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2018 Minerals Yearbook

ZEOLITES [ADVANCE RELEASE]

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Zeolites

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In 2018, natural zeolites were mined by seven companies in the United States. Mine production increased by 4% to 86,100 metric tons (t) from 82,400 t in 2017, and sales decreased slightly to 80,500 t in 2018 from 81,300 t in 2017. The major end uses for natural zeolites in 2018 were animal feed, odor control, and water purification, in decreasing order by tonnage; these three applications collectively accounted for nearly 75% of domestic sales. Imports and exports of natural zeolites (other than gem quality) were each estimated to be less than 1,000 t. World production was estimated to be in the range of 1.0 to 1.3 million metric tons (Mt), unchanged from 2017 (table 1).

Zeolites are a group of hydrated aluminosilicate minerals of the alkali and alkaline earth metals with a microporous crystalline structure. Approximately 50 naturally occurring zeolite minerals have been identified, but only a handful (chabazite, clinoptilolite, erionite, mordenite, and phillipsite) have commercial applications and are abundant in nature. Zeolites are valuable for a variety of absorption, filtering, and ion exchange applications because they contain loosely bound cations within their crystal lattice that can be exchanged by other cations or by molecular water. Each zeolite mineral has a unique crystal structure that imparts distinct physical and chemical characteristics. Zeolite deposits in the United States were formed primarily by the alteration of volcanic tuffs in alkaline lake deposits, open hydrologic systems, and hydrothermal environments. They predominantly occur in Arizona, California, Idaho, Nevada, New Mexico, Oregon, Texas, and Wyoming (Eyde and Holmes, 2006, p. 1039–1048).

Sustained mining of natural zeolites in the United States did not begin until the early 1970s. Prior to the 1950s, natural zeolites were considered to be mineralogical curiosities that filled vugs and fractures in igneous rocks. Large deposits of zeolite-rich volcanic tuffs were discovered in the Western United States during the late 1950s, and many large mining and petroleum companies conducted exploration programs between 1950 and the mid-1980s. Although these programs uncovered additional resources, markets for natural zeolites did not develop as anticipated, and only a few hundred metric tons of zeolites were mined annually through the mid-1970s. By the mid-1980s, most of the major companies had withdrawn from the industry owing to low annual production and sales. Small-scale mining companies then stepped in and gradually developed the natural zeolites market into the small yet sustainable industry that exists today. Domestic production and sales have steadily increased since the early 1990s, although production significantly declined for a few years after 1994 owing to an imbalance between production and market demand. In 2018, mine production of natural zeolites was more than double that in 2000 (fig. 1).

End uses for naturally occurring zeolite minerals have changed considerably since the 1970s. Zeolites were initially treated as bulk commodities, with producers seeking large-volume markets. Pet litter applications became the mainstay of the industry, representing more than 50% of annual sales in the mid-1980s. However, producers recognized that low-value bulk sales of zeolites could not sustain the industry and began developing value-added applications. Pet litter currently commands a far smaller share of the overall market, and usage in other applications such as animal feed, fertilizer carrier, oil and gas absorbent, odor control, synthetic turf, traction control (ice melt), wastewater treatment, and water purification has increased.

Synthetic zeolites are manufactured by chemical processes and exhibit more uniform chemical composition, crystal lattice structure, and pore size than natural zeolites. Whereas natural zeolites have fixed properties, synthetic zeolites can be engineered to satisfy exact specifications for a particular application. Consequently, natural zeolites cost significantly less than their synthetic counterparts but are not suitable for certain commercial end uses. Synthetic zeolites are primarily used as water softening agents in detergents and catalysts in petroleum refining. Synthetic zeolites dominate the global zeolite market; the worldwide value of synthetic zeolite sales totals tens of billions of dollars, whereas the value of natural zeolite sales is probably on the order of tens of millions of dollars.

Production

Domestic data for natural zeolites in 2018 were collected by means of a voluntary canvass of the U.S. mining industry. Survey forms were received by seven companies that operated 10 mines, which represented a 100% response rate of the known zeolite-producing mining community. However, some survey data were incomplete, which required production and sales estimates for some mining locations.

