SODIUM SULFATE

By Dennis S. Kostick

Sodium sulfate is an important inorganic chemical that has several significant industrial uses. It is produced from naturally occurring sodium sulfate-bearing brines or crystalline evaporite deposits and as a byproduct from different chemical processes, such as ascorbic acid, boric acid, cellulose, chromium chemicals, lithium carbonate, rayon, resorcinol, and silica pigments. The byproduct sodium sulfate is considered a waste product but has marketability; both types of sodium sulfate, however, have several important and useful applications in various consumer products.

Production

Domestic production and inventory data for natural sodium sulfate are developed by the U.S. Geological Survey (USGS) from monthly and annual surveys of U.S. operations. Of the two natural sodium sulfate operations to which a survey request was sent, both responded, representing 100% of the natural sodium sulfate data used in this report.

Synthetic sodium sulfate data were collected by the U.S. Department of Commerce, Bureau of the Census, from quarterly and annual surveys (aggregate data published in Current Industrial Reports, Inorganic Chemicals, MQ28A and MA28A) of companies engaged in recovering and selling byproduct sodium sulfate. Any revised Bureau of the Census data have been included using the most recent statistics. These data are aggregated with USGS natural sodium sulfate data and included in several tables.

Two companies produced natural sodium sulfate from a total of two plants in California and Texas. The domestic natural sodium sulfate industry supplied about 73% of the total output of U.S. sodium sulfate. Because of the location of these plants, most natural sodium sulfate is marketed in the West and Southern Gulf areas. Based on final 1994 data from the Bureau of the Census, byproduct material was supplied by 16 establishments located primarily in the Midwest and Mid-Atlantic regions. The number of plants, by process, was natural, three; viscose rayon, three; sodium dichromate, one; and phenol, boric acid, formic acid, and other, nine. Total rated production capacity in 1995 was 738,000 tons, and the industry operated at 61% of this capacity.

Domestic natural sodium sulfate production increased nearly 10% in 1995 as demand improved for powdered laundry products in the soap and detergent sector. Based on preliminary Bureau of the Census data for total sodium sulfate, 424,000 metric tons were produced in 1995, of which 327,000 tons were from natural sources and 124,000 tons were from byproduct sources. This was the fourth consecutive year that sodium sulfate production declined. Sodium sulfate failed to make the list in an annual survey of the top 50 domestic inorganic chemicals produced.[1] The quantity of byproduct material reported by the Bureau of the Census was less than expected, based on the strength of certain domestic and export sales and the opinions of industry analysts. It is possible that the total sodium sulfate production has been underreported during 1995. Ending inventories of natural sodium sulfate were 16,000 tons.

GNB Technologies of Columbus, GA, came on-stream with a battery acid recycling plant that recovers byproduct sodium sulfate. The operation has an annual capacity of 27,000 tons (30,000 short tons). Two other battery recyclers, Schuilkill Metals of Baton Rouge, LA, and RSR Corp. of Scotchtown, NY, were scheduled to come on-stream with new byproduct sodium sulfate capacity in 1996. The planned capacity of the plants were 14,000 tons (15,000 short tons) and 23,000 tons (25,000 short tons), respectively.[2]

Consumption

The estimated distribution of sodium sulfate by end use was soap and detergents, 42%; textiles, 15%; pulp and paper, 12%; glass 11%; and other, 20%. Miscellaneous uses included sodium sulfate for carpet fresheners, starch manufacture, etc. Apparent consumption decreased 11% to 424,000 tons; however, industry analysts indicate that this amount was less than expected based on strong export and domestic sales. One possibility is that, as mentioned above, production of byproduct sodium sulfate may be under reported, causing apparent consumption to be lower.

The U.S. sodium sulfate industry benefited from the unfortunate problems in the Mexican economy that led to the devaluation of the peso. The demand for less expensive consumer products led detergent manufacturers to reformulate powdered home laundry products using more sodium sulfate as filler. The Mexican natural sodium sulfate producer, Quimica del Rey, diverted a lot of its supply dedicated for export to domestic consumption. This allowed U.S. producers and others to fill the void in various world markets.

