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2019 Minerals Yearbook

DIATOMITE [ADVANCE RELEASE]

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Diatomite

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Production of diatomite in the United States decreased by 20% to 768,000 metric tons (t) with a corresponding value of $259 million free on board (f.o.b.) plant compared with production of 957,000 t valued at $319 million f.o.b. plant in 2018 (table 1). The production and value decreases were caused by large production decreases at several mining facilities operated by a single company. The United States was the world's leading producer of diatomite in 2019, accounting for 35% of the estimated world production total of 2.19 million metric tons (Mt) (table 5). Other leading producers included Denmark, accounting for 17% of world production; Turkey, 8%; China, 7%; and Peru, 5%. Diatomite was produced in 28 countries in 2019.

Diatomite used for filtration represented 48% of domestic consumption. Its use as a cement additive, as a filler, and as an absorbent represented 52% of consumption. Other diatomite applications, including abrasives, insecticides, and soil conditioner totaled less than 1% (table 2). Major diatomite products were sold as various grades of calcined powders. Encroachment into diatomite markets by natural and synthetic substitute material remained minimal, particularly for beverage filtration.

Diatomite is a chalk-like, soft, friable, earthy, very-fine-grained, siliceous sedimentary rock comprised of fossilized diatom remains. Diatomite often has a light color (white if pure, commonly buff to gray in situ, and rarely black). It is extremely lightweight because of its low density and high porosity and is essentially chemically inert. Diatomaceous earth (often abbreviated as D.E.) is a common alternate name but is more appropriate for the unconsolidated or less lithified sediment. Diatomite is also known as kieselguhr (Germany), tripolite (after an occurrence near Tripoli, Libya), and moler (an impure Danish form). Alfred Nobel named his explosive invention “dynamite” following his discovery that nitroglycerin could be stabilized if first absorbed in diatomite (Nobel, 1868). A unique attribute of diatomite is found within its microstructure, which often contains thousands of individual holes. These hollows are typically present in three distinct sizes, from micron to submicron diameters. The number and sizes of holes vary with the species (Imerys Minerals Ltd., 2020).

Diatomite deposits form from an accumulation of amorphous hydrous silica cell walls of dead diatoms in oceanic and fresh waters. These microscopic single-cell aquatic plants (algae), also known as diatoms, contain an internal, elaborate siliceous skeleton consisting of two frustules (valves) that vary in size from less than 1 micrometer (µm) to more than 1 millimeter in diameter but are typically 10 to 200 µm in diameter. The frustules have a broad variety of delicate, lacy, perforated shapes, including cylinders, discs, feathers, ladders, needles, and spheres. Given their unique structure and large species variety, diatoms are frequently used in the interpretation of geologic paleoenvironmental studies, including a study of tidal environments in Oregon and Washington (Sawai and others, 2016). The oldest diatomite occurrences are thought to be of Cretaceous age, deposited about 66 million to 138 million years ago. Older diatomite occurrences may have been altered into other forms of silica, particularly chert, owing to diagenesis, burial, and exposure. Additional information on the environmental and physical properties of diatoms and geology of diatomite can be found in Dolley and Moyle (2003), Moyle and Dolley (2003), and Wallace (2003).

Production

Domestic production data for diatomite were developed by the U.S. Geological Survey (USGS) from a voluntary annual survey of U.S. diatomite-producing sites and company operations. The USGS canvass for 2019 was sent to six diatomite-producing companies with 13 mining areas. All companies responded on the basis of returned surveys or through the disclosure of production information as published in company annual reports filed with the U.S. Securities and Exchange Commission. All percentages in this report were calculated using unrounded data.

In 2019, 768,000 t of diatomite was produced from 13 separate mining areas in California, Nevada, Oregon, and Washington. Major producers were Celite Corp. (a subsidiary of Imerys S.A.) with mines and facilities in California, Nevada, and Washington and EP Minerals, LLC (a subsidiary of U.S. Silica Holdings, Inc.) with operations in Nevada and Oregon. California and Nevada were the top two producing States. U.S. Silica Holdings reported financial difficulties, which may have affected operations at EP Minerals (U.S. Silica Holdings, Inc., 2020).

