BARITE

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Barite, a name that was derived from the Greek word "barus" (heavy), is the mineralogical name for barium sulfate. In commerce, the mineral is sometimes referred to as "barytes." As used in this report, the term "primary barite" refers to the first marketable product, which includes crude barite (run of mine) and the products of simple beneficiation methods, such as washing, jigging, heavy media separation, tabling, flotation, and magnetic separation. Most crude barite requires some upgrading to minimum purity or density. Barite that is used as an aggregate in a "heavy" cement is crushed and screened to a uniform size. Most barite is ground to a small uniform size before it is used as a filler or extender, an addition to industrial products, or a weighting agent in petroleum well-drilling mud [American Petroleum Institute (API) or Oil Companies' Materials Association (OCMA)] specification barite. Barite used for drilling petroleum wells can be blue, black, buff, brown, or gray depending on the ore body. It must be finely ground so that at least 97% of the material, by weight, can pass through a 200-mesh (75-micrometer) (Tyler) screen, and no more than 30%, by weight, can be less than 6 micrometers, effective diameter, which is measured using sedimentation techniques. The ground barite also must be dense enough that its specific gravity is 4.2 or greater, soft enough to not damage the bearings of a tricone drill bit, and both chemically inert and containing no more than 250 milligrams per kilogram of soluble alkaline salts (American Petroleum Institute, 1993, p. 6-11). A small percentage of iron oxide is allowable. An additional feature of barite is noninterference with magnetic measurements taken in the borehole, either during logging-while-drilling or in separate drill-hole logging. In offshore drilling, the U.S. Environmental Protection Agency limits the content of mercury to 1 milligram per kilogram of barite and that of cadmium to 3 milligrams per kilogram of barite (U.S. Environmental Protection Agency, 1997). Although barite contains a heavy metal (barium), it is not a toxic chemical under section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 because it is very insoluble.

Production

Domestic production and sales data for barite were derived from voluntary responses to a survey of U.S. operations and followup telephone calls by the U.S. Geological Survey (USGS). Barite production for 2001 was 400,000 metric tons (t), essentially unchanged from that of 2000. Of the known 34 operations, 15 responded by returning survey forms, and 19 responded to telephone inquiry. Three operations were idle, 1 was under construction, and 30 were active. Nine mines were included in the survey; seven were producing, and two were idle. Of the producing mines, four were in Nevada, two were in Georgia, and one was in Tennessee; one idle mine was in Nevada, and one idle mine was in Missouri. There were 26 mills/grinding plants operating for the reporting year. Three grinding plants were in Nevada, all associated with mines. Five of the six active mines had associated grinding plants. None of the Nevada-mined ore was sent to the Gulf of Mexico coast for grinding; it was ground onsite and sold into the northwestern U.S. and southwestern Canadian petroleum exploration and development (E&D) market. There were 16 facilities on the Gulf of Mexico coast that produced API-grade barite in 2001. These stand-alone grinding plants received relatively low-priced crude barite primarily from China and India for grinding to petroleum-well-drilling specifications and small amounts for filler and extender markets. In Texas, there were two plants in Brownsville, three in Corpus Christi, one in Galveston, and two in Houston. In Louisiana, there was a grinding plant in Amelia, a grinding plant in Houma, two near Lake Charles, two near Morgan City, one in New Iberia, and one near New Orleans.

There were two stand-alone grinding plants in Illinois producing both filler-and-extender- and chemical-grade for industry markets using imported river-barged crude barite and one new filler-and-extender-grade-grinding plant under construction for startup in 2002 near Dyersburg, TN, that will use imported river-barged crude barite. Two grinding plants in Georgia were associated with mines and produced filler-and-extender- and chemical-grade industry barite. One grinding plant in California was associated with a mine in Nevada to produce filler and extender barite, and one grinding plant in Missouri used material from a stockpile from a nearby idle mine.

The quantity of primary barite sold or used by domestic producers was essentially unchanged from that of 2000, and weighted average prices increased by about 10%. About 2% of barite sales from domestic producers was for industrial end uses. The remaining sales were for petroleum-well-drilling API specification markets.

