December	62,500	8,340	13,600	3,830	1,140,000	6,730
Total	127,000	16,400	27,400	7,710	1,980,000	XX
2016:						
January–June	64,300	5,100	12,600	3,580	1,010,000	7,110
July–December	65,300	5,010	14,500	4,080	1,070,000	7,450
Total	130,000	10,100	27,100	7,660	2,090,000	XX

XX Not applicable.

¹Table includes data available through June 21, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Based on the per ton sold or used values.

TABLE 4
PHOSPHATE ROCK SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY PERIOD¹

(Thousand metric tons and thousand dollars)

Period	Rock	P ₂ O ₅ content	Value ²
2015:			
January–June	12,800	3,620	788,000
July–December	13,400	3,770	1,130,000
Total	26,200	7,390	1,920,000
2016:			
January–June	12,600	3,580	1,050,000
July–December	14,000	3,980	1,080,000
Total	26,700	7,550	2,130,000

¹Table includes data available through June 21, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Free on board mine.

TABLE 5
U.S. EXPORTS OF DIAMMONIUM PHOSPHATE^{1,2}

(Thousand metric tons and thousand dollars)

Country or locality	2015		2016	
	Quantity	Value	Quantity	Value
Argentina	48	22,100	33	12,000
Australia	56	25,200	41	14,200
Brazil	248	107,000	258	84,700
Canada	129	44,100	87	36,800
Colombia	149	68,400	130	45,800
Honduras	78	35,700	65	22,800
India	636	287,000	552	182,000
Japan	126	59,000	118	42,400
Mexico	206	94,600	205	72,200
Peru	126	57,200	157	52,700
Other	311 ^r	142,000	67	23,300
Total	2,110	943,000 ^r	1,710	588,000

^rRevised.

¹Table includes data available through June 21, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Presentation of annual data is based on the top 10 quantities of the leading countries in 2016.

Source: U.S. Census Bureau.

TABLE 6
U.S. EXPORTS OF MONOAMMONIUM PHOSPHATE^{1,2}

(Thousand metric tons and thousand dollars)

Country or locality	2015		2016	
	Quantity	Value	Quantity	Value
Argentina	72	32,300	91	30,100
Australia	320	143,000	262	93,800
Brazil	683	303,000	913	301,000
Canada	819 ^r	429,000 ^r	953	394,000
Columbia	121	54,800	123	41,900
Japan	90	42,000	93	33,100
Mexico	54 ^r	27,200 ^r	76	29,100
Peru	16	7,390	12	3,690
Uruguay	45	20,200	30	10,100
Venezuela	26	11,600	24	7,830
Other	35	17,700 ^r	4	2,470
Total	2,280 ^r	1,090,000 ^r	2,580	947,000

^rRevised.

¹Table includes data available through June 21, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Presentation of annual data is based on the top 10 quantities of the leading countries in 2016.

Source: U.S. Census Bureau.

TABLE 7
U.S. EXPORTS OF PHOSPHORIC ACID^{1,2}

(Thousand metric tons and thousand dollars)

Country or locality	2015		2016	
	Quantity	Value	Quantity	Value
Brazil	91	36,400	88	32,000
Canada	6	1,830	5	1,690
India	269 ^r	99,100 ^r	416	124,000
Mexico	42	12,500	140	41,400
Other	7	2,510	14	4,920
Total	415 ^r	152,000 ^r	663	204,000

^rRevised.

¹Table includes data available through June 21, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Excludes superphosphoric acid tonnage.

Source: U.S. Census Bureau.

TABLE 8
U.S. EXPORTS OF ELEMENTAL PHOSPHORUS¹

Country or locality	2015		2016	
	Quantity (metric tons)	Value ² (thousands)	Quantity (metric tons)	Value ² (thousands)
Brazil	13,700 ^r	\$49,200 ^r	13,100	\$50,000
Canada	1,360	4,080	1,110	3,690
Netherlands	3,250	6,540	1,690	3,220
Vietnam	193	1,030	336	1,290
Other	128 ^r	381 ^r	282	861
Total	18,600 ^r	61,200 ^r	16,500	59,000

^rRevised.

