IODINE

By Phyllis A. Lyday

Three producers of crude iodine supplied about 32% of domestic demand; the remainder was imported. Because some exports and imports are in product categories rather than crude products, net imports are not clearly distinguished. The major world producer, Japan, produced iodine from brines associated with gas production. The second largest producer, Chile, produced iodine as a coproduct of sodium nitrate.

Legislation and Government Programs

The Strategic and Critical Materials Stock Piling Act, as amended, gives the U.S. Department of Defense authority to maintain a stockpile of strategic and critical materials to supply the military, industry, and essential civilian needs of the United States for national defense. By 1968, 3.7 million kilograms (kg) (8.1 million pounds) had been acquired. In 1992, Public Law 102-484 reduced the stockpile goal to zero, and Congress authorized the sale of excess material. Proposed sales of iodine for fiscal year 1996 were 204,117 kg (450,000 pounds). No stockpile iodine was sold or bartered during 1996 and the excess iodine remained at 2,362,235 kg (5,207,831 pounds).

The U.S. Environmental Protection Agency (EPA) was seeking revision of more than a dozen types of polymers and resins, according to a notice published in the November 25, 1996, Federal Register. (Iodine is used as a stabilizer in tall oil resins (TOR).) The new proposal would affect control requirements for storage vessels, continuous process vents, equipment leaks, heat exchange systems, and wastewater that were included in two final rules promulgated by EPA in September. One rule regulates emissions of hazardous air pollutants from the manufacture of nine types of polymers and resins used in elastomers. A second regulation covers the manufacture of seven categories of polymers and resins used in thermoplastics (Chemical Marketing Reporter, 1996d).

Production

Domestic production data for iodine are derived from a voluntary survey of U.S. operations by the U.S. Geological Survey (USGS). Of the three operations to which a survey request was sent, all responded, representing an estimated 100% of the total production. (*See tables 1 and 6.*)

In 1987, IOCHEM Corp. began producing iodine by the blowing-out process at a plant 1.2 kilometers (km) east of Vici, Dewey County, OK,. IOCHEM is a privately held joint venture between Tomen America Inc. and a private family. The majority of production was shipped to Schering AG, Germany, under a long-term contract. IOCHEM reported to have nine production wells and four injection wells with a total production capacity of 1,400 tons per year at Vici.

North American Brine Chemicals began operating a miniplant at Dover in Kingfisher County, OK, in 1983. Two plants are at an oilfield injection disposal site that obtains brines from about 50 wells in the Oswego Formation. Iodine concentrations were as much as 1,200 parts per million (ppm). In 1993 the company closed a plant that began operating in 1991 because of the low market prices for iodine.

Woodward Iodine Corp., which began production in 1977 was purchased by Asahi Glass Co. of Japan in 1984. Woodward operated the plant in Woodward County, OK that produced iodine from 22 brine production wells using the blowing-out process and injected waste through 10 injection wells.

Consumption

Estimated end uses by percentage for iodine in 1996 were estimated from a USGS canvass of consumers as follows: Sanitation (39%); pharmaceutical (24%); heat stabilizers (13%); catalyst (9%); animal feed (7%); and other (8%). Other smaller uses included inks and colorants, photographic chemicals, laboratory reagents, production of batteries, high-purity metals, motor fuels, and lubricants. (*See table 2.*)

Iodine deficiency is the world's leading cause of mental defects in the form of severe retardation, deafness, mutism, and partial paralysis, as well as more subtle problems, such as clumsiness, lethargy, and reduced learning capacity. Iodine is an essential part of a thyroid hormone that contributes to fetal brain development and metabolism after birth. A worldwide effort is underway to eliminate iodine-deficiency disorders by fortifying the world's salt supply.

TOR is used as a "paper size," and in ink resins and tackifying resins for adhesives. The main competition for TOR was hydrocarbon resins made from byproducts of ethylene production. Three U.S. companies use iodine to stabilize TOR. Arizona Chemical, the speciality products division of International Paper, developed a new resin that helps adhesives and sealant manufacturers achieve better processing and reduce the amount of tackifiers found in their formulations (Chemical Marketing Reporter, 1996c).