An estimated 44% of the total sodium sulfate consumed in the United States is for use as a filler in powdered laundry detergents. Many areas in the country have adopted phosphate bans or limitations because phosphatic detergents contribute to the environmental problems of eutrophication. The affected areas represent about 33% of the U.S. population. In response to this environmental issue, detergent manufacturers have reformulated many of their detergents by switching from sodium tripolyphosphate (STPP) to tetrasodium pyrophosphate, which has the same building power as STPP but requires less to be

used, thereby reducing the amount of phosphate released into the environment. These reformulations used more sodium sulfate as filler, which was beneficial to the sodium sulfate industry.

Some domestic detergent manufacturers began adding additional quantities of sodium sulfate to powdered laundry products, reportedly to substitute for higher priced zeolites and surfactants.

The use of sodium sulfate in textiles apparently is increasing, according to industry sources. Salt traditionally has been used in the dyeing process to separate organic contaminants, promote "salting out" of dyestuff precipitates, and blending with dyes to standardize concentrated dyes. The equipment used in this process used stainless steel, which was susceptible to corrosion because of the salt. The textile industry began substituting the salt with sodium sulfate, which is not corrosive to the manufacturing equipment.

Stocks

Yearend 1995 inventories of natural sodium sulfate stored by the two producers were 16,000 tons, which was a 53% decrease over that of 1994. The material stockpiled was anhydrous sodium sulfate. Synthetic sodium sulfate was marketed mainly through major chemical distributors, which have separate storage facilities from the producers.

Prices

Producers of natural sodium sulfate tend to market and sell most of their own product, but most synthetic producers use major chemical distributors or chemical supply companies as sales agents. The principal product made and sold by the synthetic sodium sulfate producer is the primary economic factor. Because sodium sulfate is considered a waste product, it will be sold at a price that ensures prompt sales. This practice tends to set the rates at which the natural product can be sold.

The list prices quoted in trade journals or by producers of all grades of sodium sulfate differ from the annual average values reported by the USGS. The value represents the combined amount of total revenue of domestic natural sodium sulfate sold at list prices, spot prices, long-term contracts, discounts, and export divided by the aggregated quantity of sodium sulfate sold. The published value does not necessarily correspond to the posted list price.

The average value increased from $81.25 per metric ton ($73.71 per short ton) in 1994 to $84.55 per metric ton ($76.70 per short ton) in 1995 for bulk sodium sulfate, f.o.b. mine or plant.

Foreign Trade

Imports of sodium sulfate were 206,000 tons, or 8% more than the 190,000 tons imported in 1994. More than 72,000 tons of anhydrous sodium sulfate were imported in 1995, primarily from Canada and Mexico. Shipments from Canada represented nearly 99% of total imports of anhydrous sodium sulfate. Belgium, Germany, India, and Japan shipped the remainder. Imports of crude sodium sulfate were almost exclusively from Canada. Canada also supplied about 63,000 tons of Glauber's salt. The total value of all sodium sulfate imports was $85.92 per ton.

Sodium sulfate exports amounted to 66,000 tons, according to Bureau of the Census data. However, industry sources indicated that one producer alone exported nearly this entire quantity by itself. This would indicate that exports may have been under reported, resulting in an erroneous apparent consumption determination. Although efforts were made to investigate the source of the data disagreement, no resolution of the matter was achieved by yearend. Of the 66,000 tons, crude sodium sulfate exports of 60,000 tons was exported to 13 nations. Brazil received the largest share; about 33% of the total, followed by Canada, 29%; and Colombia, 19%. Anhydrous sodium sulfate exports to 11 countries were 7,000 tons. Mexico imported the most; nearly 68% of the total.

World Review

Approximately 63% of the world sodium sulfate production in 1995 was from natural sources; the balance was represented by synthetic sodium sulfate recovered from various chemical and manufacturing processes. Although the USGS collects or estimates data from 32 sodium sulfate-producing countries, other countries are known or assumed to have produced synthetic sodium sulfate, but production statistics are not reported, and available information is inadequate to make reliable estimates of output.

