SELENIUM AND TELLURIUM

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Canadian Developments

Primary selenium and tellurium are recovered in Canada as by-products from copper refining. Noranda Metallurgy Inc. produces commercial and high-purity selenium and tellurium at its CCR refinery in Montréal-Est, while Inco Limited produces crude selenium and tellurium (undewatered) at its Copper Cliff copper refinery in Sudbury.

In 1995, production of selenium at Canadian refineries from Canadian sources (Canadian copper smelters) was 553 t compared to 566 t in 1994. The decline in selenium production in 1995 was largely due to the fact that Hudson Bay Mining and Smelting Co. Ltd. began to ship its copper anodes to the United States for refining rather than to the CCR refinery in Montréal-Est.

Canadian production of tellurium is about 40 t/y.

Selenium consumption in Canada was 17.2 t in 1995 compared to 18.7 t in 1994. Statistics for tellurium consumption in Canada are withheld for reasons of corporate confidentiality.

World Developments

World production of selenium is estimated at about 1900 t/y. In addition to Canada, the largest producers in the world are Belgium, Chile, Germany, Japan and the United States. There were reports in 1995 that the selenium market experienced a supply deficit of between 100 and 150 t.

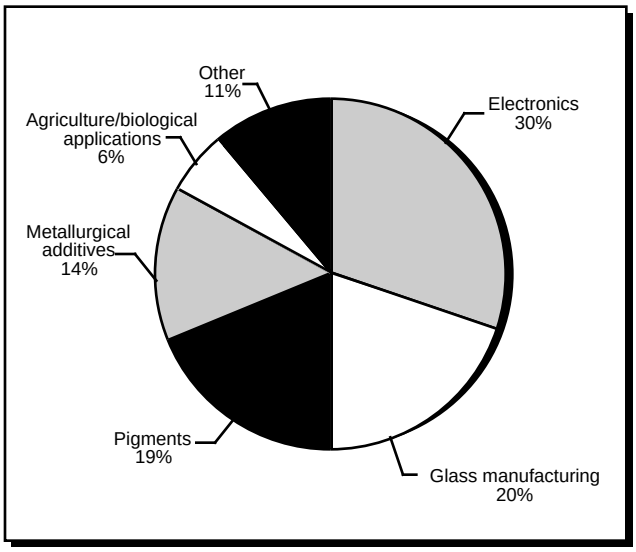
According to press reports, selenium experienced significant growth in 1995 for glass-making, ferroalloys, chemicals and pigments. Demand was reported to be particularly strong in the Far East, China and the Middle East.

World production of tellurium is estimated at between 200 and 300 t/y. The largest producers include Canada, Peru, Japan and the United States.

Consumption and Uses

The principal markets for selenium are in electronics (30%), glass manufacturing (20%), pigments (19%), metallurgical additives (14%) and agricultural/biological applications (6%).

Figure 1
Selenium Markets in the United States



Source: U.S. Bureau of Mines.

The major use of selenium in electronics is in the form of arsenic triselenide, which is used as a photoreceptor in xerography. Despite the considerable technological advances in low-cost organic photoreceptors, selenium has been able to maintain a significant segment of this market due to the large investments made over the years in selenium-based equipment.

Selenium is widely used in cadmium sulfoselenide pigments. However, this market is threatened by legislation to ban or severely restrict the use of these materials, and also by the development of substitutes including cerium-based pigments.

In the glass industry, selenium is used as both a decolourizing and colourizing agent, while in the metallurgical industry it is used to improve machinability and casting and forming properties in steel, copper and lead alloys.

Selenium is an essential micronutrient in animals. Selenium deficiency has been linked to several degenerative diseases including liver necrosis in swine, reproductive failure in sheep, white muscle disease in cattle, and Keshan and Kaschin Beck diseases in humans. Selenium compounds are added in trace amounts to animal feeds and in veterinary preparations, while soil deficiency is corrected by the addition of selenium compounds to chemical fertilizers.

Selenium deficiency is a problem in many parts of the world including Australia, China, Denmark, Finland, New Zealand, Norway, Scotland, South Africa and the United States. The lack of selenium is also a problem in parts of eastern Canada as well as in British Columbia.

Just as selenium deficiency in soils can pose a problem for animal health, there are a number of areas in the world where extremely high levels of naturally occurring selenium may result in potentially toxic levels of this element (above 5 ppm) in cultivated crops. In Canada there are several locations in the Prairie provinces where selenium toxicity may be a problem.

The major uses of tellurium are as an additive for iron, steel and copper to improve free machining, as a catalytic agent in the chemical industry, and in the electronics industry, principally in photoreceptor and photovoltaic applications.

The Basel Convention on the Transboundary Movement of Hazardous Wastes is an environmental agreement designed to restrict the transboundary movement of hazardous wastes to protect countries (particularly developing) that may not have the capability and technology to properly handle the wastes. The Basel Convention defines "waste" to include recyclable metals. Accordingly, recyclables that exhibit a hazardous characteristic are classified as hazardous wastes and are subject to strict Basel Convention movement control procedures.

At the September 1995 third Conference of Parties to the Basel Convention, member countries offered no opposition to amending the Convention to immediately ban the export of hazardous wastes arising from a Basel Annex 7 list of countries (OECD countries and Liechtenstein) that are destined for final disposal outside the Annex 7 list of countries. The amendment also bans, by December 31, 1997, the export of hazardous recyclables arising from Annex 7 countries and destined for recovery operations in non-Annex 7 countries. As of February 1996, no member country had yet ratified this "ban" amendment.