Maryland was the site of the first U.S. production of diatomite in 1884. By the late 1880s, very pure, large deposits near Lompoc, CA, became the focus of interest and have continued to dominate world markets (Dolley and Moyle, 2003). Because U.S. diatomite occurrences are at or near Earth's surface, recovery from most deposits is achieved through low-cost, open pit mining. Outside the United States, however, underground mining is fairly common owing to deposit location and topographic constraints. Explosives are generally not required for surficial or subsurface mining because of the soft, friable nature of the deposits. In Iceland, dredging is used to recover lake-bottom diatomaceous mud deposits.

Diatomite is often processed near the mine to reduce transportation costs associated with the crude ore, which can contain up to 65% water. Processing typically involves a series of crushing, drying, size-reduction, and calcining operations, using heated air for conveying and classifying within the plant. Fine-sized diatomite grains, especially from baghouses, are used most often for filler-grade products, and coarser particles are employed for filtration purposes. In the latter processing stages, calcining is performed in rotary kilns to effect chemical and physical changes.

Diatomite production costs for the United States are estimated to average 60% to 70% for processing, 20% to 30% for packing and shipping, and 10% for mining. Energy costs account for a large and growing portion (25% to 30%) of diatomite production costs, such as in the direct costs of mining and transportation as well as within the energy-intensive calcining process. Diatomite used for cement production does not normally require calcining; thus, processing costs are lower (Yilmaz and Ediz, 2008).

Consumption

Domestic apparent consumption of diatomite was approximately 710,000 t in 2019, a 21% decrease from 898,000 t in 2018. The total quantity of filter-grade diatomite sold or used by U.S. producers was 369,000 t in 2019, a 34% decrease from 560,000 t in 2018, accounting for 48% of total diatomite sold or used. The remaining quantity, which totaled 399,000 t, was primarily used for absorbent and filler purposes, which represented a slight increase from 397,000 t in 2018 (table 2).

In antiquity, diatomite was used by the Greeks as an abrasive and in the production of lightweight building bricks and blocks. In the late 1800s, diatomite became of industrial interest in Western Europe when pulverized diatomite was the preferred absorbent and stabilizer of nitroglycerine used to make dynamite.

Commercial diatomite products provide fine-sized, irregular-shaped, porous, noncaking particles that have a large surface area and high liquid-absorption capacity. The products are chemically inert, have a low refractive index, are mildly abrasive, have a low thermal conductivity with a relatively high fusion point, can be slightly pozzolanic, are very high in silica, and can be produced and delivered cost effectively for many customer applications. Sawn shapes, which continue to account for a significant part of world diatomite production, have long been used as lightweight building material, especially in China, and primarily for thermal insulation (especially the high-clay-content Danish moler). Dried natural products and calcined products are used in construction applications. The largest consumers for these products typically include the agriculture, automotive, biofuel, chemical, food and beverage, oil and gas, paint and coatings, pharmaceuticals, plastics, rubber, and spirits industries (U.S. Silica Holdings, Inc., 2020, p. 10). The major use of diatomite continues to be as a filtration medium for beverages (especially beer and wine), sugar and sweetener liquors, oils and fats, petroleum and chemical processing (including reprocessing waste dry cleaning fluids), pharmaceuticals, and water (industrial process, potable, swimming pool, and waste). Other uses are as an absorbent for industrial spills (oil and toxic liquids) as well as an absorbent in pet litter.

Another important, broad category of use is as a filler, often serving a dual purpose, such as an extender and flatting agent in paints and coatings, a bulking and anticaking agent in granular materials, and as a multieffect component in plastics (including preventing films from sticking). Other filler uses are as an extender and absorbent carrier for catalysts, nontoxic pesticides (as a desiccating agent), pharmaceuticals, and other chemicals.

Brightness, whiteness, and abrasive hardness are important for specialized diatomite applications. Free-crystalline silica content, although normally low, is required to be identified, particularly for calcined products. Calcining removes organics, increases filtration rate, oxidizes iron, increases specific gravity, increases particle hardness, and can lighten color. Flux calcining significantly affects the physical and chemical properties and makes a white product. Most filter grades are calcined.