Although the United States is one of the largest producers in the world of natural and synthetic sodium sulfate, its share has decreased from 23% of world production total in 1980 to 11% in 1995. Total U.S. production has declined 64% since 1970.

Outlook

The environmental movement in the United States has had a direct effect on the North American sodium sulfate industry. The concern about solid waste management led to legislation that regulates the discharge and handling of solid waste. The Hazardous and Solid Waste Amendments of 1984 gave the U.S. Environmental Protection Agency the authority to issue or deny permits to companies formed to collect and manage various hazardous wastes. Establishments engaged in collecting and processing lead-acid batteries and other metal-bearing wastes recover lead and trace metals and neutralize the sulfuric acid using soda ash, resulting in a high-purity byproduct sodium sulfate that can be sold. As additional metal recycling facilities are established throughout the country, more byproduct sodium sulfate could be recovered pending favorable market conditions.

Sodium sulfate is a common constituent of some of the groundwaters of central California. Sodium sulfate and other salts are formed as agricultural drainage waters leach underground rocks and soil containing the ions to form these compounds. The surface accumulation of these compounds has

caused concern about their effect on the environment and have become a disposal issue. The sale of the commingled salts is one solution that has been proposed to alleviate this growing problem. The processing costs to separate the individual compounds, competition from nearby sources, and market conditions may preclude utilization of this resource.

Changes toward oxygen-based bleaching chemicals by the pulp and paper industry have reduced the sales by several sodium sulfate suppliers. Some of the chemicals can be produced on-site at various pulp mills. One of the chosen bleaching chemicals, chlorine dioxide, produces sodium sulfate as a byproduct that can be used and partially recycled by the pulp mills. By producing their own sodium sulfate, certain pulp mills would not have to purchase any sodium sulfate.

Sodium sulfate consumption by the soap and detergent industry, which has been the largest consumer of sodium sulfate, will continue to encounter cycles because of changes in regional economic conditions in the nation. In areas with a depressed economy, powdered home laundry detergents are more in demand because they are less expensive than liquid concentrates or compact alternatives.

U.S. consumption is expected to decline further, or at least optimistically remain flat, in the next few years. Suplies of natural and byproduct sodium sulfate are more than adequate to meet any unanticipated surge in domestic demand.

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[1]Chemical & Engineering News. Facts and Figures for the Chemical Industry. June 26, 1995, v. 73, no. 26, p. 39.

[2]Chemical Marketing Reporter. Sodium Sulfate Gets a Much Needed Boost. Sept. 25, 1995, v. 248, no. 13, p. 5.

OTHER SOURCES OF INFORMATION

U.S. Geological Survey Publications

Sodium Sulfate. Ch. in Mineral Industry Surveys, annual review.

Sodium Sulfate in Mineral Industry Surveys, monthly.

Sodium Sulfate in Mineral Commodity Summaries, annual.

Smith, G.I., Jones, C.L., Culbertson, W.C., Ericksen, G.E., and Dyni, J.R., 1973, Evaporites and brines, in Brobst, D.A., and Pratt, W.P., United States Mineral Resources: U.S. Geological Survey Professional Paper 820, p. 197-216.

U.S. Bureau of Mines Publication

Soda Ash and Sodium Sulfate. Ch. in 1985 Mineral Facts and Problems.

Other Sources

Sodium Sulfate in Mining Engineering, annual commodity review.

Sodium Sulfate in Ceramic Bulletin, annual commodity review.

Sodium Sulfate Deposits, Industrial Minerals and Rocks, Society of Mining, Metallurgy, and Exploration, 6th ed., D. Carr, ed., 1994, p. 959-971.

