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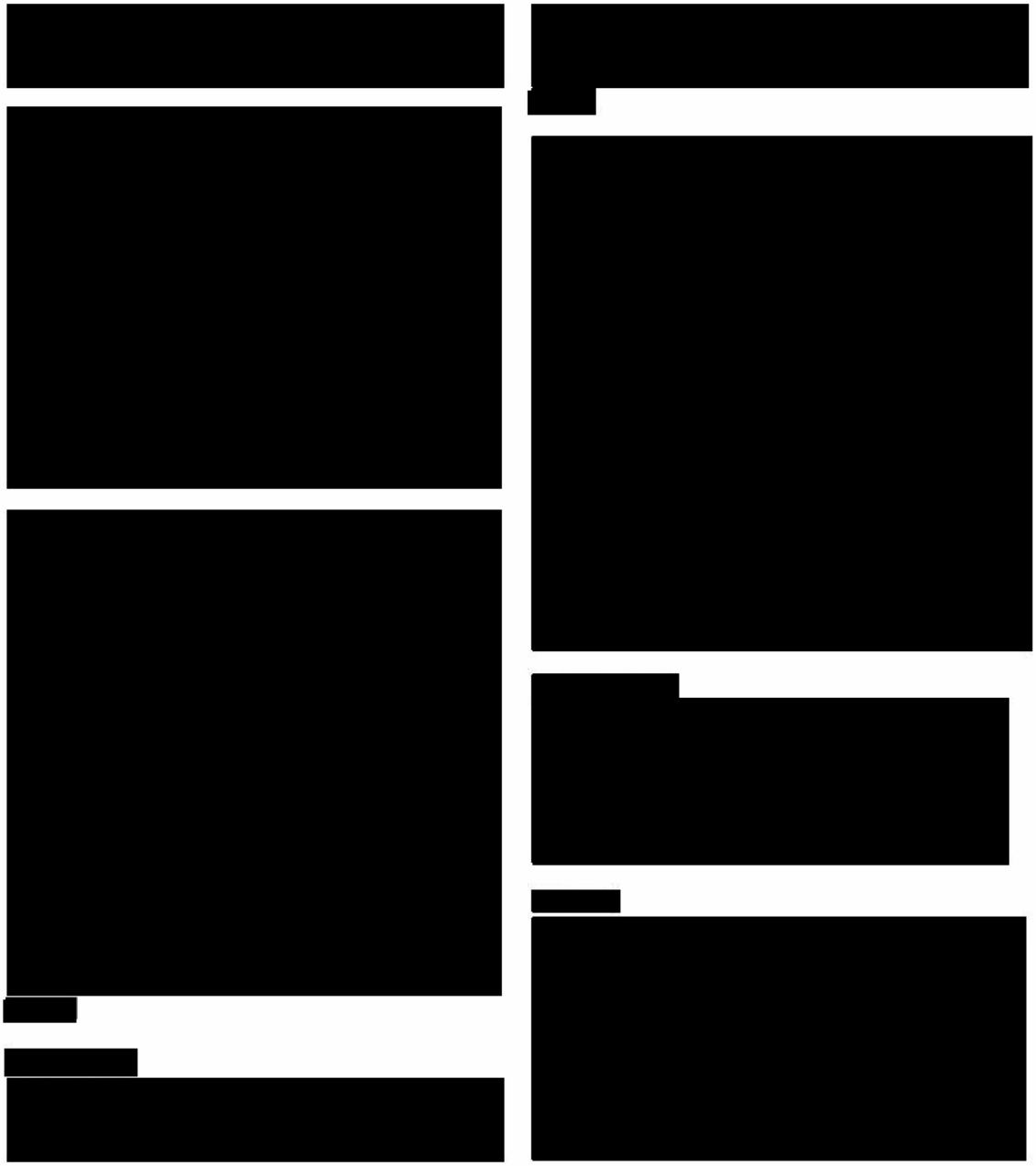


PHOSPHATE ROCK

by T.M. "Mike" Gurr, Gurr Professional Services, Inc. and Stephanie Gurr, The Vertex Companies

