



2006 Minerals Yearbook

IODINE

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Iodine production in the United States increased slightly in 2006 from 1,570 t in 2005. Imports of iodine decreased to 5,640 t valued at \$109 million in 2006 compared with 6,250 t valued at \$104 million in 2005, and exports decreased to 2,020 t valued at \$34.4 million compared with 2,660 t valued at \$27.9 million in 2005. The three U.S. producers supplied 28% of U.S. apparent consumption, which increased slightly in 2006 from 5,600 t in 2005.

Legislation and Government Programs

The fiscal year 2007 (October 1, 2006, to September 30, 2007) Annual Materials Plan authorized the disposal of 454,000 kilograms (kg) (1 million pounds) of crude iodine from the National Defense Stockpile (NDS) classified as excess to goal (Defense National Stockpile Center, 2006a). During 2006, iodine sales were approximately 467,000 kg (1,030,000 pounds) valued at \$9.90 million. The NDS uncommitted inventory was 93,900 kg (207,000 pounds) on December 31, 2006 (Defense National Stockpile Center, 2006b).

The Drug Enforcement Administration (DEA), a branch of the U.S. Department of Justice, issued proposed rulemaking for changes in the regulation of iodine crystals and chemical mixtures containing more than 2.2% iodine. Changes were proposed to track the movement of iodine and iodine mixtures more accurately in commerce and make it more difficult for the diversion of iodine for illicit production of methamphetamine. Under the proposed rule, companies or individuals conducting transactions involving iodine would have to register with the DEA, would have to comply with the trade restrictions of the Controlled Substances Act, and would be required to maintain records of all iodine transactions, regardless of size. Household and other products containing less than 2.2% iodine would not be affected by the proposed changes. Certain iodine products classified as iodophors also would be exempt from the regulation. No decision had been made at yearend concerning this proposal (U.S. Department of Justice, Drug Enforcement Administration, 2006).

In January, the U.S. Environmental Protection Agency (EPA) proposed to allow the use of pesticides that contain iodomethane as the active ingredient for nonfood use. These pesticides would be applied as preplant soil fumigants for peppers, strawberries, and tomatoes. The proposal was made because the EPA determined that iodomethane degrades rapidly into iodide, which is a naturally occurring component of soils, plants, and animals, and the levels of iodide generated would be lower than those required for toxic effects (U.S. Environmental Protection Agency, 2006). In March, the EPA decided not to register iodomethane but the agency is going to reconsider the issue in 2007 following the completion of an assessment of

other registered soil fumigants (U.S. Environmental Protection Agency, undated).

Production

The U.S. Geological Survey derived domestic production data for iodine from a voluntary canvass of U.S. operations. Two of the three companies to which a survey request was sent responded, representing more than 95% of the total production (table 1).

IOCHEM Corp. (owned by the Kita family and Tomen Corp.) produced iodine at a plant near Vici, OK. The company had nine production wells and four injection wells with a total production capacity of 1,400 metric tons per year (t/yr). North American Brine Resources operated a miniplant at an oilfield-injection-disposal site near Dover, OK. Woodward Iodine Corp. (owned by Ise Chemical Corporation of Japan) produced iodine from 22 brine wells in Woodward County, OK. U.S. production in 2006 increased slightly from 1,570 t in 2005 (table 1).

Consumption

U.S. apparent consumption of iodine increased slightly in 2006 from 5,600 t in 2005. Reported consumption decreased to 4,570 t in 2006 from 4,680 t in 2005. Domestic and imported iodine was used to produce a multitude of intermediate iodine compounds, usually by downstream manufacturers, making it difficult to gather accurate end-use statistics. However, 15 of the 22 companies to which a survey form was sent responded, representing 82% of the total consumption by major domestic users of iodine (table 2).

The consumption pattern for iodine did not change as significantly as it appears in table 2. One major consumer of iodine provided consumption by end use in 2006 but gave consumption only as crude iodine in 2005. Had a breakout been provided in 2005, less tonnage would have been reported as crude iodine and more would have been reported as sodium iodine, hydroiodic acid, and other inorganic compounds in table 2. Consequently, the only sizable changes were for potassium iodide and hydroiodic acid, the use of which decreased from 2005 to 2006. The change for potassium iodide (KI) and hydroiodic acid production was attributed to three companies that altered their product mix between 2005 and 2006.