¹Table includes data available through June 21, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Free alongside ship values.

Source: U.S. Census Bureau.

TABLE 9
U.S. IMPORTS FOR CONSUMPTION OF PHOSPHATE ROCK AND PHOSPHATIC
MATERIALS¹

(Thousand metric tons and thousand dollars)

Phosphatic materials	2015		2016	
	Quantity	Value ²	Quantity	Value ²
Phosphate rock:				
Unground	1,520	150,000	1,320	118,000
Ground	442 ^r	75,600 ^r	267	42,100
Total	1,960	226,000	1,590	160,000
Dicalcium phosphate	11	13,000 ^r	28	21,200
Elemental phosphorus	14	52,500 ^r	5	18,000
Triple superphosphate	201 ^r	81,000 ^r	295	89,400
Diammonium phosphate	599 ^r	290,000 ^r	586	213,000
Monoammonium phosphate	582	300,000 ^r	853	334,000
Fertilizer containing nitrates and phosphates	87	43,300 ^r	32	12,600
Phosphoric acid	1	197 ^r	2	401

^rRevised.

¹Table includes data available through June 21, 2018. Data are rounded to no more than three significant digits.

²Declared cost, insurance, freight values.

Sources: U.S. Census Bureau.

TABLE 10
PHOSPHATE ROCK: WORLD PRODUCTION, BY COUNTRY OR LOCALITY¹

(Thousand metric tons)