Berlex Laboratories, Wayne, NJ, with more than $500 million in 1995 sales, is a leader in magnetic resonance imaging (MRI) contrast media. Berlex is a good indicator of the value of newer generation contrast media products that use iodine (Chemical Manufacturing Reporter, 1996a).

Hoechst Aktiengesellschaft, Germany, announced that the

name "Celanese" is to become the official name of Hoechst's global basic chemicals subsidiary, headquartered in Dallas, TX. Celanese is a consumer of iodine as a heat stabilizer (Layman, 1997).

Ecolab is the leading global developer and marketer of cleaning, sanitizing, and maintenance products and services for the hospital, institutional, and industrial markets (Iodine is a major product in these products.) (The PointCast Network, unpub. Data accessed February 26, 1997, on the World Wide Web at URL http://pointcast.com.)

Mallinckrodt Medical Imaging Division of Mallinckrodt Inc., St. Louis, MO, produces substances to enhance X-ray imaging by using iodated contrast media. The company supplies several X-ray contrast agents, including Conray, Hexabrix, and Optiray. Imaging media still consist largely of X-ray products, and the contrast media are based chiefly on iodide and, to a lesser extent, barium (Chemical Manufacturing Reporter, 1996b). These products make Mallinckrodt a leader in X-ray contrast media. Optiray, an ioversol, is the only new generation X-ray contrast media discovered, developed, and marketed in the United States; ioversol is non-ionic and has an organically bound iodine content of 47.2%. The Mallinckrodt Nuclear Medicine Division has facilities to produce and ship radioactive ingredients in the United States and the Netherlands. Sodium Iodide^{131} Diagnostic Capsules and Sodium Iodide^{131} are two of the more than two dozen nuclear products in which Mallinckrodt is a world leader. Mallinckrodt Catalysts & Chemical Additives produces potassium iodide to help produce new plastics that have specific attributes, such as strength or flexibility (Mallinckrodt Inc., 1997).

Nycomed, the North American unit of Nycomed Corp., an imaging and pharmaceutical company, Oslo, Norway, produces an iohexol, Omnipaque, which is a nonionic water-soluble radiographic contrast medium with an iodine content of 46.36%. Nycomed also markets a gadodiamide, Omniscan, which is a nonionic contrast agent for use in MRI of the central nervous system. Introduced in 1993, Nycomed says Omniscan is the second most often used MRI product in the U.S. market. In 1996, the Food and Drug Administration approved three new indications for Omniscan-body, high-dose central nervous system, and pediatric (Chemical Manufacturing Reporter, 1996b).

Homeowners of private wells must disinfect their own water supply to make it bacteriologically safe to drink. A new method of disinfection involves adding iodine to water. Iodine is proven effective in a relatively short contact time. A common method of feeding iodine is the diffusion feed technique in which a portion of the water is diverted though a vessel containing iodine crystals. Water diverted through this small bypass dissolves a portion of the iodine and returns to the main flow, adding a dilute but calculated amount of iodine. High concentrations of iodine are, however, necessary to be effective, organic matter inhibits its efficiency. Iodine can also produce a taste found objectional by many and is expensive (Water Quality Association, 1996).

Prices

Crude iodine prices quoted in trade journals increased in 1996. The average declared c.i.f. value for imported crude iodine was $12.90 per kg. The average declared c.i.f. value for imported crude iodine from Japan was $12.18 per kg. The average declared c.i.f. value for iodine imported from Chile was $13.63 per kg. The average producer price was $11.47 per kg. Quoted yearend U.S. prices for iodine and its primary compounds are shown in table 3.

Foreign Trade

The General Agreement on Tariffs and Trade (GATT) was signed into law in December 1994 and took effect January 1, 1995. GATT lowers chemical tariffs by an average of 30%. Chemicals, including bromine, are the Nation's largest export commodity, as more than 10 cents out of every export dollar is a product of the chemical industry. The agreement's intellectual property provisions include greater patent protection for products developed by American firms. GATT changes patent enforcement from 17 years from the date of issue to 20 years from the date of application. Patents issued on applications filed before June 8, 1995, will be enforceable for either 17 years from the issue date or 20 years from the filing date, whichever is longer.

