2007 Minerals Yearbook

SELENIUM AND TELLURIUM [ADVANCE RELEASE]

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Selenium and Tellurium

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In 2007, the prices for selenium and tellurium increased as consumption of the metals increased. One copper refinery in Texas reported domestic production of primary selenium and tellurium. Global and domestic production of selenium and tellurium were estimated to have increased in 2007.

Selenium and tellurium, rare elements widely distributed within the Earth's crust, do not occur in concentrations high enough to justify mining solely for their content. They were recovered as byproducts of nonferrous metal mining, mostly from the anode slimes associated with electrolytic refining of copper. Selenium and tellurium were also recovered as byproducts from gold, lead, nickel, platinum, and zinc mining.

A 2006 survey of 56 worldwide electrolytic copper refiners showed that 52 and 45 plants, respectively, reported selenium and tellurium in their slimes. The selenium-containing slimes averaged 7% selenium by weight, with a few containing as much as 25% selenium. Tellurium concentrations were generally lower and averaged 2% (Moats and others, 2007, p. 202-241).

Selenium and tellurium can also be recovered economically from industrial scrap and chemical process residues. Obsolete and damaged photoreceptor drums from plain paper copy machines were shipped by manufacturers to refineries for recovery of selenium and tellurium metal. The supply of old drums, however, has declined in recent years and now appears to be nearly exhausted.

Production

Asarco LLC's (Tucson, AZ) copper refinery in Amarillo, TX, was the only U.S. producer of refined selenium and tellurium. One copper refinery produced and exported semirefined selenium and tellurium (90% selenium) for toll-refining in Asia. Two other refineries generated selenium- and tellurium-containing slimes that were exported for processing. Most of the selenium and tellurium contained in domestic anodes and slimes came from copper ores in Arizona and Utah. One refinery processed anodes imports from Canada. Domestic production of selenium and tellurium increased in 2007 compared with that of 2006 owing to a relatively disruption-free year of production at Asarco. The company has operated under bankruptcy protection since August 2005. Grupo Mexico S.A.B. de C.V. (parent company of Asarco) lost control of the Asarco refinery to an independent board that was established during bankruptcy proceedings. Asarco expected to exit bankruptcy in 2008 through the sale of its assets (Jarman, 2008; McLaughlin, 2008).

Consumption

Selenium.—In 2007, world consumption of selenium was estimated to be higher than that in 2006 owing to increases in consumption from the Chinese manganese, chemical, and agriculture industries, and from the global solar cell industry.

The global glass manufacturing industry was the leading consumer of selenium in 2007; however, the levels of consumption remained relatively unchanged. Selenium was used to decolorize the green tint caused by iron impurities in glass containers and other soda-lime silica glass. It was also used as a colorant in art and other glass, such as that used in traffic lights, and in architectural plate glass to reduce solar heat transmission through the glass. Domestic consumption of selenium in glass was estimated to be much lower than it was in 2006 owing to lower domestic glass production.

In 2007, demand for selenium from Chinese manganese producers increased compared with that in 2006 owing to the increased production of steel for which manganese was used. In China, selenium dioxide (SeO_2) was substituted for sulfur dioxide to increase yields in the electrolytic production of manganese (Selenium-Tellurium Development Association, 2002). The Chinese manganese industry produces 45% of the global manganese metal supply (Corathers, 2008). By using SeO_2 instead of sulfur dioxide, plants reduce the power required to operate electrolytic cells. This method requires about 1 kilogram (kg) of selenium per metric ton of manganese metal produced (Metal-Pages Ltd., 2004).

Metallurgical-grade selenium was used as an additive to cast iron, copper, lead, and steel alloys to improve machinability and casting and forming properties. Selenium was used as an alloy with bismuth to substitute for lead in plumbing fixtures in response to requirements of the Safe Drinking Water Act Amendments of 1996 (Public Law 104-182) to reduce lead in potable water supplies. With increased attention on the dangers of lead exposure, more restrictive legislation has been introduced. The addition of a small amount, about 0.02% by weight, of selenium to low-antimony lead alloys used in the support grid of lead-acid batteries improves the casting and mechanical properties of the alloy.