Halliburton Co. owned the Baroid Drilling Fluids Division. A joint venture between Smith International Inc. and Schlumberger Ltd. owned M-I LLC, which owned M-I Drilling Fluids. The third major U.S. barite company was Baker Hughes Inteq, a division of Baker Hughes, Inc. These three companies mined barite in Nevada with colocated beneficiation plants (mills) and grinding plants, along with the above mentioned grinding plants in Louisiana and Texas. Excalibar Minerals Inc. (a division of Newpark Resources, Inc.) was significant in the imported barite grinding industry in Louisiana and Texas.

These four companies and other smaller companies on the Gulf of Mexico received imported barite by ship to Louisiana and Texas ports. This location is closer to the large offshore drilling rigs in the Gulf of Mexico and the clusters of onshore

areas of exploration and significant discoveries (plays) in the Petroleum Administration for Defense district 3 where searching for gas and oil is most profitable. These producers import and grind or crush barite for use in drilling mud.

Consumption

Barite apparent consumption increased by about 17% to less than 2.9 million metric tons (Mt) from less than 2.5 Mt in 2000. Ground barite sales climbed by about 27% to 2.7 Mt for 2001 from 2.1 Mt. Barite imports during 2001 were up by 20% to 2.5 Mt from 2.1 Mt.

The price of natural gas peaked during December 2000 [at above $9 per million British thermal unit] and fell back to less than $3 per million British thermal units by August 2001, and the gas-directed rigs peaked at about 1,060 rigs in June 2001 and declined to less than 750 rigs in December 2001. Consumption of barite per month certainly dropped during the second half of the year following the drill rig trend. The percentage of gas-directed rigs to total rigs in the United States varied between 78% and 84% for all of 2001. For 1999 and 2000, the fundamental question has seemed to be, "How did the return-on-investment rise again for E&D, after the unprofitable experience of 1998, in the years 1999 and 2000, when it appeared that there might be too few low cost oil or gas reserves to be found for the number of drill rig crews in most of the United States?" Three articles written in 2001 paralleled and strongly expanded on last year's USGS barite Minerals Yearbook chapter (Millheim, 2001; Sumrow, 2001; Urness, 2001). Millheim believed it was aggressive planning by E&D companies and fast learning by drill crews that led to reduced drilling time and drilling cost (Millheim, 2001, p. 72). Two interesting additional explanations might be that the fast learning was not just the local geology but the analytical computers that sensed and interpreted drill rig instrumentation readout and that planning beforehand brought in the additional knowledge gained from the technological shift occurring in the E&D industry through the use of 3D and 4D seismic geophysics (Oil & Gas Journal, 2002, p. 72).

For 2001, preliminary results from John S. Herold, Inc., indicate a return to 1998 E&D levels with rises in costs for the United States, using a preliminary 203 respondent companies that report a rise to $8.46 per barrel of oil equivalent for reserve replacement cost [versus $9.31 in 1998], and $9.75 per barrel of oil equivalent for 2001 for finding and development cost [versus $13.37 in 1998] (Cacchione and Johnson, 2001, p. 9; John S. Herold, Inc., 2002§[1]). The partially comparative numbers from all their respondents, for 2000, were $4.83 per barrel of oil equivalent for reserve replacement cost and $5.40 per barrel of oil equivalent for finding and development cost. Perhaps it was, again, the low return on drilling investment and the natural gas price drop that reduced rig count in the United States from the June peak to December 2001.

For 2001 the outputs of crushers and grinders in Louisiana increased by less than 25%, and the outputs of crushers and grinders in Texas increased by nearly 33% (table 2). Industrial end-use sales by crushers and grinders of domestic and imported barite in 2001 decreased by more than 27% (table 3).

Prices

The nominal average weighted sales price for primary barite from mines and their associated beneficiation plants in the United States increased about 10% to about $27.60 per metric ton, in 2001. Nominal average weighted prices for the crushed and ground barite for oil well drilling in Louisiana and Texas increased by 5%, to $79.80 per ton, for 2001. Nominal average weighted prices of the production of the "other" region increased by about 14% to about $75.40 per ton.