The U.S. Government adopted the Harmonized Commodity Description and Coding System (Harmonized System) as the basis for its export and import tariff and statistical classification systems. The system is intended for multinational use as a basis for classifying commodities in international trade for tariff, statistical, and transportation purposes. The Harmonized System, as proposed, includes resublimed and crude iodine under the same code, and a free duty rate. Values that differ significantly could be a result of items being placed in the wrong category. (*See tables 4 and 5.*)

The ministers of the World Trade Organization met in December and approved the permanent establishment of the Committee on Trade and the Environment (CTE). The U.S. chemical industry will be an active participant because there are several major environmental issues affecting trade that it would like to see resolved. The Chemical Manufacturers Association (CMA), as a major representative of the U.S. chemical industry, finds eco-labeling to be one area on which it and its European counterparts cannot agree. Ecolabels list specific environmental standards on packaging, recycling, and even production processes before the product can be imported into Europe. In a policy paper, CMA stated, "The proliferation of different types of environmental labeling systems…contributes to the creation of nontariff barriers." Problems arise when countries try to unilaterally use trade measures to achieve environmental goals. The issue of flexibility in achieving international environmental objectives will continue at future CTE meetings (Hanson, 1997).

World Review

Chile.—Chile was the second leading producer of iodine, and new projects continued to be announced to increase production. Boron Chemical International Ltd., Vancouver, Canada, announced the commercial development of the Aguas Blancas project in northern Chile for the production of iodine, sodium sulfate, and potassium nitrate. The caliche ore body is 95 km southeast of Antofagasta. By using a cut-off of 200 parts per million (ppm) iodine, the proven and probable reserves are 29.5 million metric tons; most of the caliche averages 683 ppm iodine. Overburden is less than 1 meter. Processing of the ore involves crushing, leaching with fresh water, thickening, filtration, and iodine precipitation. Construction began during the first quarter of 1996. By 1998, the planned design would produce 1,000 tons of iodine, 150,000 tons of sodium sulfate, and 70,000 tons of potassium nitrate per year (Industrial Minerals, 1996).

Compania de Salitre Y Yodo de Chile (Cosayach) part of Inverraz S.A., mines iodine and nitrates from caliche reserves in the first and second region of Chile. Reserves consist of more than 90,000 hectares, which correlate to 300,000 tons of iodine and 50 million tons of sodium nitrate. The Cala-Cala plant, begun in 1991, has a capacity of 648-tons-per-year. The Negreiros plant, begun in 1995, has a capacity of 1080-tons-per-year. The Soledad plant, to begin in 1997, will have a capacity of 1080-tons-per-year. Total capacity in 1996 was 2808-tons-per-year. The processing uses bulldozers and truck to a leaching area where ore is deposited 4 to 4.5 meters high on a base of poly vinyl chloride waterproof liner. A sprinkling system provides water to dissolve the salts found in the ore. The solutions are captured and sent to the iodine plant for recovery where iodide is reduced with sulfur dioxide to iodide. The precipitated is refined and then washed to produce 99.7% pure iodine. The solution is concentrated by a two stage crystallizer and solar evaporation to achieve a nitrate rich solution, which produces sodium or potassium nitrate. The design capacity is 200,000-tons-per-year of nitrates. Nitrate production was expected to reach more than 400,000 tons by the end of 1999 (Sarah Hall, Tamaya Chemical Corp., written commun. 1997).

KAP Resources Ltd., Vancouver, Canada, announced that its Chilean subsidiary, Cia Minera Yolanda SA, was to begin production at the $80 million facility that is expected to be completed in 1997. Gulf Fertilizers and Chemicals has signed a 3 year contract to market the iodine (Green Markets, 1997).