Chemical and pigment uses of selenium include agricultural, industrial, and pharmaceutical applications. Selenium added to fertilizer used to grow crops used for animal feed and human consumption was the largest portion of this category. This practice is more common outside the United States, especially in countries with selenium-poor soils, such as Australia and China. Selenium's principal pharmaceutical use was in shampoo to control dandruff and dermatitis and as an antifungal agent. Cadmium sulfoselenide compounds were used as pigments in ceramics, glazes, paints, and plastics, but because of the relatively high cost and the toxicity of cadmium-based pigments, their use was generally restricted to applications where they are uniquely suited. Additionally, selenium was used in catalysts to enhance selective oxidation in plating solutions to improve appearance and durability, in blasting caps and gun bluing, in coating digital x-ray detectors, and in zinc selenide for infrared windows in carbon dioxide lasers.

Silicon-based cells were the dominant photovoltaic (PV) technology, accounting for 94% of the global total PV market. Although thin-film PV cells made up less than 6% of the PV market, production grew rapidly in 2007. There were three major types of thin-film PV cells—amorphous silicon and thin-silicon, cadmium telluride (CdTe), and copper indium gallium diselenide (CIGS). Amorphous silicon and thin-silicon account for 48% of the current thin-film PV cells with an annual production capacity of 246 megawatts (MW); CdTe accounts for 44% with annual production capacity 223 MW; and CIGS accounts for the remanding 8% with annual production capacity of 46 MW. Domestically, thin film PV cell production increased more rapidly than in the rest of the world, and in 2007, thin-film PV production was 44% of the domestic solar cell industry. Although they are more efficient, silicon-based solar cells were more costly to produce and can only be constructed in a sterile and vacuum-sealed room. Several companies announced plans to expand production of nonsilicon-based solar cells within the next several years. Some of the new production will come from selenium-containing CIGS solar cells. By 2010, it was estimated the CIGS production capacity will reach almost 1 gigawatt. Recent advancements in CIGS thin films have reduced production costs and improved performance as well as having reduced the environmental impact of production. In testing, CIGS solar cells have reached efficiencies of 19.9% and used 0.01% of the material contained in crystalline silicon-based solar cells (Advanced Materials & Processes, 2007; Metal-Pages Ltd., 2008a). It was not revealed how much selenium was needed for each MW produced.

Tellurium.—World demand for tellurium was estimated to have increased significantly in 2007. The leading use for tellurium was as a metallurgical alloying element. Tellurium was used in steel as a free-machining additive, in copper to improve machinability while not reducing conductivity, in lead to improve resistance to vibration and fatigue, in cast iron to help control the depth of chill, and in malleable iron as a carbide stabilizer. Owing to record-high prices, many steel and nonferrous metals producers have reduced consumption or found substitutes for tellurium.

Consumption in chemical, catalysts, and other uses, the next largest end-use category, declined owing to the increase in price. Tellurium was used as a vulcanizing agent and as an accelerator in the processing of rubber and in catalysts for synthetic fiber production. Other applications include the use of tellurium in blasting caps and as a pigment to produce blue and brown colors in ceramics and glass.

High-purity tellurium is used in electronics applications, such as thermal imaging, thermoelectric, phase change memory, and photoelectric devices. Consumption of tellurium in these applications was estimated to have increased more than the combined reductions in other end uses in 2007.

Mercury-cadmium-telluride is used in thermal imaging devices use to convert the raw image into a crisp picture on the screen, for infrared sensors and for heat seeking missiles.

Semiconducting bismuth telluride is used in thermoelectric cooling devices employed in electronics and consumer products. These devices consist of a series of couples of semiconducting materials which, when connected to a direct current, cause one side of the thermo element to cool while the other side heats. Thermoelectric coolers were most commonly used in electronics and military applications, such as the cooling of infrared detectors, integrated circuits, laser diodes, and medical instrumentation. Their application in consumer products, such as portable food-and-beverage coolers or automobile car seat cooling systems, continued to increase.