Prices

The calculated weighted average unit value of diatomite sold or used by U.S. producers during 2019, using USGS survey data and estimates, was $338 per metric ton f.o.b. plant, a slight increase compared with $334 per metric ton in 2018 (table 3). The average unit value for diatomite used in filtration increased by 22% in 2019 to $597 per metric ton from $489 per metric ton in 2018. The value for diatomite used for absorbent purposes was $72 per metric ton, unchanged from that in 2018. The unit value for material used as fillers increased slightly to $435 per metric ton in 2019 compared with $426 per metric ton in 2018. The average value for diatomite used in other applications in 2019 decreased by 33% to an $12 per metric ton. The large drop was likely amplified by relatively small quantities of material sold.

Foreign Trade

Export and import data from the U.S. Census Bureau may be of limited accuracy with regard to diatomite because diatomite is included with other mineral commodities within several categories in the Harmonized Tariff Schedule of the United States (HTS). Trade data were issued under heading 2512 of the HTS, described as applying to siliceous fossils, including kieselguhr, tripolite, diatomite, and similar siliceous earths of an apparent specific gravity of 1 or less. Industry sources, however, indicated that exports also included some flux-calcined material, which is included under HTS code 3802.90.2000, where it is not differentiated from activated clays. Similarly, heat-insulating mixtures and sawn and molded unfired shapes of diatomite are included under HTS code 6806.90.0090 and are not exclusively identified as diatomite. Lastly, fired, sawn, and molded shapes of diatomite are covered under heading 6901, which is not exclusively used for diatomite data.

According to U.S. Census Bureau data, diatomite and diatomite products were exported to 82 countries in 2019. Exports of diatomite from the United States in 2019 were approximately 68,000 t, unchanged from those in 2018 (tables 1, 4). Exports accounted for about 9% of total domestic production sold or used. The main export markets were Canada (13,600 t), Germany (11,300 t), Brazil (5,600 t), China (3,800 t), and Belgium and Russia (3,400 t each). These six countries accounted for 60% of total reported exports. Based on available U.S. Census Bureau data, the average unit value free alongside ship of exported diatomite was $602 per ton in 2019, unchanged from that in 2018 (table 4). Import data for diatomite indicate that 10,000 t came from 12 countries in 2019. Canada was the leading source with 6,600 t (66%), followed by Germany with 1,100 t (11%), Mexico with 860 t (9%), Argentina with 560 t (6%), and China with 430 t (4%). These five countries provided 96% of the imports to the United States in 2019.

World Review

Estimated world production of diatomite in 2019 was 2.19 Mt (table 5), an 8% decrease from the revised 2018 world production tonnage. World reserves are thought to be almost 1 billion metric tons (Gt), which represents approximately 350 times current annual world production. About 250 Mt, or 25% of the estimated 1 Gt of world reserves, is in the United States (Crangle, 2019). The world's leading producing district in terms of reserves and capacity is near Lompoc, CA. A resource assessment of this location indicated that these deposits could supply all of the world's diatomite needs at current rates of consumption for hundreds of years. Compilations of reserve estimates are not comprehensive because some data are proprietary and not released by companies or countries. Very large deposits, on the order of at least 110 Mt of reserves, have been reported in China (Lu, 1998, p. 53).

In 2019, the United States was the leading producer of diatomite, accounting for an estimated 35% of total world production, followed by Denmark with 17%, Turkey with 8%, China with 7%, and Peru with 5%. Smaller quantities of diatomite were mined in 23 additional countries (table 5).

Outlook

Adequate supplies of diatomite are likely to remain available for the foreseeable future. The economic stability of the diatomite industry owing to its use as a filtration medium, where demand remains strong, particularly in the filtration of spirits, as well as human blood plasma and other biotechnical applications. Likewise, the substitution for diatomite by more advanced filtration products, including carbon membranes, ceramics, and polymers, was not a concern in 2019. The high costs associated with these alternatives and a cultural preference toward the use of diatomite in the brewing and wine industries indicate a strong likelihood for the continued widespread use of diatomite in filtration.

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TABLE 1
SALIENT DIATOMITE STATISTICS[1]

(Thousand metric tons and thousand dollars)

	2015	2016	2017	2018	2019
United States:					
Sold or used, by producers:					
Quantity	832	686	768	957	768
Value	242,000	195,000	278,000	319,000	259,000
Exports[2]	74	66	87	68	68
Imports for consumption[2]	7	8	9	9	10
Apparent consumption[3]	765	628	690	898	710
World, production	2,470 r	2,060 r	2,340 r	2,380 r	2,190 e

[e]Estimated. [r]Revised.