Sociedad Quimica y Minera de Chile (SQM; formerly known as SOQUIMICH) produced 99.5% iodine as a byproduct of nitrate production. SQM Iodine S.A. continued production at its satellite plants, which produced about 1,000-tons-per-year of crude iodine. One satellite plant, owned by Cimin, a subsidiary of SQM Iodo (a subsidiary of SQM) is located about 100 km from the main mines. In August Cimin's Pinto plant came on line at 1,000-tons-per-year. This plant complements a 500-tons-per-year unit that opened in the first quarter. Cimin brought online 1,500 metric tons of added capacity during 1996. All the iodine production was in Chile's Region II. New construction for 1997 will be in Region I, the furthest north of Chile's 13 regions. SQM planned a 1,500-ton-per-year plant to be on stream by June 1997. The new plant is in the same area as Minera Mapocho, a medium-sized producer acquired by SQM in 1996, that added 400 tons of iodine capacity. Overall, SQM has planned to invest $30 million in iodine expansion that will take its total production capacity to more than 8,000 tons in 1997 (Chemical Marketing Reporter, 1996b, 1997b).

Chile is the second largest producer of crude iodine in the world and the U.S. depends on imports for more than half of supply, good trade relations with Chile is of national concern. Chile was invited to join the North American trade bloc, which links the United States, Canada, and Mexico, at the first Summit of the Americas in December 1994. Chile has, however, declined to go forward until the U.S. Congress passes fast-track authority. With fast track, lawmakers would vote either for or against any trade agreement with no opportunity for amendments. Trade between the United States and Chile passed the $6 billion mark during 1996. The United States imports Chilean salmon, wine, and fresh fruit, and U.S. companies are investing, for the most part in mining (PointCast Network, 1997b).

Europe.—The International Council for Control of Iodine Disorders was founded in 1986 to eliminate iodine deficiency disorder (IDD) in all countries by 2000. There are more than 400 members in some 70 countries and regions. The Council was admitted into official relations with the World Health Organization in 1994 (http://tron.is.s.u.tokyo.ac.jp/who/programmes/ina/ngo/ngo-48.htm).

Arizona Chemical will double its European capacity of high-viscosity hard resins for offset ink. Resins from Arizona's European tall oil refineries will be supplemented with gum rosin purchases sufficient to sustain the new capacity. The expansion is the second in Europe since acquiring DSM Andeno B.V.'s ink resins business in late 1995. Arizona Chemical produces ink resins in Niort, France, Sandarne, Sweden, and Valkeakoski, Finland (Chemical Marketing Reporter, 1997a).

Japan.—Japan was the world's leading producer of iodine. Six companies operated 17 plants with a total production capacity of 9 million kg per year. Production of iodine was from underground brines associated with natural gas. Two plants that closed in midyear 1994 reopened with total output reported to be 1,000 tons per year (Chemical Marketing Reporter, 1997b). On April 1, 1996, the Japanese Government repealed Japan's Provisional Measures Law on the "Importation of Specific Kinds of Petroleum Refined Products" (Oil & Gas Journal, 1996). As a result, Japan's oil companies must restructure operations to develop new strategies to compete in a more open market. The effects on the production of natural gas shall not be known until energy becomes deregulated and more abundant at less cost.

Turkmenistan.—The Nebitdag plant is located in Vyshka, 26 km south west of the Nebitdag City in Balkan velayat. The source of bromine and iodine is underground brines of the Nebitdag-Monjoukley deposit. The plant reported production capacities of 255 tons per year of iodine and 3,200 tons of

ferrous bromide per year as well as 1,300 tons of bromine derivatives and 100 tons of sodium hypochlorite per year. It was commissioned in 1969 and has 33 employees.

The Cheleken plant is located 10 km north in Cheleken City in Balkan velayat. The source of iodine and bromine is underground brines of the Cheleken deposit. The plant's reported production capacities are 335 tons of iodine and 6,400 tons of ferrous bromide per year. In addition, the plant produces 60 tons of potassium iodide, 45 tons of potassium iodate, 60 tons of other derivatives, and 100 tons per year of sodium hypochlorite per year. The plant was commissioned in 1932 and has 548 employees (Saparmurat Noureyer, 1996). (See table 6.)

Current Research and Technology

In 1995, when Chemical & Engineering News magazine investigated chemical companies on the World Wide Web (WWW), only a few had web sites. These sites had a small amount of public relations information, such as what the company produces, corporate headquarters locations, press releases, and electronic mail connections. Now some companies are planning automated shipment tracking, computerized problem solving, and two-way customer service offerings. Many companies put their WWW pages up quickly and plan to redesign them in the future. Trade associations are using the WWW to communicate with members through newsletters and mentor networks. Other associations list trade shows and position papers with links to related documents, such as the Federal Register. Some companies, however, have completely disconnected their computer system from the WWW to maintain the security of their company data (Kirschner, 1996).