According to Industrial Minerals (2001), midyear international barite prices were as follows:

- API, lump, cost, insurance, freight (U.S.) Gulf Coast, Chinese, $43 to $46 per ton; Indian, $48 to $51; Moroccan, $50 to $52.
- Unground, OCMA/API, bulk, specific gravity 4.2, free on board (f.o.b.) Morocco, $39 to $41 per ton.
- Ground, bagged, specific gravity 4.22, f.o.b. Morocco, $75 to $85 per ton.
- Ground, OCMA/API, big bags (1.5 t) f.o.b. south Turkey, $68 to $70 per ton.
- Ground, OCMA, bulk, delivered Aberdeen [United Kingdom], $70.21 to $77.23[2] [£50-£55], per ton, delivered Great Yarmouth [United Kingdom], $77.23 to $91.27 [£58-£65] per ton.
- Micronized, off white minimum 99% less than 20 micrometers delivered United Kingdom, $196.57 to $210.62 [£140-£150] per ton.
- Ground, white, paint-grade, 96% to 98% $BaSO_4$, 350 mesh, 1 to 5 t delivered United Kingdom, $273.80 to $308.90 [£195-£220] per ton.

Trade

Domestic exports were about 44,800 t, 88% of which went to Canada (table 4). Imports of Chinese barite increased to 2.1 Mt, nearly 6% above that of 2000. Imports from India, only crude, increased by more than 225% to about 330,000 t for 2001 compared with those of 2000 (table 5). Total barite imports for 2001 increased by about 20% to 2.5 Mt compared with 2000.

World Review

Since 1998, the consumption of barite in the United States has seemed to be driven more by the demand for natural gas than for oil. That is, the drilling rig count has been more responsive to rises in the price of natural gas than to rises in the price of oil in the United States. This seems to be unique to the United States; for the rest of the world, the drill rig count continues to respond to changes in the price of oil.

According to the world drill rig reports, which do not cover most of the former and present centrally planned economies, the world drill rig count (with Canadian onshore drill rigs

[1]A reference that includes a section twist (§) is found in the Internet Reference Cited Section.

[2]Where necessary, values hav been converted to U.S. dollars (US$) from United Kingdom pounds (GB£) at a rate of US$1.00=GB£0.7122.

subtracted because their operations are seasonal) rose from about 1,840 rigs in January 2001 to about 2,033 rigs in June and declined to 1,660 rigs in December [Oil & Gas Journal, 2001-2002 (the third issues of each month)]. In ascending order of regional rig count, which is indicative of regional barite consumption, the following regions had variations in rig count as follows:

Africa.—The African active drill-rig count rose from about 52 rigs in January 2001 to about 60 rigs in April, then fell off to 45 rigs in December. Offshore drill rigs rose from 23 rigs in January to 28 rigs in April and fell to 18 rigs in December. Land-based rigs rose from 29 rigs to 32 rigs in April and declined to 27 rigs in December. Except for December, the rig count in this region was always equal to or above the highest monthly total for 2000, hence barite consumption probably increased.

Asia-Pacific.—The Asia-Pacific drill rig count rose from about 145 rigs in January to about 160 rigs in June, 167 rigs in October, and about 165 rigs in December. Onshore drill rig count increased to 106 rigs at the end of the year from 90 rigs, and the offshore count rose from 55 rigs in January to 67 rigs in May and ended the year at about 60 rigs.

Europe.—European drill rigs rose from 87 total rigs in January to 99 total rigs in June, 101 rigs in October, and 99 rigs in December. Onshore rigs rose from 34 rigs in January to 41 rigs in March and October, finishing the year at 38 rigs. Offshore rigs started at 53 rigs, fell to 49 rigs in March, climbed to 65 rigs in June, and finished at 61 rigs. The European rig count was always above the 2001 monthly total; therefore, barite consumption probably increased.