In 2007, CdTe thin film PV cell industry increased investments and capacity. First Solar Inc. (Phoenix, AZ) was the leader in CdTe production, with plants in Ohio and Germany and another plant opening in Malaysia in 2008. In 2007, with an annual capacity of 210 MW, First Solar accounted for 90% of global CdTe cell capacity. By 2010, it was projected that global CdTe cell production capacity will reach 608 MW (Ullal and von Roedern, 2007). Production of CdTe solar cells emitted 89% to 98% less greenhouse gasses than current power grid generation and had the lowest amount of harmful air emissions compared with other PV technologies (Fthenakis and others, 2008). Information on how much tellurium was needed for each MW produced has not been released.

Phase change memory (PCM) requires small amounts of germanium, antimony, and tellurium (GeSbTe). PCM is used in computers and other electronic devices and can be rewritten, will not erase once power is turned off, and has higher speed and lower power than other memory chips. Although the potential for this end use could be dramatic since almost all electronics could use this type of memory, the amount of very high grade tellurium needed would be small compared with other end use (Kanellos, 2008; Savage, 2008).

Prices

The Platts Metals Week's average New York dealer price for selenium was $32.90 per pound in 2007. The price, which began rising sharply in 2003 reached a record high in mid-2005, averaging more than $50 per pound for the year. In 2007, the average price began the year at $23 per pound and rose to $44 per pound in mid-May before dropping to $33 per pound at yearend. Price volatility was attributed to fluctuating demand from Chinese manganese producers.

The United Kingdom price for lump and powder, 99.95% tellurium, as published in the Mining Journal, started the year at $50 to $70 per kilogram. The price increased to $100 to $120 per kilogram at yearend, owing to an increase in consumption in solar cell and thermoelectronics.

Foreign Trade

Imports and exports of selenium and tellurium material vary greatly in content and quality and may include residues, waste, and scrap. Material flow analyses are difficult owing to lack of specificity of U.S. Census Bureau trade data and lack of reliable consumption, production, and stockpile information.

Export of selenium materials in 2007 increased by 194% compared with those of 2006. In descending order, Belgium, Germany, Hong Kong, Australia, China, Japan, the Republic of

Korea, and Mexico accounted for 74% of selenium exports in 2007 (table 2).

In 2007, imports of selenium (SeO_2, unwrought, waste and scrap) increased by 32% to 547 metric tons (t), compared with 2006 imports (table 3). In 2007, the United States became a net exporter (14 t) of selenium, after having been a net importer (222 t) in 2006. Belgium, Germany, Japan, Canada, and the Philippines, in decreasing order, accounted for 89% of the imports of selenium metal and SeO_2 into the United States in 2007.

Imports of unwrought tellurium and tellurium waste and scrap increased by 40% in 2007 compared with those of 2006. The leading suppliers, in descending order, China, the Philippines, Canada, and Belgium, accounted for more than 90% of the total imports of tellurium metal into the United States (table 5). In 2007, tellurium exports rose to 15 t, a 326% increase, from 3.6 t in 2006. The main destinations, in descending order, China, the United Kingdom, India, and Spain, accounted for 88% of total tellurium exports (table 4).

World Review

Global selenium and tellurium output cannot be easily determined because not all companies report production and because of the trade in scrap and semirefined products.

In 2007, refinery production of selenium from a select few countries increased slightly to 1,470 t (table 6). Total world production of selenium and tellurium has been estimated between 3,000 and 3,500 metric tons per year (t/yr) and 450 to 500 t/yr, respectfully. Based on global copper refinery data (Moats and others, 2007, p. 202-241) the USGS estimates that copper anode slimes could generate 4,600 t/yr and 1,200 t/yr of selenium and tellurium, respectively.