Methyl iodide was tested by the University of California at Riverside and found to be an effective fumigant for controlling four species of fungi, one species of nematode, and seven species of weeds. Based on the results of 15 laboratory and field trials, methyl iodide was found to be more effective than methyl bromide as a fumigant (Orr, Sims, and Grech, 1996). Methyl iodide has an ozone depletion potential of less than 0.016 and appears to be a replacement for methyl bromide in most uses. Methyl iodide is about five times more expensive, however, but could utilize the same equipment as methyl bromide (European Chemical News, 1996).

Electrophilic nitroarenes can be converted to nitroanilines with an iodine derivative. This chemistry may be a way to demilitarize dimethylhydrazine rocket fuel (Chemical & Engineering News, 1996).

Lobster harvesters have been removing the eggs of lobsters by exposing the crustaceans to chlorine. To subvert this subterfuge, lobster inspectors put the small appendages of the lobster in potassium iodide solution. In the presence of chlorine, the solution turns yellow. The test was developed by the Woods Hole (Massachusetts) Marine Biological Laboratory and the State Lobster Hatchery and Research Station, Vineyard Haven, MA (Chemical & Engineering News, 1997a).

In 1979, humans were exposed to radioactive iodine at the Three Mile Island (TMI), PA, nuclear powerplant. A new study by Steven Wing, associate professor of epidemiology at the University of North Carolina, Chapel Hill, and colleagues conclude that cancer and leukemia rates in residents downwind of the reactor range from 2 to 10 times higher than those in residents living upwind. Radioactive gas was released from TMI after a partial meltdown of the plant's radioactive core (Chemical & Engineering News, 1997b).

Outlook

During the past decade, iodine production capacity in the United States and Chile has doubled, thus ensuring an adequate world supply. Future overall growth in traditional uses is projected to grow by as much as 2% per year (Chemical Product Synopsis, 1996). Uses for iodine in specialty chemicals have remained stable. Recent developments in digital images using computers can produce electronic prints and overhead transparencies without the need for wet processing. By using a digital camera or scanning the film and converting to digital, the images are produced and stored on hard drives, disks, tape, or optical storage.

Digital imaging is used for recording most sporting events, game shows, and some situation comedies for television broadcast. From 75% to 85% of all televised programs seen during prime time are recorded on 35-mm motion picture film and then transferred to video tape or laser disc for display. Furthermore, the majority of feature films for movie theater presentations are shot and printed on film because the main reason for this is better image quality. A frame of 35-mm color negative film contains about 6.6 million pixels, or about 15 times that of the best current high-definition television system and 4 times that of the digital systems now in development. Most popular home video rentals have been box office movie hits which were filmed and then transferred to video. Future use of iodine in films and processing could be limited to specialty imaging in the next decade as digital imagery technology improves and cost of acquisition of equipment become more affordable.

New uses of fluoroiodocarbon as halogen replacements may cause an increased demand for iodine. More tests need to be completed on the iodated fluorocarbons before they are acceptable, but preliminary tests are promising. Supplemental programs designed to alleviate IDD in China and India are consuming large amount of iodine. X-ray contrast media, containing up to 60% iodine, continues to have between 4% and 5% annual growth. In Mexico and Chile, the use of individual water purification units that use iodine are a new application. Purification applications could become significant consumers of iodine (Chemical Marketing Reporter, 1997b).

Automotive International reports that the director of engineering material at Du Pont Automotive foresees a 72% increase in the use of nylon during the next eight years; iodine is used as a stabilizer in nylon. This would result in about 7 kg of nylon in the average car in the United States by 2005. Air

intake manifolds provide the greatest growth area, although nylon is also making inroads into other components, such as cylinder-head covers (FT Information Online Ltd., 1997).