TABLE 1
SALIENT SODIUM SULFATE STATISTICS 1/

(Thousand metric tons and thousand dollars)

	1991	1992	1993	1994	1995
United States:					
Production, natural	354	337	327	298	327
Production, synthetic	376 r/	216	210	180 r/	124
Synthetic and natural:					
High Purity	370 r/	345	320	W	W
Low Purity (99% or less)	360 r/	207	217	W	W
Total 2/	730 r/	552	537	478 r/	451
Value 3/	$63,800 r/	$50,800	$41,100	$38,800 r/	$35,800
Per ton	$87.34	$91.79	$76.53	$81.25 r/	$84.55
Exports	103	155	89	65	66
Value	$11,500	$11,900	$8,540	$7,020	$7,250
Imports for consumption	157	158	163	190	206
Value	$13,800	$13,400	$13,600	$15,700	$11,800
Stocks, Dec. 31: Producers	35	47	42	34	16
Apparent consumption	788 r/	544	616	611 r/	609
World: Production	4,750 r/	4,100	4,090 r/	3,960 r/	4,020 e/

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes natural and synthetic. Total production data for synthetic sodium sulfate, obtained from the Bureau of the Census, were revised in first quarter 1996 MQ28A Inorganic Chemicals, Current Industrial Report.

3/ The value for synthetic sodium sulfate is based upon the average value for natural sodium sulfate.

TABLE 2
U.S. PRODUCERS OF NATURAL AND SYNTHETIC SODIUM SULFATE IN 1995

Product and company	Plant nameplate capacity (thousand metric tons)	Plant location	Source
Sodium sulfate, natural:			
North American Chemical Co., Westend plant	218	Trona, CA	Dry lake brine.
Ozark-Mahoning Co.	141	Seagraves, TX	Do.
Total	359		
Sodium sulfate, synthetic:			
Lenzing A.G.	34	Lowland, TN	Rayon manufacture.
Courtaulds North American Inc.	45	La Moyne, AL	Do.
Flour Corp., Doe Run Co.	9	Boss, MO	Battery recycling.
4M Paper Corp.	6	Ft. Madison, IA	Pulping process.
FMC Corp.	41	Bessemer City, NC	Lithium carbonate.
Hoffman-La Roche Inc.	14	Belvidere, NJ	Ascorbic acid.
W. R. Grace & Co., Organic Chemicals Div.	8	Nashua, NH	Chelating agents.
J. M. Huber	32	Etowah, TN	Silica pigment.
Do.	14	Havre de Grace, MD	Do.
Indspec Chemical Corp.	35	Petrolia, PA	Resorcinol manufacture.
North American Rayon Corp.	14	Elizabethton, TN	Rayon manufacture.
Occidental Chemical Corp.	109	Castle Hayne, NC	Sodium dichromate manufacture.
Pineville Kraft	3	Deer Park, TX	Pulping process.
Public Service of New Mexico	6	Waterflow, NM	Flue gas desulfurization.
Teepak, Inc.	6	Danville, IL	Cellulose manufacture.
Star Enterprise	3	Delaware City, DE	Flue gas desulfurization.
Total	379		
Grand total	738		

TABLE 3
SODIUM SULFATE YEAREND PRICES

		1994	1995
Sodium sulfate (100% Na2SO4):			
East, bulk, carlot, works, freight equalized	per ton	$113.00-$114.00	$113.00-$114.00
Gulf, bulk, carlot, same basis	do.	110.00	110.00
West, bulk, carlot, same basis	do.	127.00	127.00
Salt cake (100% Na2SO4):			
East, bulk, f.o.b. works	do.	72.00	82.00

Sources: Chemical Marketing Reporter. Current Prices of Chemicals and Related Materials. v. 247, no. 1, Dec. 30, 1995, p. 32, and v. 249, no. 1, Jan. 1, 1996, p. 32.

