

Belgium-based Solvay S.A., the leading soda ash producer in the world, bought American Soda, a soda ash joint venture formed between Williams Companies Inc. and American Alkali in 2000. The deal gave Solvay soda ash capacity in excess of 9 million tons, roughly 20 percent of worldwide soda ash capacity.

The term *borate minerals* encompasses such boron-producing minerals as borax and kernite and includes colemanite, ulexite, and probertite. Boron was used in gasoline, jet and rocket fuel, and as an ingredient in industrial plasticizing and dehydrating processes. Borax was used in the production of enamel for bathtubs, stoves, refrigerators, and metal signs, and as an agent for ensuring brilliance and clarity in the manufacture of glass. Other uses for borax included disinfectants, preservatives, starches, lumber treatment, detergents, fertilizers, weed killers, and metallurgical applications. Borax and other borate compounds were also used as intermediate chemicals in a wide variety of industrial processes. Colemanite and ulexite were used in glass manufacturing and in the production of glass wool used for insulation.

U.S. production of boron minerals was centered in California and handled by four companies. The three regions responsible for much of the production were Kern County, San Bernardino, and Inyo County. The four borate mineral producers were American Borate Co., Fort Cady Minerals Corp., North American Chemical Co., which was owned by IMC Global, and U.S. Borax, Inc. The United States was the largest producer of boron compounds globally in 2003 and exported roughly 50 percent of its output. The largest producer of boron ore globally was Turkey. The United States continued to import borates, primarily from Turkey and Chile. The principal end uses of boron compounds in 2003 were glass and ceramic products (78 percent), soaps and detergents (6 percent), agriculture (4 percent), fire retardants (4 percent), and other uses (9 percent).

FURTHER READING

“Boron.” *Mineral Commodity Summaries*. Washington, DC: United States Geological Survey, January 2004. Available from <http://minerals.er.usgs.gov/minerals>.

Kostick, Dennis S. “Soda Ash.” *U.S. Geological Survey Minerals Yearbook*. Washington, DC: U.S. Geological Survey, 2002. Available from <http://minerals.er.usgs.gov/minerals>.

Lyday, Phyllis A. “Boron.” *U.S. Geological Survey Minerals Yearbook*. Washington, DC: U.S. Geological Survey, 2002. Available from <http://minerals.er.usgs.gov/minerals>.

Monfort, Olivier. “Soda Ash: Finding A Way Out of the Crisis.” *Glass*, November 2000. Available from <http://minerals.er.usgs.gov/minerals>.

“Potash.” *Mineral Commodity Summaries*. Washington, DC: United States Geological Survey, January 2004. Available from <http://minerals.er.usgs.gov/minerals>.

Searls, James P. “Potash.” *U.S. Geological Survey Minerals Yearbook*. Washington, DC: U.S. Geological Survey, 2002. Available from <http://minerals.er.usgs.gov/minerals>.

“Soda Ash.” *Mineral Commodity Summaries*. Washington, DC: United States Geological Survey, January 2004. Available from <http://minerals.er.usgs.gov/minerals>.

SIC 1475

PHOSPHATE ROCK

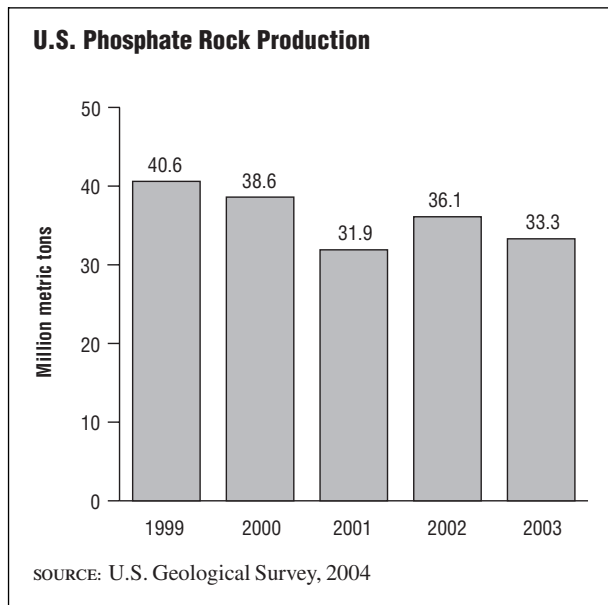
This category covers establishments primarily engaged in mining, milling, drying, calcining, sintering (heating without melting), or otherwise preparing phosphate rock, including apatite.