Basel member countries have no harmonized definition of "hazardous waste." This was recognized as a problem by the third Conference of Parties that could cause interpretive difficulties in implementing a "ban" amendment. Accordingly, member countries mandated a Technical Working Group to compile lists of hazardous wastes that would be subject to the "ban" amendment.

In May, Pacific Rare Metals of the Philippines reported that it was experiencing difficulties with the importation of selenium scrap for processing because of the Basel Convention.

Prices and Stocks

From a range of between US$4.70 and $5.40/lb at the end of 1992, selenium prices declined to between $3.50 and $4.20/lb in mid-1995. However, as a result of strong selenium demand in 1995 and low stock levels, selenium prices rebounded to a range of between US$3.80 and $4.50/lb in the second half of the year. In January 1996, selenium was quoted at between US$3.70 and $4.40/lb.

In September, it was reported in the press that selenium producer stocks would fall to 388 t at the end of 1995. According to the same report, this would represent just 2.3 months of forecast Western selenium consumption.

Information on tellurium prices is not published. According to the U.S. Geological Survey, the price of tellurium in 1995 was thought to be about US$27/lb.

Outlook

For both selenium and tellurium, significant potential exists for the growth of applications involved in the production of photovoltaic cells for the generation of electricity. For tellurium, significant potential also exists for the production of thermoelectric devices.

The use of selenium as a substitute for lead in brass plumbing applications offers significant growth potential for this element. While a significant amount of research is still under way to develop unleaded free machining brasses (red or semi-red brasses), favourable test results have been obtained with several bismuth-selenium alloys. These alloys contain between 0.07% and 1.2% selenium and between 0.5% and 2.5% bismuth. It is estimated that the worldwide market for selenium in free machining brasses could increase total selenium demand by about 500 t/y.

Selenium forms a bond with mercury that lessens the latter element's bioavailability. For lakes that have become contaminated with mercury from either anthropogenic or natural sources, experimental work is under way to determine the effectiveness of using selenium to reduce mercury levels.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 70. (2) Information in this review was current as of February 29, 1996.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2804.90	Selenium	Free	Free	Free	Free
2804.50	Tellurium	Free	Free	Free	Free

Sources: Customs Tariff, effective January 1996, Revenue Canada; Harmonized Tariff Schedule of the United States, 1996.

TABLE 1. CANADA, SELENIUM PRODUCTION, TRADE AND CONSUMPTION, 1993-95

Item No.		1993		1994		1995p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
PRODUCTION							
	Total	542	6 900	566	5 857	553	5 530
IMPORTS							
2804.90	Selenium						
	Philippines	4	134	28	282	18	313
	Japan	3	176	7	359	2	130
	United States	10	247	1	27	1	42
	United Kingdom	–	–	...	2	...	1
	Germany	...	...	...	...	–	–
	Total	17	557	36	670	21	486
EXPORTS							
2804.90	Selenium						
	Philippines	129	5 908	100	4 866	160	6 781
	United Kingdom	95	4 280	146	6 670	119	4 086
	United States	146	4 058	174	4 647	128	3 060
	Netherlands	25	1 112	44	1 719	44	2 298
	Ukraine	–	–	–	–	40	1 724
	Other countries	76	3 067	43	1 832	119	4 442
	Total	471	18 425	507	19 734	610	22 391
CONSUMPTION[2]							
	Total	19	..	17	..	..	..

Sources: Natural Resources Canada; Statistics Canada.
– Nil; .. Not available; ... Amount too small to be expressed; p Preliminary.
1 Primary recoverable content from Canadian sources. 2 Available data as reported by consumers.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, SELENIUM PRODUCTION, EXPORTS AND CONSUMPTION, 1975, 1980 AND 1985-95

	Production[1]	Exports[2]	Consumption[3]
		(tonnes)	
1975	342	218	10
1980	377	307	11
1985	361	310	14
1986	354	350	14
1987	430	353	15
1988	321	428	14
1989	213	392	15
1990	369	393	14
1991	227	377	19
1992	345	351	16
1993	542	471	19
1994	566	507	17
1995p	553	610	..

Sources: Natural Resources Canada; Statistics Canada.
.. Not available; p Preliminary.
1 Until 1985, refinery output of selenium from all sources, including imported concentrates, blister and scrap and domestic scrap; from 1986 onwards, primary recoverable output from Canadian sources. 2 Exports of selenium, metal powder and scrap. 3 Consumption (selenium content) as reported by consumers.

TABLE 3. CANADA, PRODUCTION AND CONSUMPTION OF TELLURIUM, 1975, 1980 AND 1985-95

	Production	Consumption
	Total Refined[1]	Refined[2]
	(tonnes)	
1975	42	w
1980	9	w
1985	19	w
1986	20	w
1987	13	w
1988	19	w
1989	8	w
1990	12	w
1991	16	w
1992	25	w
1993	27	w
1994	42	w
1995p	91	..

Sources: Natural Resources Canada; Statistics Canada.
.. Not available; p Preliminary; w Withheld to avoid disclosing company data.
1 Refinery output of tellurium from all sources, including imported concentrates, blister, and scrap and domestic scrap, 1985. From 1986 onward, primary recoverable output from Canadian sources.
2 Consumption (tellurium content), as reported by consumers.