Seven natural zeolite mines were active in 2018. An additional three mines were idle, with some sales from preexisting stockpiles. The Owyhee Mining Co. (Medford, OR) received a mining permit in 2015 for a site near Rome, OR, but had not reached the commercial production stage by yearend 2018 (Bend Bulletin, The, 2015). Chabazite was mined in Arizona, and clinoptilolite was mined in California, Idaho, New Mexico, Oregon, and Texas (table 2). Domestic mine production of natural zeolites increased by 4% to 86,100 t from 82,400 t in 2017 (table 1). Most of the tonnage consisted of clinoptilolite. The remainder was mostly chabazite, with minor quantities of ferrierrite, mordenite, and phillipsite (Eyde, 2018). New Mexico was the leading producer of natural zeolites in 2018, followed by Idaho, California, Texas, Oregon, and Arizona, in descending order of production. In 2018, KMI Zeolite Inc. (Amargosa Valley, NV) published total reserves of 49 million tons (53.7 million short tons) with a zeolites purity of 97% (KMI Zeolite Inc., 2019).

Consumption

In 2018, sales of natural zeolites decreased slightly to 80,500 t compared with 81,300 t in 2017 (table 1). Domestic uses for natural zeolites were, in decreasing order by quantity, animal feed, odor control, water purification, oil and grease absorbent, unclassified end uses, fertilizer carrier, gas absorbent (and air filtration), pet litter, desiccant, wastewater treatment, soil amendment, traction control (ice melt), synthetic turf, aquaculture, and fungicide or pesticide carrier. Animal feed, odor control, and water purification collectively accounted for nearly 75% of the domestic sales tonnage. Data for individual markets were withheld to avoid disclosing company proprietary data.

Total sales of natural zeolites decreased slightly in 2018. Among the specified end uses, sales of natural zeolites increased for aquaculture, desiccant, gas absorbent, oil and grease absorbent, and pet litter. Sales of natural zeolites for animal feed, fertilizer carrier, fungicide or pesticide carrier, water purification, and wastewater treatment all decreased. During the 2017–18 agricultural season for corn, sorghum, barley, and oats, harvested acreage decreased by 8% from the prior agricultural season (U.S. Department of Agriculture, 2019). Comprehensive information regarding the sales trends for soil amendment, odor control, synthetic turf, and traction control was not available. Outside the United States, natural zeolites were primarily used in cement pozzolans and other construction materials, filtration, odor control, and soil amendments (Eyde, 2018).

Prices

Prices for natural zeolites vary with the percentage of zeolites present in the product, the chemical and physical properties of the zeolite mineral(s), particle size, surface modification and (or) activation, and end use. In 2018, unit values (free on board, mine or plant) obtained through the U.S. Geological Survey canvass of domestic zeolite producers ranged from an estimated $100 to $300 per metric ton. The average estimated unit value was roughly $140 per metric ton, unchanged from that in 2017.

Foreign Trade

Comprehensive trade data were not available for natural zeolites because they were included under the generic U.S. Census Bureau Harmonized Tariff Schedule code 2530.90.8050 (mineral substances not elsewhere specified or included). Some zeolites may have also been classified as part of an ion-absorption unit or labeled as ion-exchange media rather than as zeolite. Imports and exports of natural zeolites (other than gem-quality specimens) in 2018 were estimated to be less than 1,000 t each, unchanged from those in 2017. Nearly all of the U.S. zeolite trade was in synthetic zeolite products.

World Review

Countries that mine large tonnages of zeolites typically use them in low-value, high-volume construction applications, such as dimension stone, lightweight aggregate, and pozzolanic cement. A significant percentage of the material sold in some countries also likely consists of ground or sawn volcanic tuff that contains only a small proportion of zeolite minerals. As a result, production data for some countries may not accurately indicate the quantities of natural zeolites used in the high-value applications that are reflected in the domestic production data. In addition, most countries either do not report production of natural zeolites or report output with a 2- to 3-year lag time. Therefore, data in this section were estimated except where otherwise noted.