Middle East.—The Middle East rig count declined from about 180 rigs in January to about 164 rigs in March then rose to 189 rigs in July and finished at 188 rigs in December, with onshore rigs starting at 150 rigs, declining to 141 rigs in April, increasing to 152 rigs in August, and finishing at 151 rigs. Offshore rigs started at 30 rigs, dipped to 22 rigs in March, rose to 41 rigs in October, and finished at 37 rigs in December. The regional total rig count was always above the monthly number in 2000, averaging about 23 rigs above last year by month and ranging between 15 rigs and 40 rigs.

Latin America.—Latin America increased from about 253 rigs in January to about 270 rigs in April. The rig count declined to about 252 rigs in October, which was 13 rigs less in that region than the 2000 rig count for October. The regional rig count averaged about 34 rigs greater than 2000 on a month-by-month basis, but in October, November, and December were less than the year 2000 rig counts for those months.

Canada.—Canadian drill rig usage peaked at 562 in February 2001 and declined to a low of 217 rigs in April, and rose to a peak of 325 in August and declined to 264 in December. The peak rig count in February 2002 was 433 drill rigs, down 23% from 2001. Canada is also an important gas supplier to the United States.

The above regional analysis of drill rig count shows that all but the Middle Eastern countries' counts fell back in October. The petroleum demand outlook was apparently poorer after September. Early results from Herold indicate a worldwide rise in cost from a preliminary 203 companies that showed a rise to $7.76 per barrel of oil equivalent for reserve replacement cost and $9.08 per barrel of oil equivalent for 2001 for finding and development cost (John S. Herold, Inc., 2002§). The partially comparative numbers from all their respondents for 2000 were $3.54 per barrel of oil equivalent for reserve replacement cost and $3.85 per barrel of oil equivalent for finding and development cost. According to Herold, the worldwide reserve replacement cost and finding and development cost did not rise in 1998 (Caccione and Johnson, 2001). Perhaps it was not just the oil price drop that started in November 2000 or the natural gas price drop that started in January 2001 that reduced rig count worldwide from June peak to December 2001 or the attack of September 11; it may have been the E&D decline in profit in 2001, possibly first seen in the first half-year business reports, equivalent to 1998, that reduced drill rig activity.

Outlook

In the United States, the gas industry looks more viable and profitable in the E&D department and should be a market for barite consumption for many years; however, the industry will have to determine the cause of the 2001 higher-than-normal E&D costs and bring down these costs or accept more imports from lower cost petroleum regions.

It may be that the source of barite-for-drilling-mud market will slowly move away from the United States over the long term as more petroleum fuel is imported into the United States and less is produced or some other energy source replaces some petroleum end uses. The four U.S. barite suppliers will continue to support drilling activity as those centers of activity move to Africa, Asia-Pacific, the former Soviet Union, and Latin America.

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TABLE 1
SALIENT BARITE STATISTICS 1/ 2/

(Thousand metric tons and thousand dollars)

	1997	1998	1999	2000	2001
United States:					
Barite, primary:					
Sold or used by producers:					
Quantity	692	476	434	392	400
Value	$15,500	$11,400	$11,100	$9,840	$11,000
Exports:					
Quantity	22	15	22	36	45
Value	$2,430	$2,310	$2,750	$4,180	$5,330
Imports for consumption: 3/					
Quantity	2,260	1,890	871	2,100	2,510
Value	$136,000	$122,000	$59,000	$108,000	$125,000
Consumption, apparent: 4/	2,930	2,350	1,280	2,460	2,870
Crushed and ground, sold or used by processors: 5/					
Quantity	2,180	1,890	1,370	2,100	2,670
Value	$173,000	$146,000	$108,000	$159,000	$206,000
World, production	6,780	6,470 r/	6,180 r/	6,590 r/	6,700 e/

e/ Estimated. r/ Revised.
1/ Data are rounded to no more than three significant digits.
2/ Barium chemicals data withheld to avoid disclosing company proprietary data.
3/ Includes crude and ground.
4/ Sold or used plus imports minus exports.
5/ Includes imports.

