

## TANTALUM

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### Summary

**P**rimary production of tantalum in 1994 (outside the Commonwealth of Independent States (C.I.S.) and China) is estimated, from nine-month statistics compiled by the Tantalum-Niobium International Study Centre (T.I.C.), to be about 258 t tantalum (Ta) content, a decrease of 9.3% compared to 1993. World consumption is estimated at close to 1010 t Ta content, about 4% lower than in 1993, but still about 11% greater than the average level of consumption between 1989 and 1992.

The recent rise in consumption was a result of increased industrial activity, while the drop in production resulted mostly from reduced output from tin slag processing as a result of tin mine closures brought about by depressed tin prices.

The supply excess experienced in the past few years is expected to continue in 1995, with the market continuing to work down its inventories. Accordingly, prices are expected to remain at current levels. Consumption is expected to increase in the short term due to increased demand resulting from the economic recovery in the industrial economies of the West. Stock levels, as a result, will decline.

### Uses

Tantalum is a refractory metal that is ductile, easily fabricated, has a high melting point (2996°C), is highly resistant to corrosion by acids, and is a good conductor of heat and electricity.

Through chemical treatment, tantalite concentrates are first converted into potassium tantalum fluoride ( $K_2TaF_7$ ), which is reduced to obtain tantalum metal powder. For a higher-purity material, such as for high grades of tantalum capacitor powders,  $K_2TaF_7$  can be melted in an electron beam furnace.

The U.S. Bureau of Mines (USBM) reports that the major end use for tantalum, as tantalum metal powder, is in the production of electronic components, mainly tantalum capacitors which consume slightly less than 50% of produced tantalum. Applications for tantalum capacitors include computers, communication systems, and instruments and controls for aircraft, missiles, ships, and weapon systems.

Because of its high melting point, good strength at elevated temperatures, and good resistance to corrosion, tantalum is combined with cobalt, iron and nickel to produce superalloys that are employed in aerospace structures and jet engine components.

Tantalum carbides, used mostly in mixtures with carbides of certain metals such as niobium, titanium and tungsten, are used in cemented carbide cutting tools, wear-resistant parts, farm tools, and turning and boring tools.

Also, because of its excellent corrosion-resistant properties, tantalum mill and fabricated products are used in the chemical industry in applications such as heat exchangers, evaporators, condensers, pumps, and liners for reactors and tanks.

### Canadian Developments

In 1994, Canada produced about 36 000 kg of contained tantalum pentoxide ( $Ta_2O_5$ ), making it the world's third largest producer of tantalum ores and concentrates.

Canada's sole producer, the Tantalum Mining Corporation of Canada Ltd. (Tanco), operates the Bernic Lake mining complex located about 180 km northeast of Winnipeg, Manitoba. The Bernic Lake facility produces tantalum by processing fresh ore from the underground mine, or from the processing of tailings. The average ore grade is 0.10%  $Ta_2O_5$  while the tailings average 0.055%  $Ta_2O_5$ . These are beneficiated on site to obtain a final concentrate grading about 38%  $Ta_2O_5$ , or 28% tantalum content. Tanco's production in 1994 came mostly from the retreatment of tailings between the months of May and October.

Canada's reported consumption of ferrotantalum, which is rolled up with ferroniobium, was up 28% at 805 t (combined niobium-tantalum content) in 1993. In 1994, imports, consisting mostly of tantalum and articles, unwrought tantalum, and tantalum waste and scrap, were valued at C\$6 million, an increase of 47.6% over 1993, while exports, consisting mostly of ores and concentrates, were worth C\$3.37 million, up from only \$1.09 million in 1993.

### World Developments

According to statistics compiled by the T.I.C. for the first nine months of 1994, tantalum production (not including the C.I.S. and China) for the year from tantalite mining and tin slag processing is estimated at 348 135 kg  $Ta_2O_5$  content, a decrease of about 9% compared to 1993.

Processors' receipts in 1994 from primary raw materials (758 300 kg Ta or 1 025 000 kg  $Ta_2O_5$ ) and from secondary materials (scrap metal, oxides and others) are estimated at close to 992 000 kg contained tantalum, while processors' shipments are estimated at 1 011 000 kg contained tantalum. Processors' receipts increased 26% in 1993 because of a major increase from primary raw material sources.