Canada.—Yukon Zinc Corp. (Vancouver, British Columbia) received the final major permit, the “A” Water License, in October 2007 for development of the Wolverine zinc deposit. The company had previously been granted a mining license in December 2006. The deposit has an unusually high level of selenium, which had previously been considered a negative factor until the rapid price rise beginning in 2003. The company anticipated startup in the first quarter 2009 and expected to produce an average 53,400 t/yr of zinc in concentrate with an unknown amount of byproduct selenium (Yukon Zinc Corp., 2008, p. 2-4).

China.—In 2007, China was the leading consumer and a major producer of selenium. The Chinese Government estimated that consumption of selenium was 1,800 t and production was 320 t. Jiangxi Copper Corp. was the leading producer at 120 t and other main producers were, in descending order, Yunnan Copper Co., Ltd. (80 t), Jinchuan Group Ltd. (36 t), Tongling Nonferrous Metals Group Holdings Co., Ltd. (30 t), Daye Nonferrous Metals Co. (20 t), and Baiyin Nonferrous Co. (15 t). China depended on imports for most of its needs and imported 1,763 t of a wide range of selenium products in 2007, a 58% increase compared with 2006 imports. The major import sources were, in descending order, Japan (24%), Belgium (20%), Kazakhstan (12%), and the Republic of Korea (11%). The increase was owing to an increase in production of electrolytic manganese. After the Chinese manganese industry, the leading uses of selenium in China were, in descending order, glassmaking, pigments, ceramics, and chemicals (Metal-Pages Ltd., 2008b).

Germany.—Retorte Ulrich Scarre GmbH announced that it will change its name to Retorte Selenium Chemicals & Metals. The company abandoned its planned expansion into other metals, such as bismuth and tellurium, but planned to expand its selenium production by 25% (Kassakovich, 2007a).

India.—Sterlite Industries India Ltd. (Mumbai, India) began selenium production in May 2006 at its Tuticorin complex in the southern part of the State of Tamil Nadu. Production has averaged 10 to 12 t/yr of selenium (Kassakovich, 2007b).

Japan.—The major producers of selenium and tellurium were Mitsubishi Materials Corp.; Mitsui Metal Mining and Smelting Co., Ltd.; Nikko Metals Co., Ltd.; Nippon Rare Metals, Inc.; Shinko Kagaku Kogyo Co., Ltd.; and Sumitomo Metal Mining Co., Ltd. In 2007, selenium production was 806 t, an increase of 10% compared with that of 2006. Of the 474 t of selenium exported in 2007, 48% was exported directly to China, as reported by the Japanese Government. Japanese secondary recovery declined owing to the lack of old selenium-tellurium photoreceptors drums for processing. Tellurium production, which had been exclusively from recycling photocopier drums, ceased and stocks of tellurium were depleted. In 2007, stocks of selenium fell by 14% compared with levels in 2006, to 120 t (Roskill’s Letter from Japan, 2008a-c).

Mexico.—In 2007, Southern Copper Corp. (Phoenix, AZ) produced 34,000 kg of selenium, 22% lower than that of 2006, at the La Caridad precious metal plant in the State of Sonora (Southern Copper Corp., 2008).

Philippines.—Pacific Rare Specialty Metals and Chemical Inc. (PRMCI) (Cavite) [a subsidiary of II-VI Inc. (Saxonburg, PA)], planned to commission a new plant to double the company’s selenium output of chemical compounds to 800 t/yr. PRMCI was also a producer of refined tellurium. II-VI was a major producer of high-tech infrared and laser devices and purchased PRMCI to secure a long-term supply of selenium and tellurium (Mining Journal, 2007).

Peru.—Southern Copper produced selenium at its Ilo refinery in the southern part of Peru. In 2007, selenium production was 35,400 kg, down 29% compared with that of 2006 (Southern Copper Corp., 2008).

Poland.—Copper producer KGHM Polska Miedź S.A. (Lubin) reported producing 85 t of selenium in 2007, a 2% decrease compared with that of 2006. Selenium was produced from anode slimes generated at its Glogów and Legnica copper refineries at its precious metal plant at the Glogów smelter (KGHM Polska Miedź S.A., 2008).

