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ZEOLITES

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ZEOLITES

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In 2011, natural zeolites were mined by six companies in the United States, with one additional company working from stockpiled materials. Mine production increased to 65,400 metric tons (t) from 61,300 t in 2010. Consumption increased to 65,200 t in 2011 from 60,000 t in 2010. The major markets for natural zeolites were in animal feed, pet litter, cement, odor control, water purification, and wastewater treatment, in decreasing order by tonnage. These six applications accounted for more than 70% of domestic consumption. Exports of natural zeolites (other than gem quality) were estimated to be between 700 t and 1,500 t, and imports were estimated to be less than 150 t. World production was estimated to be in the range of 2.8 million to 3.3 million metric tons (Mt) (table 1).

Zeolite deposits in the United States are associated with the alteration of volcanic tuffs in alkaline lake deposits and open hydrologic systems. In the United States, these deposits are in Arizona, California, Idaho, Nevada, New Mexico, Oregon, and Texas. Zeolites in these deposits are chabazite, clinoptilolite, erionite, mordenite, and phillipsite. Other components, such as orthoclase and plagioclase feldspars, montmorillonite, opal, quartz, and volcanic glass, are present in some deposits.

Legislation and Government Programs

The National Institutes of Environmental Health Sciences convened a workshop to discuss the risk posed by airborne erionite. The mineralogy of zeolites and geology of deposits were discussed, as were known health effects and past and present health studies. It was generally agreed that maps showing locations of erionite needed to be updated, and sampling and analysis methodologies needed to be developed (National Institutes of Environmental Health Sciences, 2011). The National Institute for Occupational Safety and Health recommended that workers limit their exposure to airborne erionite by following precautions described in Occupational Safety and Health Administration guidance documents for asbestos (National Institute for Occupational Safety and Health, 2011).

Production

Domestic data for natural zeolites were collected by means of a voluntary survey of the domestic mining industry. Survey forms were sent to nine companies, and responses were received from eight. Two companies stopped mining zeolites, and one company worked from stocks. Responses accounted for more than 99% of the production and end-use data.

Conventional open pit mining techniques are used to mine natural zeolites. The overburden is removed to allow access to the ore. The ore may be blasted or stripped for processing by using front-end loaders or tractors equipped with ripper blades. In processing, the ore is crushed, dried, and milled. The milled ore may be air-classified based on particle size and shipped in bags or bulk. The crushed product may be screened to remove fine material when a granular product is required, and some pelletized products are produced from fine material. Producers also may modify the properties of the zeolite or blend their zeolite products with other materials before sale to enhance their performance.

Six companies mined natural zeolites in the United States and one company worked from stocks in 2011 (table 2). Chabazite was mined in Arizona; clinoptilolite was mined in California, Idaho, New Mexico, and Texas. Domestic production of zeolites increased to 65,400 t in 2011 compared with 61,300 t in 2010. New Mexico was the leading producing State in 2011, followed by Texas, Idaho, Arizona, and California.

Bear River Zeolite Co., Inc. (a subsidiary of United States Antimony Corp.) reported that sales revenue decreased to $2.04 million in 2011 compared with $2.42 million in 2010 and shipments decreased to 12,100 t of zeolites in 2011 compared with 15,300 t in 2010. The decline in tonnage sales resulted because of completion of a remediation project at a former nuclear fuel reprocessing facility in West Valley, NY (United States Antimony Corp., 2012, p. 24–25).

St. Cloud Mining, Inc. planned to expand its chabazite mine north of Bowie, TX. The U.S. Department of the Interior, Bureau of Land Management was evaluating St. Cloud Mining's mine plan. The company decided to expand the operation because of increased demand for chabazite used to remediate nuclear contamination resulting from the nuclear powerplant damage after the April 2011 earthquake near Fukushima, Japan (Johnson, 2011; U.S. Department of the Interior, Bureau of Land Management, 2012).

Consumption

Sales of natural zeolites increased to 65,200 t in 2011 compared with 60,000 t in 2010. Domestic uses for natural zeolites were, in decreasing order by tonnage, animal feed, pet litter, cement, odor control, water purification, wastewater treatment, fungicide or pesticide carrier, gas absorbent (and air filtration), fertilizer carrier, oil absorbent, desiccant, catalyst, and aquaculture. Animal feed, pet litter, cement, odor control, water purification, and wastewater treatment, accounted for more than 70% of the domestic sales tonnage.

Increased sales of natural zeolites were reported for animal feed, catalyst, cement, fertilizer, fungicide or pesticide carrier, oil absorbent, pet litter, water purification, and wastewater treatment. Sales for aquaculture, desiccant, gas absorbent, and odor control declined. The greatest tonnage increases were in animal feed, fungicide or pesticide carrier, water purification, and waste water treatment. The greatest decline in sales was for gas absorbents. Changes in sales tonnage to other markets were relatively small.

Prices

Prices for natural zeolites vary with zeolite content and processing. Unit values, obtained through the U.S. Geological Survey canvass of domestic zeolite producers, ranged from $40 to $800 per metric ton. The bulk of the tonnage was valued between $110 and $200 per ton. Eyde (2011) reported that the average price for clinoptilolite granules was about $160 per ton and that modified clinoptilolite and activated chabazite products sold for as much as $10 per kilogram. Quoted prices should be used only as a guideline because actual prices depend on the terms of the contract between seller and buyer.