U.S. marketable phosphate rock production for the 2022 crop year (July 1, 2021 to June 30, 2022) showed a decrease to 20.7 Mt from the 2021 crop year production of 22.4 Mt, as reported to the U.S. Department of the Interior by the mining companies operating in the United States during crop year 2021. Domestic consumption decreased in the 2022 crop year to 23.7 Mt, compared with the 24.4 Mt consumed in crop year 2021. U.S. imports of phosphate rock decreased to 2.42 Mt for the 2022 crop year from the 2.54 Mt for crop year 2021. Imports of phosphate rock were from Peru and Morocco. There was a decrease of 0.8 Mt in producers' stocks from 10.9 Mt in crop year 2021 to 10.1 Mt in crop year 2022 (Table 1).

For calendar year 2022, phosphate ore was mined by nine mines in four states, for an estimated 21

Table 1

Phosphate rock production.

Crop year	Crop year (July 1-June 30)					
	Production (marketable, beneficiated)				Consumption	
	Phosphate rock tonnage[2]	% BPL	Value (f.o.b. mine)[1]	Ending stocks tonnage[2]	Tonnage[2]	Value[1]
2012	28.8	63.1	$98.36	5.6	31.3	$100.51
2013	31.9	62.6	$99.58	7.14	30.9	$95.51
2014	28	62	$80.97	7.94	30.4	$80.97
2015	26.1	61.3	$72.41	6.87	28.4	$72.94
2016	26.2	61.3	$76.90	9.34	27.7	$83.78
2017	27.9	60.4	$75.45	7.45	27.2	$77.55
2018	25.7	65.6	$74.61	10.3	28.3	$74.30
2019	23.3	61.1	$69.00	10.6	26.5	$68.90
2020	24.0	60.6	$70.76	10.3	25.9	$70.00
2021	22.4	60.0	$81.00	10.9	24.4	$81.00
2022	20.7	60.0	$89.00	10.1	23.7	$87.00

[1] Price (U.S. dollars per metric ton), [2] million metric tons, [e] estimated. (Source: Stephen M. Jasinski, USGS Minerals Industry Surveys)

Mt of marketable product. Florida and North Carolina phosphate rock production accounted for 75 percent of the total U.S. production, with the balance produced in the western states of Idaho and Utah. The Florida and North Carolina percentage of U.S. production is declining. The United States is responsible for less than 10 percent of the world production of 220 Mt for calendar year 2022 (Table 2).

In calendar year 2022, U.S. phosphate production decreased slightly by 0.6 Mt; in addition, companies decreased stocks of phosphate rock by 0.7 Mt. The domestic production for the calendar year 2022 of 21 Mt represents 67 percent of the domestic production capacity of 31.1 Mt.

U. S. production and consumption of phosphate rock were lower in 2022 due to slightly lower production of phosphoric acid and elemental phosphorus. Adverse weather conditions and damage related to these weather conditions in areas of the United States, including a major hurricane during planting season, resulted in lower domestic consumption.

In 2022, supply disruptions, including the conflict between Russia and Ukraine, as well as China's new restrictions on exports of diammonium phosphate (DAP) and monoammonium phosphate (MAP) impacted the world production of phosphate rock and fertilizer. China has revised the phosphate rock production to only report production from large mines, which totals 90 Mt to 85 Mt as compared to earlier reported annual production at 140 Mt. Morocco's production has increased to 40 Mt in calendar year 2022, which is approximately 19 percent of the world's production (Table 2). While other countries increased exports, they were unable to compensate for the loss to the world market by China and Russia. Figure 1 displays the U.S. proportion of world phosphate production from 1900 through present day.

Imports/exports

There were no reported U.S. exports of phosphate rock in crop year 2022, nor have there been any reported exports of phosphate rock since crop year 2004. U.S. producers continue to prefer to export the higher-value fertilizer products, such as MAP, DAP and triple super phosphate (TSP), in preference to phosphate rock. Approximately half of the MAP, DAP and TSP produced in calendar year 2022 were exported.