Russia.—In 2007, it was estimated that Open Joint Stock Company Mining and Metallurgical Company Norilsk Nickel (Moscow) produced 80 to 100 t/yr of selenium and Open Joint Stock Co. Uralelectromed (Verkhnaya Pyshma), a subsidiary of Urals Mining and Metal Co., produced 70 to 80 t/yr of selenium. Estimates of Russian consumption and exports were 50 to 60 t/yr, and 100 to 120 t/yr, respectively (Metal-Pages Ltd., 2007).

Outlook

The supply of selenium and tellurium are directly affected by the production of the principal product from which it is derived, copper, and to a lesser extent, by the production of gold, lead, nickel, or zinc, produced from sulfide ores. Since global production of selenium and tellurium-bearing copper ore was expected to rise in 2008, global selenium and tellurium production will probably also increase. Although increased environmental regulation and prices have encouraged the recycling of electronic scrap, recycling has been declining during the past several years, owing to the reduction of available selenium- and tellurium-based copier drums and low selenium and tellurium content of most electronics. The main source is still anode slimes from copper refining. Since selenium and tellurium prices do not influence copper production, an increase in selenium or tellurium demand is not likely to result in a concurrent significant increase in the production of copper and its byproducts. However, many companies, that are currently producing slimes or other waste products that contain selenium, tellurium and other metal, and are not fully recovering selenium and tellurium, will likely start to invest in improving recovery rates.

Chinese demand for selenium is expected to increase owing to a continued demand from the Chinese agriculture and manganese industries. Global demand for selenium from the glass and solar cell manufacturers will probable increase as there are few substitutes in glass manufacturing and the expansion of solar cell production is expected to continue.

In 2008, tellurium consumption is expected to increase further, chiefly from electronics and solar cell manufacturers. As the technologies for these uses, especially solar cells and thermoelectronics, continue to advance, the manufacturers likely will find ways to reduce consumption through efficiency, recycling, and thrifting. Consumption for metallurgical alloying and chemicals were expected to decrease as the cost of tellurium continues to rise; producers of low-value products will find substitutes.

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TABLE 1
SALIENT SELENIUM AND TELLURIUM STATISTICS[1]

(Kilograms, contained metal, unless otherwise specified)

	2003	2004	2005	2006	2007
Selenium:					
United States:					
Production, primary refined	W	W	W	W	W
Shipments to consumers	W	W	W	W	W
Exports	249,000	160,000	254,000	191,000	562,000
Imports for consumption	367,000	412,000	589,000	409,000 r	544,000
Apparent consumption, metal	W	W	W	W	W
Dealers' price, average, commercial grade,[2] dollars per pound	5.68	24.89	51.43	24.57	32.90
World, refinery production	1,570,000 r	1,440,000 r	1,340,000 r	1,440,000 r	1,470,000 e
Tellurium, United States:					
Exports	10,200	6,160	51,000	3,550	15,100
Imports for consumption	48,900	62,800	42,200	31,100	43,700
Price at yearend, commercial grade,[3] dollars per kilogram	10.00	22.50	110.00	60.00	110.00

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Data are rounded to no more than three significant digits, except prices.
[2]Source: Platts Metals Week.
[3]Average yearend price published by Mining Journal for United Kingdom lump and powder, 99.95% tellurium.

TABLE 2
U.S. EXPORTS OF SELENIUM[1]