Foreign Trade

Comprehensive trade data were not available for natural zeolites. In 2011, exports of natural zeolites (other than gem-quality specimens) were estimated to between 700 t and 1,500 t. About 190 t of these exports can be documented with the shipments going to Denmark (United Business Media Global Trade, undated). Unknown quantities of natural zeolites were shipped to Japan by United States companies participating in the cleanup of nuclear contamination near Fukushima, Japan (Critical Process Filtration, Inc., 2011; Johnson, 2011; UOP LLC, 2011; World Nuclear News, 2012). In these cases, the zeolites may have been exported as part of an ion-absorption unit or as an ion-exchange media instead of being identified specifically as a natural zeolite. Imports were estimated to be less than 100 t with 42 t actually documented (United Business Media Global Trade, undated). The bulk of the U.S. zeolite trade was in synthetic zeolite products.

World Review

Many countries, particularly those with smaller production, do not report natural zeolite production. Therefore, data in this section is estimated unless otherwise noted.

World production of natural zeolites was in the range of 2.8 to 3.3 Mt in 2011 based on reported production by some countries, world market trends, and production estimates published in trade journals. World production probably remained unchanged in 2011 because of the continued impact of the 2008–09 global recession in countries where natural zeolites were sold in large volumes for construction uses.

Countries mining large tonnages of zeolites typically use them in low-value applications. The ready availability of zeolite-rich rock at low cost and the shortage of competing minerals and rocks were probably the most important factors for its large-scale use. It was also likely that a significant percentage of the material sold as zeolites in some countries was ground or sawn volcanic tuff that contained only a small amount of zeolites. Some examples of such usage are dimension stone (as an altered volcanic tuff), lightweight aggregate, pozzolanic cement, and soil conditioners.

China was by far the leading producer of natural zeolites (including zeolitic tuffs for pozzolanic cement applications). Estimated production in China was 1.8 to 2.2 Mt. The second leading producer was the Republic of Korea with 240,000 t; followed by Japan (including pozzolanic cement applications), 150,000 to 160,000 t; Turkey (excluding pozzolanic cement applications), 150,000 t; and Jordan (including pozzolanic applications), 140,000 t. Other producing countries were Slovakia, 80,000 t; the United States, 65,400 t (reported); Cuba, 26,000 t; New Zealand, 25,000 t; Bulgaria (excluding pozzolanic cement applications), 15,000 t; and Indonesia (excluding pozzolanic cement applications), 1,500 t. Countries that may produce zeolites but for which there is insufficient data available to make reliable production estimates include Argentina, Armenia, Australia, Canada, Georgia, Germany, Greece, Hungary, Italy, Mexico, the Philippines, Russia, Serbia, Slovenia, South Africa, Spain, and Ukraine. Production in most of those countries was likely less than 2,000 t.

Rota Mining Co. increased production capacity of its mill facility in Manisa, Turkey, to 100,000 metric tons per year. The expansion was made in anticipation of increased sales for environmental projects around the world (Elliott, 2011).

Outlook

U.S. production and sales of natural zeolites increased by 7% and 9%, respectively, in 2011 from those of 2010. The cleanup at the Fukushima nuclear facility in Japan may continue to provide opportunities for increased export sales of natural zeolites in 2012 and 2013. Any large changes in domestic consumption are likely to be the result of one or two special projects that have limited lifespans rather than dramatic growth in most of the existing markets. Growth in production and sales in 2012 may be slightly less than those of 2011 based on existing markets.

World demand continued to be affected by the global economic recession because a significant portion of sales in many countries were linked to construction activities, where natural zeolites and (or) zeolitic tuffs were sold as dimension stone, lightweight aggregate, and pozzolanic cement. Although the economies of some countries were recovering in 2011, many others continued to struggle with debt issues. World production and consumption are likely to remain unchanged or increase slightly in 2012.

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TABLE 1
SALIENT ZEOLITE STATISTICS[1]

		2007	2008	2009	2010	2011
United States:						
Production	metric tons	57,400	60,100	59,500	61,300	65,400
Consumption	do.	57,100	58,500	59,400	60,000	65,200
Exports[e]	do.	< 250	<200	<500	<400	700–1,500
Imports[e]	do.	<350	<200	<200	<150	<150
World, production[e]	million metric tons	2.8–3.0	2.5–3.0	2.8–3.3	2.8–3.3	2.8–3.3

[e]Estimated. do. Ditto.
[1]Data are rounded to no more than three significant digits.

TABLE 2
DOMESTIC ZEOLITE PRODUCERS IN 2011[1]

State and company	Type of zeolite
Arizona:	
St. Cloud Mining, Inc.[1]	Chabazite.
UOP LLC	Do.
California:	
KMI Zeolite Inc.	Clinoptilolite.
St. Cloud Mining, Inc.[2]	Do.
Idaho:	
Bear River Zeolite Co., Inc. (United States Antimony Corp.)	Do.
Steelhead Specialty Minerals, Inc.	Do.
Teague Mineral Products Co.	Do.
New Mexico, St. Cloud Mining, Inc.	Do.
Texas, Zeotech Corp.	Do.

Do. Ditto.
[1]Formerly GSA Resources, Inc.
[2]Formerly Ash Meadows, LLC.