Imports of phosphate rock in calendar 2022 were estimated by the U.S. Geological Survey (USGS) at 2.4 Mt, compared with 2021 imports of 2.46 Mt. Imports were from Morocco (5 percent) and Peru (85 percent).

Uses

The manufacturing of fertilizers and the production of animal feed supplements account for more than 95 percent of phosphate rock consumption. The remainder of phosphate rock was used to produce elemental phosphorus, defluorinated phosphate rock or was used for direct application to the soil. Major fertilizers include DAP, MAP and TSP. The balance is used in a variety of products, such as vitamins, pharmaceuticals, soft drinks, toothpaste, flame retardants, glass, photographic film and other consumer goods. Continued growth of the world population and the need for dependable food supplies underscore the need for phosphate fertilizers.

Synthetic eqivalents

There is no natural or synthetic substitute for phosphorus, which is essential for life in all growing things, plants and animals alike. There currently is no economical alternative to phosphate rock as the major source of phosphorus.

Prices

The calendar year 2022 average price at the mine was reported at $90/Mt, which is 6.9 percent higher than the calendar year 2021 average price of $83.10/Mt. The value of the imported phosphate in calendar year 2022 of $136/Mt also increased from $84.80/Mt in the prior calendar year.

The world capacity to produce phosphate rock is

Table 2

World phosphate production, and U.S. position.

Calendar year	Tons[1, 2]				Percentage	
	World	China	Morocco[3]	United States	United States	Morocco[3]
2012	217.0	95.3	28.0	30.1	13.87	12.90
2013	225.0	108.0	26.4	31.2	13.87	11.73
2014	218.0	100.0	30.0	25.3	11.61	13.76
2015	241.0	120.0	29.0	27.4	11.37	12.03
2016	255.0	135.0	26.9	27.1	10.63	10.55
2017	263.0	144.0	27.0	27.9	10.61	10.27
2018	267.7	140.0	33.0	25.7	9.6	12.33
2019	240.0	110.0	36.0	23.3	9.70	15.00
2020	233.0	90.0	37.0	23.5	10.54	16.59
2021	226.0	90.0	38.1	21.6	10.00	18.51
2022	220.0	85.0	40.0	21.0	10.00	19.05

[1] Estimate for 2022, [2] million metric tons, [3] includes Western Sahara. (Source: Stephen M. Jasinski, USGS Mineral Commodity Summaries, Phosphate Rock and Marketable Phosphate Rock in January 2023)

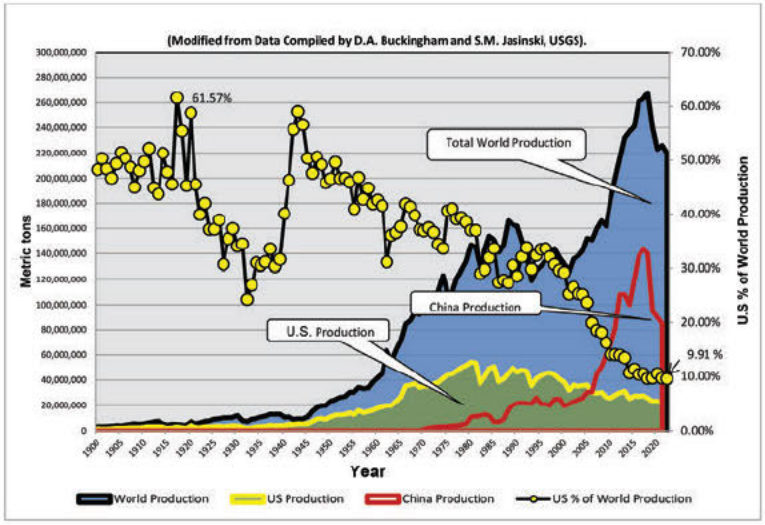
expected to continue to increase as a result of many other phosphate mine expansion projects. Active exploration and feasibility studies of the potential for development of phosphate deposits worldwide are ongoing.