NAICS CODE(S)

212392 (Phosphate Rock Mining)

In 2003, nine U.S. firms in four states mined phosphate rock ore, compared to 20 firms in 1997. In 2003 mines produced an estimated 33.3 million metric tons of phosphate rock, with a value of \$895 million f.o.b. mine. The United States is the world's leading producer and consumer of phosphate rock, over 90 percent of which is used to produce chemical fertilizers and animal feed supplements. In 2003, it accounted for about one-fourth of total global production, down from one-third in the late 1990s. The states of Florida and North Carolina produced 85 percent of the total U.S. phosphate rock output, with Idaho and Utah contributing the rest. After growing for seven consecutive years in the late 1990s, phosphate rock production in the United States began to wane, plunging from 40.6 million metric tons in 1999 to 31.9 million metric tons, its lowest point in 30 years, in 2001. Although production rebounded somewhat to 36.1 million metric tons in 2002, it dipped to 33.3 million metric tons in 2003. This decline was due in large part to reduced exports to China, where the market for diammonium phosphate (DAP) had weakened considerably. Between 2000 and 2001, U.S. phosphate rock exports had plunged from 299,000 metric tons to 9,000 metric tons. By 2003, exports were down to a mere 5,000 metric tons.

The mineral phosphate took over 150 natural forms and was required by all plant and animal life for existence. All of the U.S. production of phosphate minerals—and 90 percent of worldwide production—was the sedimentary phosphate rock known as phosphorite, which was largely comprised of carbonite apatite. The phosphate rock mining and preparation industry produced the phosphorus that comprised one of three primary ingredients of agricultural fertilizers.



A substantial percentage of mined low-grade phosphate was used in an untreated state as soil fertilizer. This natural phosphate released its phosphorus content into soils relatively slowly, however, so greater volumes had to be extracted to achieve the same effects as more concentrated processed phosphate fertilizers. Common forms of treated or processed phosphate compounds include phosphoric acid, triple superphosphate, ammonium phosphate, and superphosphate. The harvesting of one ton of wheat required the application of about 18 pounds of phosphoric acid fertilizer, which was usually applied to the soil through irrigation water.

In addition to its use as a fertilizer, phosphate rock provided orthophosphoric acid and elemental phosphorus, which were used in applications such as leavening agents, photographic chemicals, water softeners, oil refining, beverages, insecticides, ceramics, detergents, plasticizing chemicals, and scouring powders. Phosphate rock was also widely used as a source of fluorine for making plastics and resins, laboratory dies, refrigerants, solvents, lubricants, and aerosol propellants. Phosphorus also played a role in the production of explosives and fireworks and in steel production. Phosphate rock found in Idaho contained vanadium, which was used as a bonding agent in the manufacture of titanium steel, as a stabilizing agent in steel production, and as a rust-resistant element in high-speed tools.

The extremely high costs of acquiring and holding mineral properties, conducting feasibility studies and exploration operations, purchasing and maintaining mining equipment, and developing and operating the mines themselves, made the mining industry one of the most capital-intensive in the United States. Historically, the majority of phosphate rock mined in the United States

was extracted from open pits, but the number of underground mining operations gradually increased. Open pit mining was performed by large excavating machines, which stripped the “overburden” (nonproductive overlay) and removed it from the site. A typical operation involved washing the mined phosphate with a hydraulic jet and then pumping it in liquefied “slurry” form to a washing plant. The phosphate was then mechanically graded by size, concentrated, and dried.

Phosphate mining began in Idaho in 1906 and in Montana in 1920. The use of phosphate fertilizers in sugar beet fields first occurred in the western United States in the mid-1930s. The production of phosphate rock grew rapidly during World War II and reached 10.7 million metric tons by 1950. And by 1964, 23.3 million metric tons were produced in the United States alone. Although worldwide consumption of phosphate fertilizers increased from the 1970s to the 1990s, its rate of growth steadily fell off, from 5 percent a year to 2 percent or lower by the mid-1990s. The International Fertilizer Industry Association predicts phosphate fertilizer consumption to grow an average of 2.7 percent between 2003 and 2008.

One of the most important trends in the U.S. phosphate mining industry in the late 1990s and early 2000s was industry consolidation. Grain surpluses, an excess supply of phosphate fertilizer worldwide, and depressed prices between 1981 and 1986 forced North American phosphate producers to begin seeking greater efficiencies. For example, Potash Corporation of Saskatchewan (PCS) bought two phosphate mines and chemical plants in Florida to complement its existing phosphate complex in North Carolina. The 1996 purchase gave PCS control of approximately 39 percent of U.S. phosphate reserves, the largest in the industry, and made PCS the third-largest phosphate producer in the world. Similar consolidation activities by U.S. phosphate mining firms—such as the merger of IMC Global and Vigoro—created significant economies of scale within the industry. Several idle mines were purchased and reopened. IMC Global paid \$16 million to Agrifos Fertilizer LLC for its Florida-based Nichols Mine, including 6.6 million metric tons of phosphate rock reserves, in 2002. As of 2004, the firm operated five phosphate mines in Florida.