TABLE 2
CRUSHED AND GROUND BARITE SOLD OR USED BY PROCESSORS IN THE UNITED STATES, BY STATE 1/ 2/

	2000			2001		
State	Number of plants	Quantity (thousand metric tons)	Value (thousands)	Number of plants	Quantity (thousand metric tons)	Value (thousands)
Louisiana	7	1,120	$85,200	8	1,400	$110,000
Texas	8	574	43,400	8	763	62,600
Other 3/	9	408	30,800	9	510	33,600
Total	24	2,100	159,000	25	2,670	206,000

1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Includes imports.
3/ Includes California, Georgia, Illinois, Missouri, and Nevada.

TABLE 3
CRUSHED AND GROUND BARITE SOLD OR USED BY
PROCESSORS IN THE UNITED STATES, BY USE 1/ 2/

(Thousand metric tons and thousand dollars)

Use	2000		2001	
	Quantity	Value	Quantity	Value
Barium chemicals, filler and/or extender, glass	77	18,000	56	12,600
Well drilling	2,030	141,000	2,620	194,000
Total	2,100	159,000	2,670	206,000

1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Includes imports.

TABLE 4
U.S. EXPORTS OF NATURAL BARIUM SULFATE (BARITE), BY COUNTRY 1/

Country	2000		2001	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Argentina	38	$10	40	$10
Australia	17	9	--	--
Brazil	--	--	17	4
Canada	32,500	2,630	39,500	3,410
Chile	--	--	17	5
China	67	164	1,410	462
Colombia	2	9	--	--
Costa Rica	147	42	106	27
Ecuador	--	--	204	30
El Salvador	19	4	--	--
Hong Kong	16	5	--	--
India	7	15	--	--
Italy	260	58	6	19
Japan	234	61	373	121
Korea, Republic of	17	24	10	6
Mexico	2,890	959	2,480	966
Netherlands	4	20	--	--
Oman	11	47	--	--
Pakistan	--	--	1	5
Russia	--	--	489	179
Saudi Arabia	6	56	--	--
South Africa	13	4	2	4
Trinidad and Tobago	--	--	27	8
Venezuela	82	63	135	71
Total	36,300	4,180	44,800	5,330

-- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF BARITE, BY COUNTRY 1/

Country	2000 Quantity (metric tons)	2000 Value 2/ (thousands)	2001 Quantity (metric tons)	2001 Value 2/ (thousands)
Barite, crude:				
Canada	9,930	$2,080	185	$13
China	1,950,000	84,000	2,090,000	86,500
Germany	3,340	158	--	--
Hong Kong	--	--	4,540	198
India	101,000	5,950	328,000	18,400
Indonesia	--	--	34,200	1,580
Mexico	2,340	195	550	55
Morocco	--	--	17,400	779
United Kingdom	290	23	--	--
Total	2,070,000	92,400	2,470,000	107,000
Barite, ground:				
China	15,000	1,540	5,910	609
Mexico	1,190	120	551	37
Total	16,200	1,660	6,460	646
Barite, other sulfates of:				
Belgium	--	--	16	31
Canada	623	533	7,210	1,910
China	298	107	14,300	3,140
Germany	8,800	8,890	8,360	8,020
Italy	4,650	2,680	3,760	2,160
Japan	742	1,540	738	1,190
Netherlands	147	96	183	63
Spain	40	49	116	97
Switzerland	20	28	177	228
Taiwan	--	--	42	7
Thailand	1	10	--	--
Turkey	5	8	--	--
United Kingdom	33	48	163	25
Total	15,400	14,000	35,100	16,900

-- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Cost, insurance, freight value.

Source: U.S. Census Bureau, as adjusted by the U.S. Geological Survey.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF BARIUM CHEMICALS 1/

	2000 Quantity (metric tons)	2000 Value 2/ (thousands)	2001 Quantity (metric tons)	2001 Value 2/ (thousands)
Barium chloride	1,240	$752	341	$291
Barium oxide, hydroxide, peroxide	5,290	4,770	3,780	3,300
Barium nitrate	4,930	4,540	5,010	6,070
Barium carbonate, precipitated	26,200	14,300	18,600	9,210
Other barium compounds	14,100	13,100	12,700	11,500

1/ Data are rounded to no more than three significant digits.
2/ Cost, insurance, freight value.