The discrepancies between primary production and processors' receipts, and between the latter and processors' shipments, mirror the situation in 1993

and indicate a major supply imbalance in 1994. The industry was working down its inventories at all levels of the chain. Specifically, the large difference between primary production and processors' receipts can be explained by production coming from secondary materials and production from all feed types outside T.I.C. members, such as from the C.I.S. and China.

Based on statistics compiled by the T.I.C. for the first nine months of 1994, world tantalum consumption for the whole year is estimated at around 1 010 284 kg tantalum content, a decrease of about 4% compared to 1993. Consumption of tantalum, which held steady at about 907 000 kg between 1989 and 1992, had jumped 10% in 1993. Notably, the electronics segment increased its consumption in 1994 by about 3%, and the mill products segment, especially for tantalum capacitor-grade wire, by 12%. On the other hand, consumption in the tantalum carbide segment is down about 20%.

Eighty percent (80%) of the primary production of tantalum comes from tantalite mining. Australia accounts for about 60% of that production, followed by Brazil, Canada, central and South African countries, and Thailand. The remaining primary production (20%) comes from the treatment of by-product slags from tin processing operations such as the ones located in Thailand and Malaysia.

#### *Australia*

Australia's production of tantalum is from both the mining of tantalite deposits and the processing of tin slags. Most of the country's output of tantalum ores and concentrates, which accounts for about 50% of world production, comes from the Greenbushes and Wodgina mines located in Western Australia. In 1994, Australia's tantalite production is estimated at around 263 155 kg Ta<sub>2</sub>O<sub>5</sub>, about 25% more than in 1993.

The Greenbushes mine, owned by Gwalia Consolidated Ltd., is an open-pit operation with production capacity of about 300 000 kg/y of Ta<sub>2</sub>O<sub>5</sub> contained in concentrates grading 40% Ta<sub>2</sub>O<sub>5</sub>. However, due to depressed demand for tantalum products in recent years, the mine has been operating at less than 70% of capacity. For now, Gwalia sells all of its production to Cabot Corp. in the United States, and to Germany's Hermann C. Starck, but it aims to sell 50% of its production on the spot market.

Pancontinental Mining Ltd. and Goldrim Mining operate the Wodgina Pan West mine which is located in Australia's Pilbara region. This open-pit operation has a production capacity of about 90 000 kg/y of contained Ta<sub>2</sub>O<sub>5</sub> and is reported to be producing at close to capacity.

#### *Brazil*

Brazil, with only 4% of the world's reserves of tantalum, was the world's second largest producer of ores and concentrates in 1994 with about 19% of the market economy countries' (MEC) output. Tantalum ores and concentrates were mostly produced from mining operations in Brazil's Minas Gerais and the Rio Grande do Norte states. Brazil is also an important producer of tantalum as a by-product from the processing of tin slags.

Parapanema SA Industria e Construo, the leading tin producer in Brazil, has plans to diversify its production by marketing the other ores found with tin at its Pitinga mine in the western Amazon. A tantalum-niobium recovery plant built in 1988 near Sao Paulo was operated at a reduced capacity in 1994 and could produce 45 000 to 90 000 kg of contained Ta<sub>2</sub>O<sub>5</sub>. On hold since 1988, the company is now studying how to position itself in the market.

#### *United States*

Cabot Performance Materials, a leading producer of tantalum products, started operating a second 1200-kW electron beam furnace at its Boyertown, Pennsylvania facility, effectively doubling its melting capacity. This will allow the company to improve productivity by minimizing changeovers between the production of niobium and tantalum. Both furnaces produce tantalum and niobium ingots for upgrading contracts with the U.S. Defense Logistics Agency, for other ballistic applications, and for the U.S. superconductor supercollider project (currently on hold).

Also, Showa Cabot Supermetals K.K. announced it has succeeded in producing a new variety of tantalum powder (named S-500) with a higher capacitance voltage that will enable the design of higher performance chip-type capacitors. Demand for these capacitors, pushed by the miniaturization in electronic applications, shows the highest growth rate.