Country	2006 Quantity (kilograms, contained Se)	2006 Value	2007 Quantity (kilograms, contained Se)	2007 Value
Argentina	1,280	$19,800	--	--
Australia	2,820	43,700	50,100	$923,000
Belgium	54,000	837,000	103,000	1,870,000
Canada	5,230	156,000	24,300	693,000
China	7,080	124,000	48,200	736,000
Colombia	1,450	22,500	50	4,730
Costa Rica	2,240	34,700	--	--
Dominican Republic	788	12,200	--	--
El Salvador	7,630	118,000	7,840	95,100
France	1,110	20,900	5,160	80,000
Germany	25,500	396,000	80,600	1,370,000
Guatemala	4,330	67,100	--	--
Hong Kong	2,960	45,900	73,600	1,280,000
India	1,420	30,900	301	2,800
Italy	221	3,430	658	10,200
Japan	6,800	77,000	35,300	546,000
Korea, Republic of	4,190	48,600	26,600	237,000
Mexico	13,800	214,000	24,900	386,000
Netherlands	5,960	92,400	24,300	365,000
Philippines	5,370	83,300	20,400	321,000
Singapore	3,970	56,800	2,950	25,500
South Africa	435	8,460	5,470	84,700
Taiwan	2,350	38,700	14,900	230,000
Thailand	11,900	124,000	4,820	101,000
United Arab Emirates	224	4,760	--	--
United Kingdom	3,410	52,800	749	14,400
Venezuela	14,200	221,000	6,180	95,900
Vietnam	273	16,500	1,600	24,800
Total	191,000	2,970,000	562,000	9,500,000

-- Zero.

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

Source: U.S. Census Bureau.

TABLE 3

U.S. IMPORTS FOR CONSUMPTION OF SELENIUM[1]

Class and country	2006 Quantity (kilograms, contained Se)	2006 Value	2007 Quantity (kilograms, contained Se)	2007 Value
Selenium:				
Australia	--	--	998	$5,500
Belgium	149,000	$6,960,000	260,000	10,600,000
Canada	56,500	3,010,000	49,900	2,720,000
China	17,000	751,000	24,900	1,090,000
France	6,080	223,000	--	--
Germany	41,500	2,090,000	78,900	5,620,000
Japan	57,100	1,940,000	54,200	3,180,000
Korea, Republic of	5,000	242,000	8,190	83,800
Mexico	--	--	4,030	209,000
Netherlands	3,330	136,000	8,750	268,000
Peru	600	22,300	--	--
Philippines	41,400	1,590,000	30,800	1,370,000
United Kingdom	20,400	1,070,000	15,400	886,000
Total	398,000	18,000,000	536,000	26,000,000
Selenium dioxide:[2]				
Germany	8,850 r	695,000	7,460	594,000
Japan	354 r	36,600	709	62,000
Liechtenstein	--	--	12	2,500
Philippines	1,420 r	73,800	--	--
Total	10,600	805,000	8,180	658,000
Grand total	409,000	18,800,000 r	544,000	26,600,000

[r]Revised . -- Zero,

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

[2]Calcualted as 71% of gross weight of material.

Source: U.S. Census Bureau.

TABLE 4
U.S. EXPORTS OF TELLURIUM[1]

Country	2006 Quantity (kilograms, contained Te)	2006 Value	2007 Quantity (kilograms, contained Te)	2007 Value
Argentina	--	--	5	$4,920
Belgium	98	$4,880	429	37,200
Brazil	145	23,600	284	22,800
China	730	101,000	9,300	596,000
France	279	207,000	160	117,000
Germany	212	137,000	108	163,000
India	--	--	545	47,900
Japan	700	26,900	262	19,700
Korea, Republic of	--	--	65	6,750
Malaysia	168	4,920	--	--
Mexico	--	--	45	4,510
Spain	500	118,000	500	118,000
Sweden	238	35,700	87	13,000
Taiwan	340	31,400	315	17,900
Turkey	97	13,800	--	--
Ukraine	45	5,000	--	--
United Kingdom	--	--	3,020	364,000
Total	3,550	711,000	15,100	1,530,000

-- 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 TELLURIUM[1]

Country	2006 Quantity (kilograms, contained Te)	2006 Value	2007 Quantity (kilograms, contained Te)	2007 Value
Belgium	18,200	$1,310,000	4,610	$394,000
Canada	7,410	1,420,000	9,320	1,670,000
China	3,490	642,000	15,000	1,720,000
France	100	3,970	--	--
Germany	64	33,900	50	24,300
Japan	45	11,800	53	18,300
Peru	1,010	55,600	2,070	254,000
Phillippines	--	--	10,700	653,000
Ukraine	738	127,000	882	87,000
United Kingdom	82	23,500	1,050	154,000
Total	31,100	3,630,000	43,700	4,980,000

-- Zero.