Source: U.S. Census Bureau.

TABLE 7
BARITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1997	1998	1999	2000	2001 e/
Afghanistan e/ 3/	2,000	2,000	2,000	2,000	2,000
Algeria	39,140	37,006	50,150	51,925 r/	52,000
Argentina	13,121	13,500	4,365	4,500 r/ e/	4,500
Australia e/	15,000	13,000	18,000	20,000	20,000
Belgium e/	30,000	40,000	30,000	30,000	30,000
Bolivia	4,402	2,500	6,005	3,050 r/	3,000
Bosnia and Herzegovina e/ 4/	2,000	2,000	2,000	2,000	2,000
Brazil (beneficiated)	51,961	46,632	44,906	53,741 r/	55,000
Bulgaria e/ 5/	120,000	1,000	120,000	120,000	100,000
Burma	17,111	22,004	24,651	30,370 r/	34,000
Canada	77,000	90,000	123,000 r/	67,000 r/	70,000
Chile	2,654	1,430	823	1,026 r/	1,000
China e/	3,500,000	3,300,000	3,500,000	3,500,000	3,600,000
Colombia e/	900 r/ 6/	600	600	600	600
France	75,000	75,000 e/	75,000	75,000	75,000
Georgia e/	20,000	20,000	15,000	15,000	15,000
Germany (marketable Ba_2SO_4)	118,698	120,000 e/	120,000	120,000 e/	120,000
Greece (crude ore) e/	905 6/	800	800	800	800
Guatemala e/	2,800	2,800	7,500 r/	113,000 r/	100,000
India	409,498	749,412	360,000 r/ e/	840,000 r/	850,000
Iran 3/	181,174	187,677	183,850	185,000 e/	185,000
Italy e/	26,300	30,000	25,000	25,000	25,000
Kazakhstan 4/	38,000 e/	9,000	13,300	14,000 e/	45,000
Kenya	20 e/	10 e/	-- r/	-- r/	--
Korea, North e/	120,000	100,000	70,000	70,000	70,000
Korea, Republic of	105 e/	--	--	30 r/	--
Laos	7,330 r/	9,050	7,900 r/	1,100 r/	5,000
Malaysia	2,608	1,580 e/	13,506	7,274 r/	1,300
Mexico	236,606	161,555	157,953	127,420 r/	130,000
Morocco	343,314	353,438	328,945 r/	320,243 r/	320,000
Nigeria e/	4,000	5,000	5,000	5,000	5,000
Pakistan	23,390	20,657	20,505	21,234	22,000
Peru	63,600 r/	7,506	3,512	11,403	12,000
Poland	3,400	--	--	--	--
Romania (processed)	12,000	15,000	15,000	14,000 r/	15,000
Russia e/	60,000	60,000	60,000	60,000	60,000
Saudi Arabia e/	8,000	8,000	7,000	8,000	8,000
Slovakia (concentrate)	62,000	15,000	16,000	14,000 r/	15,000
South Africa	2,071	610 e/	2,844	1,628	--
Spain (Ba_2SO_4)	28,000	28,000	26,000	26,000	26,000
Thailand	54,817	105,221 r/	76,092 r/	56,180 r/	57,000
Tunisia	12,841	8,011	530	3,702	4,000
Turkey (run-of-mine)	226,594	160,042	150,058 r/	120,893 r/	100,000
United Kingdom	74,000	68,000 r/	59,000 r/	55,000 r/	60,000
United States 7/	692,000	476,000	434,000	392,000	400,000
Total	6,780,000	6,470,000 r/	6,180,000 r/	6,590,000 r/	6,700,000

e/ Estimated. r/ Revised. -- Zero.

1/ World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

2/ Table includes data available through June 10, 2002.

3/ Data are for fiscal year beginning March 21 of that stated.

4/ Based on an estimated 70% recovery factor.

5/ Barite concentrates.

6/ Reported figure.

7/ Sold or used by producers.