[1]Table includes data available through April 15, 2020. Data are rounded to no more than three significant digits.

[2]Source: U.S. Census Bureau.

[3]Production plus imports minus exports.

TABLE 2
DIATOMITE SOLD OR USED, BY MAJOR USE[1, 2]

(Thousand metric tons)

Use	2018	2019
Filtration	560	369
Other[3]	397	399
Total	957	768

[1]Table includes data available through April 15, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes exports.

[3]Includes abrasives, absorbents, cement, fillers, insulation, and unspecified uses.

TABLE 3
ESTIMATED AVERAGE VALUE PER METRIC TON OF DIATOMITE, BY MAJOR USE[1]

(Dollars per metric ton)

Use	2018	2019
Absorbents	72	72
Fillers	426	435
Filtration	489	597
Insulation	441 r	441
Other[2]	18	12 e
Weighted average	334	338

[e]Estimated. [r]Revised.

[1]Table includes data available through April 15, 2020. Data are rounded to no more than three significant digits.

[2]Includes abrasives, lightweight aggregates, and unspecified uses.

TABLE 4
U.S. EXPORTS OF DIATOMITE[1, 2]

(Thousand metric tons and thousand dollars)

Year	Quantity	Value[3]	Principal destinations
2018	68	41,000 r	Canada, 22%; Germany, 18%; China, 8%; Brazil, 5%; South Africa, 4%.
2019	68	40,200	Canada, 20%; Germany, 17%; Brazil, 8%; China, 6%; Belgium, 5%; Russia, 5%.

[r]Revised.
[1]Table includes data available through April 8, 2020. Data are rounded to no more than three significant digits.
[2]Harmonized Tariff Schedule (HTS) code 2512.00.0000, natural and straight-calcined grades, but in practice may include an undetermined quantity of flux-calcined product, which should be reported as HTS code 3802.90.2000.
[3]Free alongside ship value.

Source: U.S. Census Bureau.

TABLE 5
DIATOMITE: WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Thousand metric tons)

Country or locality	2015	2016	2017	2018	2019
Algeria	2	3	3	3 e	3 e
Argentina	61	57	70	70 e	70 e
Armenia	16	22	20	20 e	20 e
Australia[e]	14	12	12	12	12
Brazil, beneficiated	3	3	3	3 e	3 e
Chile	26	27	28	25 r	25 e
China	350	169 r	147 r	150 r, e	150 e
Costa Rica	20 e	20 e	7 r	7 r	7 e
Czechia	15	26	34	31 r	31 e
Denmark[2]	469 r	421 r	406 r	366 r	370 e
Ethiopia[e]	5	5	5	5	5
France[e]	75	75	75	75	75
Germany, siliceous earth	50	52 e	52 e	52 e	52 e
Hungary[e]	1	1	1	1	1
Iran[e]	10	10	10	10	10
Japan	50 e	41	40 e	40 e	40 e
Kenya	1	1 r	1 r	2 r	2 e
Korea, Republic of, diatomaceous earth	15	21	134	26 r	26 e
Mexico	90 e	97	96	96 e	96 e
Mozambique	(3) e	1	5	5 e	5 e
New Zealand, diatomaceous earth[e]	40	40	40	40	40
Peru	121	107	110	110 e	110 e
Poland[e]	1	1	1	1	1
Russia	66	47	52 r	51 r	51 e
Spain[e, 4]	50	50	50	50	50
Thailand	(3) r	1	1 e	1 e	1 e
Turkey	87	62	170	170 e	170 e
United States[5]	832	686	768	957	768
Total	2,470 r	2,060 r	2,340 r	2,380 r	2,190 e

[e]Estimated. [r]Revised.
[1]Table includes data available through April 16, 2020. 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.
[2]Data represent "extracted moler" (reported cubic meters times 2.3). Danish extracted moler figures, in thousand cubic meters, are as follows: 2015—203; 2016—183; 2017—176; 2018—159; and 2019—161 (estimated). Contains about 30% clay.
[3]Less than ½ unit.
[4]Includes tripoli.
[5]Sold or used by producers.