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

Source: U.S. Census Bureau.

TABLE 6
SELENIUM: WORLD REFINERY PRODUCTION, BY COUNTRY[1, 2]

(Kilograms, contained selenium)

Country[3]	2003	2004	2005	2006	2007[e]
Belgium[e]	200,000	200,000	200,000	200,000	200,000
Canada[4]	288,064 [r]	271,073 [r]	107,000 [r]	106,000 [r]	62,000 [p]
Chile[e]	83,000	82,000	84,000	74,000 [r, e]	75,000
Finland	49,163	61,256	62,000	62,000 [e]	60,000
Germany[e]	661 [r]	1,000 [r]	2,000 [r]	2,500 [r]	2,500
India[e, 5]	12,000	12,000	13,000	13,000	14,000
Japan	733,973	599,170	624,630	730,100 [r]	805,600 [6]
Peru	47,800	51,900	48,800	49,800	45,000 [p]
Philippines[e]	45,000	48,000	68,000	65,000	65,000
Russia[e]	81,000	85,000	100,000	110,000	110,000
Serbia[e]	7,000 [r, 6, 7]	7,000 [r, 7]	7,000 [r, 7]	7,000 [r]	7,000
Sweden[e]	20,000	20,000	20,000	20,000	20,000
United States	W	W	W	W	W
Total	1,570,000 [r]	1,440,000 [r]	1,340,000 [r]	1,440,000 [r]	1,470,000

[e]Estimated. [p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in total.
[1]World totals, U.S. data, and estimated data have been rounded to three significant digits; may not add to totals shown.
[2]Insofar as possible, data relate to refinery output only; thus, countries that produced selenium contained in copper ores, copper concentrates, blister copper, and/or refinery residues but did not recover refined selenium from these materials indigenously were excluded to avoid double counting. Table includes data available through May 27, 2008.
[3]In addition to the countries listed, Australia, China, Iran, Kazakhstan, Mexico, Poland, and Uzbekistan produced refin selenium, but output is not reported, and available information is inadequate for formulation of reliable estimates of output levels. Australia is known to produce selenium in intermediate metallurgical products and has facilities to produce elemental selenium. In addition to having facilities for processing imported anode slimes for the recovery of selenium and precious metals, the United Kingdom has facilities for processing selenium scrap.
[4]Excludes selenium intermediates exported for refining.
[5]Data are for Indian fiscal year beginning April 1 of year stated.
[6]Reported figure.
[7]Montenegro and Serbia formally declared independence in June 2006 from each other and dissolved their union.

TABLE 7
TELLURIUM: WORLD REFINERY PRODUCTION, BY COUNTRY[1, 2]

(Kilograms, contained selenium)

Country[3]	2003	2004	2005	2006	2007[e]
Canada[4]	40,000	55,000 [r]	11,000 [r]	11,000 [r]	8,000 [p]
Japan	33,154	32,703	22,623	24,324 [r]	--
Peru	22,000	22,000	32,880	33,000	33,000 [p]
United States	W	W	W	W	W

[e]Estimated. [p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data. -- Zero.
[1]Estimated data are rounded to three significant digits.
[2]Insofar as possible, data relate to refinery output only; thus, countries that produced tellurium contained in copper ores, copper concentrates, blister copper, and/or refinery residues but did not recover refined tellurium are excluded to avoid double counting. Table is not totaled because of exclusion of data from major world producers.
[3]Australia, Belgium, Chile, China, Colombia, Germany, Mexico, the Philippines, Poland, and some countries of the Commonwealth of Independent States, including Kazakhstan and Russia, are known to produce refined tellurium, but output is not reported; available information is inadequate for formulation of reliable estimates of output levels.
[4]Excludes tellurium intermediates exported for refining.