World production of natural zeolites in 2018 was estimated to be 1.0 to 1.3 Mt, unchanged from that in 2017. China was the leading producer of natural zeolites, with production of 320,000 t (including crude ore). The second-ranked producer was the Republic of Korea with 144,000 t, followed by Indonesia with 130,000 t, Slovakia with 117,000 t, New Zealand with 100,000 t, the United States with 86,100 t, Turkey with 65,000 t, Cuba with 52,600 t, Russia with 35,000 t, and Jordan with 10,000 t. Countries thought to produce natural zeolites, but for which insufficient data were available to make reliable production estimates, included Argentina, Armenia, Australia, Bulgaria, Canada, Georgia, Germany, Greece, Hungary, Indonesia, Iran, Italy, Japan, the Philippines, Russia, Serbia, Slovakia, Slovenia, South Africa, Spain, and Ukraine.

Outlook

The global detergents industry is expected to increase demand for zeolites in upcoming years (Wood, 2018). In the United States, a significant portion of natural zeolite sales are linked to livestock industries; zeolites are used in animal stalls to control odors and as an additive in animal feed to enhance nutrient uptake and reduce digestive issues. Globally, natural zeolite sales are partially linked to the construction industry, where zeolites and (or) zeolitic tuffs are sold as dimension stone, lightweight aggregate, and pozzolanic cement. Economic trends in these industries are expected to continue to influence production and sales of natural zeolites in the coming years.

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TABLE 1
SALIENT NATURAL ZEOLITE STATISTICS[1]

		2014	2015	2016	2017	2018
United States:						
Production	metric tons	62,800	75,100	75,200	82,400	86,100
Sales	do.	62,500	73,200	71,300	81,300	80,500
Exports[e]	do.	<1,000	<1,000	<1,000	<1,000	<1,000
Imports[e]	do.	<1,000	<1,000	<1,000	<1,000	<1,000
World production[e]	million metric tons	1.0–1.3	1.0–1.3	1.0–1.3	1.0–1.3	1.0–1.3

[e]Estimated. do. Ditto.
[1]Table includes data available through March 12, 2020. Data are rounded to no more than three significant digits.

TABLE 2
DOMESTIC NATURAL ZEOLITE OPERATIONS, BY TYPE, IN 2018[1]

State and company	Type of zeolite
Arizona:	
St. Cloud Mining Co.[2]	Chabazite.
UOP LLC	Do.
California:	
KMI Zeolite Inc.	Clinoptilolite.
St. Cloud Mining Co.	Do.
Idaho:	
Bear River Zeolite Co.	Do.
PDZ Co., LLC	Do.
New Mexico, St. Cloud Mining Co.	Do.
Oregon:	
PDZ Co., LLC	Do.
Teague Mineral Products	Do.
Texas, Zeotech Corp.	Do.

Do. Ditto.
[1]Table includes data available through March 12, 2020.
[2]St. Cloud Mining Co. operates two natural zeolite mines in Arizona.

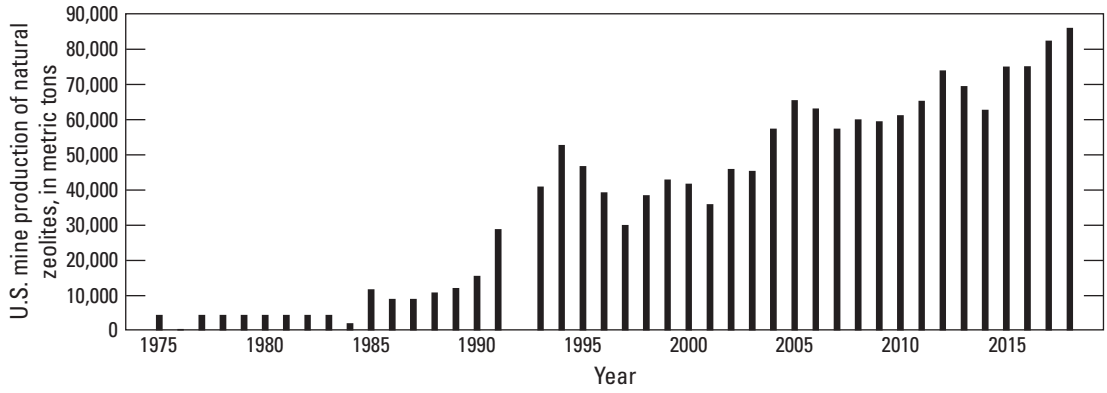

Figure 1. Mine production of natural zeolites in the United States, 1975 through 2018. Production was estimated based on historical data for some years prior to 1988.