In 1994, Kazakhstan, Romania and the Republic of South Africa were granted the Generalized System of Preferences tariff for trade, which allows them free access to the U.S. market. This will undoubtedly assist exports from Kazakhstan where the Ulba Metallurgical Plant (Ulba), the leading producer of tantalum products in the C.I.S., manufactures tantalum ingots, tantalum capacitor powders, wire and foil, and mill products. To help achieve this goal, Ulba became a member of the T.I.C. in 1993.

#### *Thailand*

While Thailand's production of tantalite ores and concentrates is negligible, its production of tantalum from the processing of tin slags represents about 17% of MEC production from that feed source, or 3.5% of world tantalum production. The country's output is produced at Thai Tantalum Inc.'s Maab Ta Phut

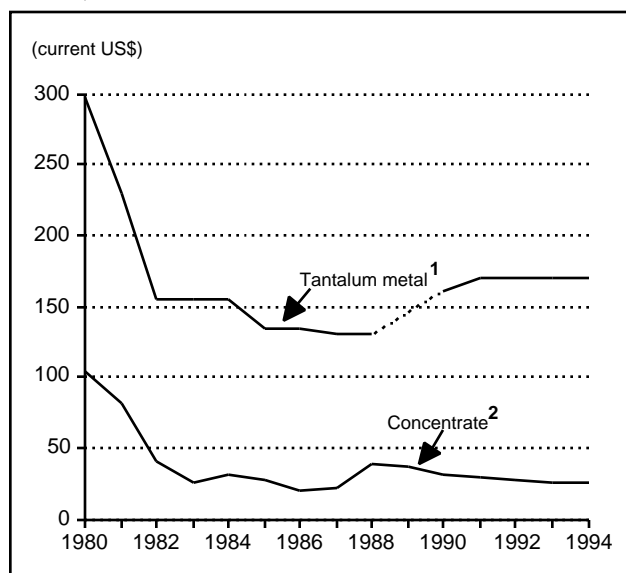
plant located in Rayong province, which was commissioned in 1992 and has a capacity to produce 45 350 kg of metal powder and about 317 600 kg of tantalum potassium chloride. The plant sources most of its tin slag feed from the Thailand Smelting and Refining Co. Ltd. (Thaisarco), but may also take some from Thai Pioneer Enterprise's Pathum Thani smelter.

In 1993, Thai Tantalum Inc. reportedly produced around 20 000 kg of electronic-grade tantalum metal powder, and planned on producing between 25 000 and 30 000 kg in 1994. However, as a result of domestic mine closures brought about by depressed tin prices, the company may have to gradually source more of its feed from imports.

## Prices

In 1994, the tantalum market remained oversupplied, which kept prices down. An increase in demand as a result of greater industrial activity in North America, Western Europe, and especially Japan, which is coming out of a recession, helped reduce inventories. However, stocks will have to come down further before market fundamentals change.

**Figure 1**  
Tantalum Price Variations in the Past Fifteen Years, 1980-94



Sources: *Metal Bulletin*; U.S. Bureau of Mines.

..... Price not available for that year.

<sup>1</sup> Average year-end price per pound.

<sup>2</sup> Year average U.S. spot price per pound contained  $Ta_2O_5$ , for concentrate 25-40% basis, 30%  $Ta_2O_5$ .

The range of spot prices for tantalum concentrates, as published in *Metals Week*, widened in mid-January 1994 from a March 1993 quote of US\$25.50-\$26.50/lb of contained pentoxide to US\$25.50-\$27.00/lb, where it remained until year-end. As reported by the USBM, average prices for tantalum mill products and tantalum capacitor-grade powder remained stable at the past year's price of US\$170/lb and US\$145/lb respectively.

## Outlook

In 1995, Tanco estimates production to be around 9000 kg of  $Ta_2O_5$  as a by-product of its spodumene circuit. No production is expected from the processing of tailings or from underground ore.

Consumption of tantalum powder for capacitors is expected to remain flat for the near future. While the number of units produced increased by about 6% in 1994 compared to 1993, the development of higher-capacity powders has enabled capacitor manufacturers to reduce the volume of powder required per unit. Also, capacitor producers have steadily increased the production yields of capacitors and minimized the loss of tantalum during processing.