Morocco. Morocco phosphate rock prices at 70 percent BPL increased from $173/Mt in January 2022 to a high of $320/Mt during July through September 2022, closing in December 2022 at $300/Mt.

Fertilizers. DAP spot prices, U.S. Gulf granular, free on board (f.o.b.), increased from $699.38/Mt in January 2022 to a high of $954/Mt in April, closing in December 2022 at $625/Mt. TSP increased from $674.38/Mt in January 2022 to a high of $856/Mt in April, closing in December 2022 at $584.38/Mt.

Figure 1

U.S. proportion of world phosphate production.



Industry news

There are currently two phosphate rock producers mining in Florida, one in the Central District (Mosaic) and one in the North District (Nutrien, Ltd). There is one producer in North Carolina: Nutrien Ltd. Mosaic's phosphate operating earnings were $1.3 billion in 2022, up from $1.2 billion in 2021, despite Hurricane Ian's impacts to Mosaic facilities, affecting production and shipments. Higher prices offset lower production and sales, and production has returned to normal rates as of February 2023. Mosaic anticipates a recovery in demand for fertilizers in 2023 due to strong agricultural commodity pricing trends. Nutrien's phosphate earnings were $7.7 billion in 2022, up from $3.2 billion despite a reduction in sales volumes, due to a significant increase in fertilizer prices.

In Idaho and Utah, there are currently three producers: Bayer (which acquired Monsanto); Itafos, a Brazilian operation (which acquired Nutrien); and J. R. Simplot. All the producers are developing/permitting replacement mines for mines nearing exhaustion of reserves. The new mines will generally be located near existing facilities. Southeast Idaho has the largest, most complex nonenergy leasable minerals program in the Forest Service and Bureau of Land Management (BLM). BLM is the leading agency for administering and approving phosphate mining. These openpit phosphate mines are responsible for approximately 22 percent of domestic production and four percent of world production.

China has transitioned from the largest importer of phosphate to the largest exporter of phosphate. China is reported to be ahead of the United States in exports of all phosphate products except MAP. In addition, China is the largest exporter of P_2O_5 products in the world. However, in 2022 China exports were reported to be less than in prior years.

Saudi Arabia's Ma'aden's phosphate mine is currently producing up to 5 Mt/a of concentrated phosphate rock from the Beneficiation Plant. Peru is also producing 5 Mt/a.

Environmental, regulatory and reclamation issues

Mosaic has continued to mine the newly permitted

extension reserves of the Wingate East Mine, the South Pasture Mine extension, the Ona Mine, and the newly permitted South Ft. Meade Eastern Extension Mine. The future Desoto Mine, which was denied mining permits by the local county commission, has the Florida Department of Environmental Protection mining permits, but the Army Corps of Engineers application was withdrawn, and public information workshops are still being held at the county level prior to any future county commission hearings. Mosaic is preparing the permit applications to further extend the South Fort Meade Eastern Reserves approximately 6,000 acres further east in Hardee County. Permits are estimated to be submitted in 2023.

Because of the difficulties of permitting and declining reserves in Florida, there are numerous permitting activities ongoing in the western states.

Exploration activities on western phosphate lands have been extensive over the past few years. The permitting activities include extensions of existing phosphate mines, expansions of existing mines, or new phosphate mines.

The BLM issued a record of decision for the J.R. Simplot Dairy Syncline Mine in April 2020 and the J.R. Simplot East Smokey Canyon Mine in July 2020. In July 2020 the BLM Salt Lake and the U.S. Department of Agriculture Forest Service approved the new Falcon Isle Resources Inc. Diamond Fork Phosphate Mine, Spanish Fork, UT. The mine will produce phosphate for direct application to soil for organic farming. The BLM is currently processing the application for the Itafos Husky 1/North Dry Ridge Mine.

Trends and outlook

Domestic production and consumption were lower in 2022 due to adverse weather conditions causing facility damage and shipping delays during planting season. However, higher prices offset the decrease in production. Repairs have been completed on facilities, and production has returned to normal rates.