Iodine and its derivatives were used principally in animal feed, catalysts, colorants, inks, pharmaceutical and medical applications, photographic equipment, sanitation or disinfectants, and rosin stabilizers.

Commercial crude iodine normally has a minimum purity of 99.5% to 99.8%, depending on the supplier. Impurities, in order

of quantity, are chiefly insoluble materials, iron, sulfuric acid, and water. The U.S. Pharmacopeia specifies an iodine content of not less than 99.8%. The Committee on Analytical Reagents of the American Chemical Society allows a maximum of 0.005% total bromine and chlorine and 0.010% nonvolatile matter.

Prices

Actual prices for iodine are negotiated on long- and short-term contracts between buyers and sellers. The average free alongside ship (f.a.s.) value for exported crude iodine was \$17.03 per kilogram, an increase from \$10.49 per kilogram in 2005. The average declared cost, insurance, and freight (c.i.f.) value for imported crude iodine was \$19.34 per kilogram, an increase from \$16.75 per kilogram in 2005. The average declared c.i.f. value for iodine imported from Chile was \$20.00 per kilogram in 2006 compared with \$16.97 per kilogram in 2005. The average declared c.i.f. value for imported crude iodine from Japan was \$17.30 per kilogram in 2006, an increase from \$15.11 per kilogram in 2005. The average sale price of iodine sold by the DNSC was \$21.29 per kilogram (\$9.66 per pound) in 2006 compared with \$18.36 per kilogram (\$8.33 per pound) in 2005 (Defense National Stockpile Center, 2006b).

In general, prices for iodine have increased during the past year owing to high demand and high capacity utilization (Mineral Price Watch, 2006).

Foreign Trade

Exports of crude iodine decreased to 2,020 t with an f.a.s. value of \$34.4 million in 2006 compared with 2,660 t valued at \$27.9 million in 2005 (table 4). Exports of KI increased to 82 t with an f.a.s. value of \$1.95 million in 2006 compared with 68 t valued at \$1.55 million in 2005. Imports of crude iodine decreased to 5,640 t with a c.i.f. value of \$109 million in 2006 compared with 6,250 t valued at \$104 million in 2005 (table 3). Imports of KI increased to 471 t with a c.i.f. value of \$12.0 million in 2006 compared with 458 t valued at \$9.88 million in 2005. Iodine also was exported and imported in many other forms other than elemental iodine and KI, so net trade is not clearly delineated.

World Review

World production of iodine in 2006 was estimated to be 25,000 t, excluding the United States, compared with 26,500 t in 2005 (table 5). Chile was the leading producer of iodine with 62% of world production, followed by Japan with 32%. Iodine also was produced in the United States and six other countries.

Chile.—Atacama Minerals Corp. submitted its environmental report to CONAMA, the environmental authority of Chile, for a proposed expansion of its Aguas Blancas Mine, near Antofagasta. The company announced that it would change from heap leach processing to continuous-agitated leach processing by mid-2007. This change will allow the company to increase iodine production to 1,500 t/yr from 840 t/yr. A pilot plant was commissioned in April. Atacama also added a third blowout

tower and sulfur plant to handle the added capacity of the new leach plant (Atacama Minerals Corp., 2006a, b).

Sociedad Química y Minera de Chile S.A. (SQM) purchased the iodine and iodine derivatives assets of Royal DSM N.V. The transaction included DSM's iodine operations in Chile and iodine processing facilities in Europe. The Chilean operations have a production capacity of 2,200 t/yr of iodine (Sociedad Química y Minera de Chile S.A., 2006).

Iran.—The Ministry of Industries and Mines reported that drilling in Iran located iodine reserves in the northern province of Golestan. Iodine concentrations were about 75 milligrams per liter of water from three wells. Additional wells were to be drilled. The size of the reserves were not indicated (Mehrnews.com, 2006).

Outlook

Most of the iodine producers were operating close to nominal capacity although new capacity is expected to come online in 2007. Prices were expected to increase slightly because of increased demand worldwide.