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[1]Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT IODINE STATISTICS 1/

(Thousand kilograms unless otherwise specified)

	1992	1993	1994	1995	1996
United States:					
Production	2,000	1,940	1,630	1,220	1,270
Imports for domestic consumption 2/ 3/	3,750	3,620	4,360	3,950	4,810
Exports 2/ 3/	1,810	1,220	1,200	1,220	2,380
Consumption:					
Reported 4/	3,400	3,550	3,690	3,680	3,910
Apparent 5/	3,930	4,330	4,780	3,540	3,700
Price, imports, average c.i.f. value 6/, dollars per kilogram	$9.03	$7.98	$8.02	$10.32	$12.82
World: Production	16,500	15,700	14,200 r/	12,900 r/	13,100 e/

e/ Estimated. r/ Revised.

1/ Except for prices, data are rounded to three significant digits; may not add to totals shown.

2/ Bureau of the Census.

3/ Only the crude iodine "content" of the potassium iodide as declared by tables 4 and 5 is incorporated in data or calculations for this table.

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

5/ Defined as "Imports minus exports plus adjustments for Government and domestic industry stock changes."

6/ Bureau of the Census. "Cost, insurance, and freight" (c.i.f.).

TABLE 2
DOMESTIC CONSUMPTION OF CRUDE IODINE, BY PRODUCT 1/

(Thousand kilograms)

	1995		1996	
Product	Number of plants	Quantity	Number of plants	Quantity
Inorganic compounds:				
Resublimed iodine	8	198	6	336
Potassium iodide	8	955	7	893
Sodium iodide	4	87	6	380
Ammonium iodide	2	W	1	W
Calcium iodate	1	W	2	W
Cuprous iodide	3	29	3	21
Hydriodic acid	3	27	3	255
Potassium iodate	3	73	5	82
Other inorganic compounds	10	613	8	412
Total	XX 2/	1,830	XX 2/	2,500
Organic compounds:				
Ethylenediamine dihydroiodide	3	608	5	480
Methyl and/or ethyl iodide	1	W	3	20
Povidone-Iodine (Idophors)	3	829	2	W
Other organic compounds	3	410	5	905
Total	XX 2/	1,850	XX 2/	1,410
Grand total:				
Reported consumption 3/	XX 2/	3,680	XX 2/	3,910
Apparent consumption 4/	XX	3,540	XX	3,700

XX Not applicable. W Withheld to avoid disclosing company proprietary data; included with "Other inorganic/organic compounds", respectively.

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

2/ Nonadditive because some plants produce more than one product concurrently.

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

4/ Calculated by using domestic consumption plus imports minus exports.

TABLE 3
YEAREND 1996 PRICES OF ELEMENTAL IODINE AND SELECTED COMPOUNDS

Elemental iodine/ compounds	Value (dollars) Per kilogram 1/	Per pound 1/
Calcium iodate, FCC drums, f.o.b. works	16.42	7.45
Calcium iodide, 50-kilogram drums, f.o.b. works	30.00	13.61
Iodine, crude, drums	15.00-16.00	6.81-7.26
Iodine, U.S.P., drums	15.01	6.80
Potassium iodide, U.S.P., drums, 5,000-pound lots, delivered	26.48	12.01
Sodium iodide, U.S.P., crystals, 5,000-pound lots, drums, freight-equalized	36.38	16.50

1/ Conditions of final preparation, transportation, quantities, and qualities not stated are subject to negotiations and/or somewhat different price quotations.

Source: Chemical Market Reporter. Current Prices of Chemicals and Related Materials; V. 250, No. 27, Dec. 30, 1996, p. 20-27.

TABLE 4
U.S. CRUDE IODINE AND POTASSIUM IODIDE IMPORTS FOR DOMESTIC CONSUMPTION, BY COUNTRY OF ORIGIN 1/

(Thousand kilograms and thousand dollars)

Material type and country of origin 2/	1995 Quantity	1995 Value 3/	1996 Quantity	1996 Value 3/
Iodine, crude:				
Canada	12	146	9	75
Chile	1,890	18,300	2,340	32,000
Germany	--	--	4	93
Japan	1,860	18,800	2,250	27,400
Russia	39	354	54	560
Total	3,800	37,500	4,660	60,100
Iodide, potassium: 4/				
Brazil	(5/)	3	--	--
Canada	105	927	182	1,920
Chile	24	400	11	175
India	20	276	5	64
Italy	2	10	--	--
Japan	--	--	1	9
Total	151	1,610	199	2,230
Grand total	3,950	39,100	4,860	62,300