Country or locality ²	Gross weight					P ₂ O ₅ content				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
Algeria	1,250	1,151	1,418	1,289 ^r	1,270	375 ^e	345 ^e	415 ^{r,e}	380 ^{r,e}	375 ^e
Australia ^{e,3}	2,800 ^r	2,500 ^r	2,900 ^r	3,300 ^r	3,000	644 ^r	580 ^r	750 ^r	860 ^r	750
Brazil, concentrate	6,740	6,715	6,513	5,800 ^{r,e}	5,200	2,388	2,504	2,521	1,900 ^{r,e}	1,550
Canada	650	300	--	--	(4) ^e	230 ^e	111 ^e	--	--	(4)
Chile:										
Apatite	9	12	9	7 ^r	7 ^e	3 ^e	4 ^e	3 ^{r,e}	2 ^{r,e}	2
Guano	NA ^r	NA ^r	NA ^r	NA ^r	3 ^e	NA	NA	NA	NA	NA
Phosphorite	NA ^r	--	11	NA ^r	9	NA	NA ^r	NA ^r	NA	NA
China	95,000 ^r	111,700	120,000	142,000 ^r	135,000 ^e	28,500 ^e	33,500 ^e	36,000 ^e	42,600 ^{r,e}	40,500 ^e
Colombia	30	41 ^r	30 ^r	90 ^r	43 ^e	9 ^e	12 ^{r,e}	9 ^{r,e}	27 ^{r,e}	13 ^e
Egypt, beneficiated	6,236	5,922	5,378 ^r	5,303 ^r	5,000	1,835	1,777	1,620	1,591 ^r	1,500
Finland, apatite, concentrates	858	877	946	957 ^r	940	313 ^e	320 ^e	345 ^e	350 ^{r,e}	343 ^e
India	2,124 ^r	1,536 ^r	1,296 ^r	1,959 ^r	2,000	531 ^r	384 ^r	324 ^r	490 ^r	450
Iran, ore ^e	370	109 ^r	75 ^r	85 ^r	100	110	33 ^r	23 ^r	26 ^r	30
Iraq, beneficiated	250	350 ^r	34 ^e	--	--	44 ^r	64	7 ^e	--	--
Israel, beneficiated	3,513 ^r	3,578	3,357	3,849 ^r	3,947	1,090 ^e	1,100 ^e	1,040 ^e	1,190 ^{r,e}	1,030 ^e
Jordan	6,383	5,399	7,144	8,336 ^r	7,991	2,043	1,728	2,286	2,668 ^r	2,560 ^e
Kazakhstan ^e	1,995 ^r	1,866 ^r	1,589 ^r	1,760 ^r	1,500	439	411	350	387	330
Korea, North	-- ^r	-- ^r	-- ^r	-- ^r	-- ^e	-- ^r	-- ^r	-- ^r	-- ^r	-- ^e
Mexico	1,725	2,217	1,663	1,677	1,700 ^e	483	620	466	470	472 ^e
Morocco ⁵	27,060	26,400	27,390	26,264 ^r	26,929	8,659	8,448	8,580 ^r	8,040 ^r	8,470 ^e
Pakistan	69	105 ^r	89 ^r	86 ^r	115	13 ^{r,e}	20 ^r	17 ^r	35 ^r	24
Peru	3,209	3,546	3,801	3,881	3,850 ^e	975	1,075	1,155	1,180	1,160 ^e
Philippines	3	3	4	5	5	1	1	1	2 ^r	2
Russia ^e	10,300	10,700 ^r	10,800 ^r	11,600	12,400	3,960 ^r	4,130 ^r	4,150 ^r	4,480	4,780
Saudi Arabia	3,000	3,262 ^r	3,425 ^r	4,100 ^r	4,200 ^e	975	1,044 ^r	1,096 ^r	1,281 ^r	1,280 ^e
Senegal	1,416 ^r	909 ^r	1,285 ^r	2,100 ^r	2,200	450	290	417 ^r	580 ^r	730
South Africa	2,242 ^r	2,132	2,011 ^r	1,852 ^r	1,700 ^e	829	788 ^r	743 ^r	685 ^r	636
Sri Lanka	48 ^r	49 ^r	36 ^r	37 ^r	37	13 ^{r,e}	13 ^{r,e}	10 ^r	10 ^r	10
Syria	1,534	1,000	1,234	538 ^{r,e}	--	460	300	370	167 ^{r,e}	--
Tanzania	20	30 ^{r,e}	30 ^r	-- ^r	--	6 ^e	9 ^{r,e}	9 ^r	-- ^r	--
Thailand	2	-- ^r	1	-- ^r	-- ^e	1	-- ^r	-- ^r	-- ^r	--
Togo	1,159	1,214	1,098 ^r	1,150 ^r	850 ^e	420 ^e	440 ^e	395 ^{r,e}	417 ^r	300
Tunisia, washed	2,762	3,283	3,784	3,240 ^r	3,660 ^e	829 ^{r,e}	985 ^r	1,135 ^r	972 ^r	1,060
Turkey	-- ^r	510	604	713 ^r	700	-- ^r	153	181	214 ^r	210 ^e
United States	30,100	31,200	25,300	27,400	27,100	8,590	8,930	7,110	7,710	7,660
Uzbekistan ^e	800	850	800	800 ^r	900	136 ^r	145	136 ^r	136 ^r	150
Venezuela	152 ^r	106 ^r	36 ^r	26 ^r	25 ^e	41 ^r	29 ^r	10 ^r	7 ^r	--
Vietnam	2,365	2,656 ^r	2,471 ^r	2,758 ^r	2,800	665 ^e	745 ^e	700 ^{r,e}	800 ^{r,e}	840
Zimbabwe, concentrate ^e	20	6	9	9	9	8 ^r	2	3	3	3
Total	216,000	232,000	237,000	263,000 ^r	255,000	66,100 ^r	71,000 ^r	72,400 ^r	79,700 ^r	77,200

^eEstimated. ^rRevised. NA Not available. -- Zero.

¹Table includes data available through November 23, 2017. All data are reported unless otherwise noted. Totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²In addition to the countries and (or) localities listed, Burkina Faso and Nauru produced phosphate rock, and France and Luxembourg made basic Thomas converter slag, but information was inadequate to estimate output.

³Includes production from Christmas Island.

⁴Less than ½ unit.

⁵Includes production from Western Sahara.