Biocides and Disinfectants.—Iodine is used in biocides and disinfecting chemicals. The water treatment market is expected to increase with more growth anticipated in Asian areas such as China, India, and Pakistan. Expanding treatment of municipal water supplies will probably increase the demand for biocides and disinfectants in the future.

Nutrition.—Iodine is used in animal feed to prevent goiter and regulate metabolism. People commonly receive iodine from KI added to salt. Demand for KI as a preventative of cancer of the thyroid in the event of a nuclear accident continued to influence sales of pills to government and private individuals. More countries are providing these pills to individuals, and the demand for this compound continued to increase.

Other Uses.—Developments in digital imaging have produced electronic prints and overhead transparencies without the need for wet processing film. Despite this, 75% to 85% of all televised programs seen during prime time are recorded on 35-millimeter motion picture film and then transferred to videotape or laser disc for display. Furthermore, the majority of feature films for movie theater presentations are shot and printed on film because film provides higher image resolution. In the next decade, uses of iodine in films and processing may be limited to specialty film imaging as digital imagery technology for motion pictures improves and digital equipment and printers become more affordable.

Use of x-ray contrast media, which contain as much as 60% iodine, is expected to continue to grow between 4% and 5% per year. More medical tests on an aging population will result in increased demand for iodine-containing x-ray contrast media.

Consumption of iodine for iodine-adsorbed polyvinyl alcohol polarizing films for liquid crystal displays (LCD) is expected to increase with the expanding use of LCDs in electronic equipment.

New uses of fluoroiodocarbon as halogen replacements may increase demand for iodine in fire suppression chemicals. More tests need to be completed on the iodated fluorocarbons before they are acceptable, but preliminary tests were promising.

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GENERAL SOURCES OF INFORMATION

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Other

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TABLE 1
SALIENT IODINE STATISTICS¹

(Metric tons and dollars unless otherwise specified)

	2002	2003	2004	2005	2006
United States:					
Production	1,420	1,090	1,130	1,570	W
Imports:					
Quantity, for consumption ²	6,190	5,750	5,700	6,250	5,640
Price, average ³ dollars per kilogram	12.70	11.81	13.38	16.75	19.34
Exports ²	1,580	1,590	1,270	2,660	2,020
Consumption:					
Reported ⁴	4,540	3,930	4,070	4,680	4,570
Apparent ⁵	6,520	5,240	5,560	5,600	W
World, production^c	21,000	24,600 ^r	24,800	26,500 ^r	25,000

^cEstimated. ^rRevised. W Withheld to avoid disclosing company proprietary data.

¹Data are rounded to no more than three significant digits, except prices.

²Source: U.S. Census Bureau information reported by Harmonized Tariff Schedule of the United States code 2801.20.0000.

³Cost, insurance, and freight valuation.

⁴Reported by voluntary response to the U.S. Geological Survey from a survey of domestic establishments.

⁵Calculated using domestic production plus imports minus exports plus adjustments for Government and domestic industry stock changes.

TABLE 2
DOMESTIC CONSUMPTION OF IODINE, BY PRODUCT¹

Product	2005		2006	
	Number of plants	Quantity (metric tons)	Number of plants	Quantity (metric tons)
Inorganic compounds:				
Crude iodine	8	833	7	615
Resublimed iodine	7	116	7	51
Potassium iodide	4	578	4	398
Sodium iodide	5	375	6	463
Hydriodic acid	2	131	3	93
Potassium iodate	3	33	3	34
Miscellaneous iodate, and iodides ²	1 ^r	25	1	39
Other inorganic compounds	3	312	5	507
Total	XX ³	2,400 ^r	XX ³	2,200
Organic compounds:				
Ethylenediamine dihydroiodide	2	197	2	189
Povidine-iodine (iodophors)	2	397	2	439
Other organic compounds ⁴	5	1,680	4	1,740
Total	XX ³	2,280	XX ³	2,370
Grand total reported consumption ⁵	XX	4,680	XX	4,570
Apparent consumption ⁶	XX	5,600	XX	W

^rRevised. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

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

²Includes calcium iodate and cuprous iodide.

³Nonadditive because some plants produce more than one product concurrently.