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Import information for "Crude iodine" and "Potassium iodide" are reported by HTS numbers 2801.20.0000 and 2827.60.2000, respectively.
3/ Declared c.i.f. valuation.
4/ Gross potassium iodide contains 76% crude iodine.
5/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 5
U.S. EXPORTS OF CRUDE IODINE AND POTASSIUM IODIDE, BY COUNTRY OF DESTINATION 1/

(Thousand kilograms and thousand dollars)

Material type and country of origin 2/	1995 Quantity	1995 Value 3/	1996 Quantity	1996 Value 3/
Iodine, crude/resublimed:				
Brazil	24	190	--	--
Canada	49	816	50	948
Egypt	--	--	2	34
France	75	723	35	524
Germany	561	4,650	370	4,540
Ghana	2	38	--	--
India	17	199	10	143

See footnotes at end of table.

TABLE 5--Continued
U.S. EXPORTS OF CRUDE IODINE AND POTASSIUM IODIDE,
BY COUNTRY OF DESTINATION 1/

(Thousand kilograms and thousand dollars)

Material type and country of origin 2/	1995		1996	
	Quantity	Value 3/	Quantity	Value 3/
Iodine, crude/resublimed--Continued:				
Israel	12	43	4	45
Italy	6	100	36	469
Mexico	388	3,280	1,670	9,190
Netherlands	--	--	90	1,070
Turkey	--	--	16	22
United Kingdom	13	99	15	191
Other 4/	23	294	15	390
Total	1,170	10,400	2,320	17,600
Iodide, potassium: 5/				
Australia	(6/)	5	(6/)	2
Belgium	5	93	11	155
Canada	18	364	38	713
Mexico	4	48	7	82
Netherlands	--	--	10	138
Thailand	1	24	(6/)	10
Turkey	15	238	15	246
Other 7/	2	64	6	147
Total	45	836	88	1,490
Grand total	1,220	13,000	2,400	19,100

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

2/ Export information for "Iodine: Crude/resublimed" and "potassium iodide" are reported by HTS numbers "2801.20.0000" and "2827.60.2000," respectively.

3/ Declared "Free alongside ship" (f.a.s.) valuation.

4/ Includes Argentina and Belgium (1996); Colombia; Denmark (1996); El Salvador (1995); Honduras, Hong Kong and Indonesia (1996); Japan; the Republic of Korea (1995); Malaysia (1995); Panama; Philippines (1996); South Africa and Sweden (1995); Switzerland (1996); Venezuela.

5/ Gross potassium iodide contains 76% crude iodine.

6/ Less than 1/2 unit.

7/ Includes Argentina (1995); Brazil, Denmark, France, Guatemala, India, Indonesia, and Jamaica (1996); Malaysia; Peru (1996); Philippines, Switzerland (1996); Taiwan; Venezuela (1996).

Source: Bureau of the Census.

TABLE 6
CRUDE IODINE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand kilograms)

Country	1992	1993	1994	1995	1996 e/
Azerbaijan e/	600	500	400	350	300
Chile e/ 3/	5,839 4/	5,550	5,600	5,000	5,000
China e/	500	500	500	500	500
Indonesia	35 e/	14	89	77	75
Japan	6,764	6,489	5,592	5,492 r/	5,500
Russia e/	200	180	160	160	150
Turkmenistan e/	600	500	251	137 r/ 5/	255
United States	2,000	1,940	1,630	1,220	1,270 5/
Total	16,500	15,700	14,200	12,900 r/	13,100

e/ Estimated. r/ Revised.

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 10, 1997.

3/ Includes iodine production reported by Servicio Nacional de Geologia y Minería (SERNAGEOMIN) as follows in thousand kilograms: 1992--1,028; 1993--1,121; 1994--1,268; and 1995-96--not available.

4/ Includes iodine production reported by the nitrate industry (Industria Salitrera).

5/ Reported figure.