TABLE 4
U.S. EXPORTS OF SODIUM SULFATE, BY COUNTRY 1/

	Disodium sulfate, salt cake		Disodium sulfate, other		Total	
Country	Quantity (metric tons)	Value 2/	Quantity (metric tons)	Value 2/	Quantity (metric tons)	Value 2/
1994:						
Australia	11,800	$1,110,000	1	$5,950	11,800	$1,120,000
Belgium	4,610	410,000	--	--	4,610	410,000
Brazil	--	--	269	103,000	269	103,000
Canada	14,400	1,440,000	--	--	14,400	1,440,000
China	--	--	32	39,800	32	39,800
Colombia	7,510	300,000	--	--	7,510	300,000
Costa Rica	2,630	292,000	--	--	2,630	292,000
Dominican Republic	--	--	11	3,060	11	3,060
Ecuador	--	--	3	2,780	3	2,780
El Salvador	2,500	250,000	--	--	2,500	250,000
Guatemala	7,800	780,000	--	--	7,800	780000
Honduras	--	--	20	5,100	20	5,100
Hong Kong	--	--	15	14,800	15	14800
Japan	--	--	8	10,800	8	10,800
Korea, Republic of	7,030	415,000	(3/)	3,000	7,030	418,000
Mexico	750	85,200	5,190	1,700,000	5,940	1,780,000
Netherlands	--	--	3	12700	3	12700
Philippines	88	28,600	--	--	88	28,600
Spain	80	8,290	--	--	80	8,290
Total	59,200	5,120,000	5,550	1,900,000	64,800	7,020,000
1995:						
Argentina	--	--	14	205,000	14	205,000
Australia	56	5,730	58	511,000	114	517,000
Brazil	19,500	1,490,000	14	24,200	19,500	1,510,000
Canada	17,100	1,470,000	--	--	17,100	1,470,000
China	--	--	32	39,300	32	39,300
Colombia	11,600	690,000	--	--	11,600	690,000
Denmark	--	--	(3/)	3,180	(3/)	3,180
Germany	179	19,600	--	--	179	19,600
Ghana	--	--	(3/)	2,640	(3/)	2,640
Guatemala	4,960	521,000	--	--	4,960	521,000
Jamaica	168	20,300	--	--	168	20,300
Japan	184	19,000	--	--	184	19,000
Korea, Republic of	--	--	70	24,200	70	24,200
Mexico	439	51,200	4,700	1,080,000	5,130	1,140,000
New Zealand	2,000	177,000	2,020	476,000	4,020	653,000
Philippines	305	43,900	--	--	305	43,900
Taiwan	11	3,540	--	--	11	3,540
United Kingdom	--	--	2	15,600	2	15,600
Venezuela	3,060	353,000	(3/)	3,840	3,060	357,000
Total	59,500	4,860,000	6,910	2,390,000	66,400	7,250,000

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ F.a.s. value at U.S. ports.
3/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 5
U.S. IMPORTS OF SODIUM SULFATE, BY COUNTRY 1/

Country	Disodium sulfate, salt cake 2/ 3/		Disodium sulfate, other		Total	
	Quantity (metric tons)	Value 4/	Quantity (metric tons)	Value 4/	Quantity (metric tons)	Value 4/
1994:						
Canada	107,000	$10,100,000	68,700	$5,270,000	176,000	$15,400,000
Germany	252	28,500	51	69,500	303	98,000
India	--	--	21	23,000	21	23,000
Japan	795	156,000	--	--	795	156,000
Mexico	10	2,940	12,300	90,800	12,300	93,800
Total	108,000	10,300,000	81,100	5,460,000	190,000	15,700,000
1995:						
Belgium	--	--	1	1,360	1	1,360
Canada	69,800	6,580,000	71,700	4,960,000	141,000	11,500,000
Germany	--	--	37	33,000	37	33,000
India	--	--	58	70,200	58	70,200
Japan	130	16,800	20	24,900	150	41,700
Mexico	--	--	822	153,000	822	153,000
Total	69,900	6,600,000	72,600	5,240,000	143,000	11,800,000

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Salt cake is HTS No. 2833.11.1000.
3/ Includes Glauber's salt, HTS No. 2833.11.5050.
4/ C.i.f. value at U.S. ports.

Source: Bureau of the Census.