⁴Includes methyl and/or ethyl iodide.

⁵Reported by voluntary response to the U.S. Geological Survey in a survey of domestic establishments.

⁶Calculated using domestic production plus imports minus exports plus adjustments for Government and domestic industry stock changes.

TABLE 3
U.S. IMPORTS OF CRUDE IODINE AND POTASSIUM IODIDE FOR
CONSUMPTION, BY COUNTRY OF ORIGIN¹

Type and country of origin ²	2005		2006	
	Quantity (metric tons)	Value ³ (thousands)	Quantity (metric tons)	Value ³ (thousands)
Iodine, crude:				
Belgium	18	\$302 ^r	--	--
Chile	4,850	82,300 ^r	4,330	\$86,600
France	30	470 ^r	36	601
India	(4)	13	12	37
Japan	1,350	20,400 ^r	1,260	21,800
Russia	7	101	--	--
Other	(4) ^r	2 ^r	(4)	6
Total	6,250	104,000 ^r	5,640	109,000
Potassium iodide:⁵				
Brazil	74	1,560 ^r	52	1,350
Canada	233	5,130 ^r	337	8,460
Chile	136	2,950 ^r	76	2,020
Other	14 ^r	236 ^r	5	137
Total	458	9,880 ^r	471	12,000

^rRevised. -- Zero.

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

²Import information for crude iodine and potassium iodide are reported by Harmonized Tariff Schedule of the United States codes 2801.20.0000 and 2827.60.2000, respectively.

³Declared cost, insurance, and freight valuation.

⁴Less than ½ unit.

⁵Gross potassium iodide contains 76% crude iodine.

Source: U.S. Census Bureau.

TABLE 4
U.S. EXPORTS OF CRUDE IODINE AND POTASSIUM IODIDE, BY COUNTRY OF ORIGIN¹

Type and country of origin ²	2005		2006	
	Quantity (metric tons)	Value ³ (thousands)	Quantity (metric tons)	Value ³ (thousands)
Iodine, crude/resublimed:				
Argentina	80	\$231	1	\$3
Australia	20	61	18	66
Belgium	495	1,450	114	2,030
Canada	385	7,430	596	12,900
Chile	192	2,770	144	2,610
Germany	600	8,840	677	10,900
Japan	121	1,930	38	627
India	371	2,970	180	2,370
Mexico	122	547	144	846
Venezuela	29	218	12	178
Other	241 ^r	1,440 ^r	97	1,890
Total	2,660	27,900	2,020	34,400
Potassium iodide: ⁴				
France	4	134	36	888
Germany	9	41	2	62
Korea, Republic of	5	113	7	128
Mexico	6	177	9	254
Netherlands	1	38	1	23
Taiwan	24	3	16	290
Turkey	2	493	4	83
Other	15 ^r	550	8	217
Total	68 ^r	1,550	82	1,950

^rRevised.

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

²Export information for iodine, crude/resublimed and potassium iodide are reported by Harmonized Tariff Schedule of the United States codes 2801.20.0000 and 2827.60.2000, respectively.

³Declared free alongside ship valuation.

⁴Potassium iodide contains 76% crude iodine.

Source: U.S. Census Bureau.

TABLE 5
CRUDE IODINE: ESTIMATED WORLD PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

Country	2002	2003	2004	2005	2006
Azerbaijan	300	300	300	300	300
Chile ³	11,648 ⁴	15,580 ^{r,4}	14,931 ⁴	15,364 ^{r,4}	15,500
China	500	500	550	550	560
Indonesia	75	75	75	75	75
Japan	6,548 ⁴	6,524 ⁴	7,264 ⁴	8,095 ^{r,4}	8,000
Russia	300	300	300	300	300
Turkmenistan	200	200	200	270	270
United States ⁴	1,420	1,090	1,130	1,570	W
Uzbekistan	2	2	2	2	2
Total	21,000	24,600 ^r	24,800	26,500 ^r	25,000

^rRevised. W Withheld to avoid disclosing company proprietary information.

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

²Table includes data available through June 10, 2007.

³Includes iodine production reported by Servicio Nacional de Geología y Minería.

⁴Reported figure.