Industry firms also turned to advanced mineral processing technologies such as the WPPA manufacturing process. As a result, coupled with increased global demand for phosphate-based agricultural fertilizer, the outlook for the U.S. phosphate mining industry in the early 2000s was favorable. Asia, Oceania, and South America are all expected to see significant increases in phosphate consumption, and U.S. exports to those areas are forecasted to increase, according to the U.S. Geological Survey.

FURTHER READING

Jasinski, Stephen M. "Phosphate Rock." *U.S. Geological Survey Minerals Yearbook*. Washington, DC: U.S. Geological Survey, 2002. Available from <http://minerals.er.usgs.gov/minerals>.

"Phosphate Rock." *Mineral Commodity Summaries*. Washington, DC: United States Geological Survey, January 2004. Available from <http://minerals.er.usgs.gov/minerals>.

SIC 1479

CHEMICAL AND FERTILIZER MINERAL MINING, NOT ELSEWHERE CLASSIFIED

This category covers establishments primarily engaged in mining, milling, or otherwise preparing chemical or fertilizer mineral raw materials, not elsewhere classified. Establishments primarily engaged in milling, grinding, or otherwise preparing barite not in conjunction with mining or quarry operations are classified in **SIC 3295: Minerals and Earths, Ground or Otherwise Treated**; similar establishments preparing other minerals of this industry are included here. Establishments primarily engaged in producing salt by evaporation of sea water or brine are classified in **SIC 2899: Chemicals and Chemical Preparations, Not Elsewhere Classified**.

NAICS CODE(S)

212393 (Other Chemical and Fertilizer Mineral Mining)

INDUSTRY SNAPSHOT

Salt represents nearly half of all industry chemical and fertilizer mineral industry shipments. Consequently, the performance of the salt industry tends to reflect overall industry conditions. U.S. salt production between 2000 and 2003 declined from 45.6 million metric tons to 41.2 million metric tons, while consumption declined from 51.6 million metric tons to 50.1 million metric tons over the same time period. Because production was declining faster than production, the United States increased its reliance on imports to 23 percent of domestic consumption in 2003, compared to 16 percent of consumption in 2000. At the same time, exports declined from 1.12 million metric tons in 2001 to 500,000 metric tons in 2003.

ORGANIZATION AND STRUCTURE

The major products mined by the chemical and fertilizer minerals industry included salt, sulfur, barite, fluor spar, lithium, and strontium. Salt represents approximately 50 percent of the value of all industry shipments and is primarily produced in Louisiana, Texas, and New York. The second largest segment of the miscellaneous

chemicals and fertilizer minerals mining industry is sulfur, which comprises roughly one-third of the value of all industry products. The third largest product in the miscellaneous chemical and fertilizer mineral mining industry is barite, although it represents less than 5 percent of the value of all industry shipments.

CURRENT CONDITIONS

Salt. The United States was the world's largest producer of salt in the early 2000s, followed by China, India, Germany, and Canada. Twenty-nine U.S. companies operated 69 salt-producing plants in 15 states in 2003, producing salt in four basic forms: salt in brine (51 percent of all salt sold or used), rock salt (30 percent), vacuum pan salt (11 percent), and solar salt (8 percent).

There were roughly 14,000 end uses for salts, with the largest being chemicals (45 percent), road de-icing/ice control salt (31 percent), salt sold to distributors (8 percent), industrial uses (8 percent), agricultural salt (6 percent), food (including table salt, 4 percent), primary water treatment applications (2 percent), and exports/other uses (less than 1 percent). Along with limestone, coal, and sulfur, salt was one of the four most important minerals used by the chemicals industry. As early as 1939, salt was being used in the production of 74 industrial chemicals in the form of sodium and chlorine, and the largest U.S. salt mining or producing firms historically were operated by chemical companies that processed the extracted salt into commercial products. Salt was used by the chemical industries as a feedstock in the manufacture of chlorine and caustic soda, which was used to make everything from soap, dyes, and dairy products to glass, pulp, and paper. Other uses included water conditioning and treatment processes, textiles and rayon manufacturing, metallurgical applications, leather treatment, agriculture, refrigeration, meat packing, and fish curing.

U.S. salt producers accounted for 19.6 percent of the world's total production in 2003, and six industry firms accounted for the majority of all salt sold overseas: Akzo Nobel Salt Inc., Cargill Salt Co. and its affiliate Leslie Salt Co., North American Salt Co., Morton Salt Co., Western Salt Co., and United Salt Co.

In 2003, 50.1 million metric tons of domestic and imported salt was used in the United States. In 1970, a total of 50 salt-producing companies had operated 95 plants in the United States. By 2003, several factors had reduced this industry segment to 29 companies and 69 plants. Among these factors were cheaper salt imports, intensified market competition, surplus production capacity, and high energy and labor costs. Among the major salt industry events of 1990s were the announcement of a joint venture between Continental Salt, Eastern Cargill Inc., and Petroquímica de Venezuela, S.A. to produce