TABLE 6
SODIUM SULFATE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1991	1992	1993	1994	1995 e/
Natural:					
Argentina (mirabilite)	16,140	24,796	6,554	10,000 e/	10,000
Canada 4/	332,000	282,000	320,000	317,000 r/	301,000 5/
Chile e/ 6/	13,000	13,200	13,200	13,200	13,200
China e/ 7/	28,000	28,000	29,000	29,000	29,000
Egypt	41,110	41,000 e/	25,600	25,000 e/	25,000
Iran	144,204	237,459	280,000	280,000 e/	280,000
Mexico 8/ (bloedite)	517,600	534,445	500,000 e/	500,000 e/	525,000
Netherlands e/	22,000	22,000	20,000	20,000	20,000
South Africa	--	37,169	36,380	44,544	43,971 5/
Spain e/ 9/	700,000	675,000	650,000	600,000	600,000
Turkey (concentrates)	115,000 e/	75,058	171,000 r/	170,000 r/ e/	307,049 5/
Turkmenistan e/	XX	100,000	67,500	50,000	45,000
U.S.S.R. e/ 10/	320,000	XX	XX	XX	XX
United States	354,000	337,000	327,000	298,000	327,000 5/
Total	2,600,000	2,410,000	2,450,000 r/	2,360,000 r/	2,530,000
Synthetic:					
Austria e/	120,000	120,000	120,000	120,000	100,000
Belgium e/	260,000	250,000	250,000	250,000	250,000
Bosnia and Herzegovina e/	XX	5,000	1,000	500	500
Brazil e/	9,000	9,000	9,000	9,000	9,000
Chile 11/	33,796	46,407	46,000 r/ e/	46,400 r/ e/	47,000
Finland e/	33,000	30,000	30,000	30,000	30,000
France	93,000	77,000	62,000 e/	65,000 e/	70,000
Germany	145,943	113,660	106,789	113,000 r/	110,000
Greece e/	6,000	6,000	6,000	6,000	6,000
Hungary e/	6,000	6,000	6,000	6,000	6,000
Italy e/	125,000	125,000	125,000	125,000	125,000
Japan	249,817	242,771	229,346	210,950 r/	210,000
Macedonia e/	XX	3,000	1,000	1,000	1,000
Netherlands e/	15,000	15,000	15,000	15,000	15,000
Pakistan e/	1,000	1,000	1,000	1,000	1,000
Portugal e/	50,000	50,000	50,000	50,000	50,000
Serbia and Montenegro	XX	10,948	3,668 r/	3,500 r/ e/	3,500
Spain e/	150,000	150,000	150,000	150,000	150,000
Sweden e/	100,000	100,000	100,000	100,000	100,000
Turkey e/	30,000	30,000	30,000	30,000	30,000
U.S.S.R. e/ 10/	220,000	XX	XX	XX	XX
United Kingdom e/	90,000	90,000	90,000	90,000	60,000
United States 12/	376,000 r/	216,000	210,000	180,000 r/	124,000 5/
Yugoslavia 13/	35,000 e/	XX	XX	XX	XX
Total	2,150,000 r/	1,700,000	1,640,000 r/	1,600,000	1,500,000
Grand total	4,750,000 r/	4,100,000	4,090,000 r/	3,960,000 r/	4,020,000

e/ Estimated. r/ Revised. XX Not applicable.

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through June 21, 1996.

3/ In addition to the countries listed, Norway, Poland, Romania, and Switzerland are known or are assumed to have produced synthetic sodium sulfate, and other unlisted countries may have produced this commodity, but production figures are not reported; and general information is inadequate for the formulation of reliable estimates of output levels.

4/ Excludes byproduct production from chemical plants.

5/ Reported figure.

6/ Natural mine output, excluding byproduct output from nitrate industry, which is reported separately under "Synthetic" in this table.

7/ Byproduct sodium sulfate is known to be recovered, but reliable data are not available; not included under "Synthetic."

8/ Series reflects output reported by Industries Penoles plus an additional 22,000 tons estimated production by Sulfato de Viesca.

9/ N_2SO_4 content of glauberite and thenardite.

10/ Dissolved in Dec. 1991. Information is inadequate to formulate reliable estimates for individual countries other than Turkmenistan.

11/ Byproduct of nitrate industry.

12/ Derived approximate figures; data presented are the difference between reported sodium sulfate production (natural and synthetic not differentiated) and reported natural sodium sulfate sold by producers (reported under "Natural" in this table).

13/ Dissolved in Apr. 1992.