The situation is similar for the consumption of tantalum carbides where tool-makers have introduced new coatings in cemented carbides for steel cutting to prolong the life of the tools. A modest increase in consumption for this application is nonetheless expected in 1995 as a result of greater industrial activity in the recovering world economies.

In mill products, such as capacitor-grade tantalum wire, only modest growth is expected in the short term.

On the supply side, as in the case of niobium, there will be excess capacity for decades to come. Australia, with its abundant proven reserves of tantalite ore, will continue to be the major supplier for the market for the foreseeable future. In 1995, output is expected to approximate 300 000 kg  $Ta_2O_5$ . The gradual decrease since 1990 in tantalum output from the processing of tin slags should continue until the tin market recovers.

Because of production overcapacity, prices for tantalum concentrates and intermediate products are expected to remain weak for the foreseeable future.

**TARIFFS**

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2615.90.00.90	Tantalum ores and concentrates	Free	Free	Free	Free
8103.10.10	Unwrought tantalum, not alloyed; powders, not alloyed	3.7%	Free	Free	Free
8103.10.20	Unwrought tantalum, alloyed; waste and scrap; powders, alloyed	8.8%	6.5%	Free	Free
8103.90	Tantalum and articles thereof, n.e.s.	8.8%	6.5%	Free	Free

Sources: Customs Tariff, effective January 1995, Revenue Canada; Harmonized Tariff Schedule of the United States, 1995.  
n.e.s. Not elsewhere specified.

**TABLE 1. CANADA, TANTALUM PRODUCTION AND TRADE, 1992-94**

Item No.	1992		1993		1994 <sup>p</sup>	
	(kilograms)	(\$000)	(kilograms)	(\$000)	(kilograms)	(\$000)
<b>PRODUCTION<sup>1</sup></b>						
Manitoba	54 177	3 977	13 796	1 093	35 974	3 005
Total	54 177	3 977	13 796	1 093	35 974	3 005
<b>IMPORTS</b>						
8103.10.10	Unwrought tantalum, not alloyed; powders, not alloyed					
	United States	4 947	2 633	4 742	2 016	3 529
	United Kingdom	2	...	-	-	-
Total		4 949	2 633	4 742	2 016	3 529
8103.10.20.10	Unwrought tantalum, alloyed; powders, alloyed					
	United States	4 298	414	1 658	152	1 750
	Russia	-	-	714	59	-
Total		4 298	414	2 372	211	1 750
8103.10.20.20	Tantalum waste and scrap					
	United States	4 453	422	5 555	491	12 037
Total		4 453	422	5 555	491	12 037
8103.90	Tantalum and articles thereof, n.e.s.					
	United States	15 054	1 939	10 794	1 356	27 545
	United Kingdom	-	-	-	-	37
	Other countries	30	3	-	-	33
Total		15 084	1 942	10 794	1 356	27 615
<b>EXPORTS</b>						
8103.10	Unwrought tantalum; including bars and rods obtained simply by sintering; waste and scrap; powders					
	Netherlands	-	-	-	-	3 000
	United States	4 854	95	907	6	4 774
Total		4 854	95	907	6	7 774
8103.90	Tantalum and articles thereof, n.e.s.					
	United States	17	4	-	-	16
Total		17	4	-	-	16

Sources: Natural Resources Canada; Statistics Canada.

- Nil; ... Amount too small to be expressed; n.e.s. Not elsewhere specified; <sup>p</sup> Preliminary.

<sup>1</sup> Producers' shipments of tantalum ores and concentrates and primary products, Ta<sub>2</sub>O<sub>5</sub> content.

Note: Numbers may not add to totals due to rounding.

**TABLE 2. CANADA, TANTALUM PRODUCTION, TRADE AND CONSUMPTION, 1975 AND 1980-94**

Year	Production <sup>1</sup> Ta <sub>2</sub> O <sub>5</sub> Content	Imports		Consumption <sup>2</sup>
		Primary Forms and Tantalum	Fabricated Metals Tantalum Alloys	Ferrocolumbium and Ferrotantalum- columbium, Cb and Ta-Cb Content
(kilograms)				
1975	178 304	..	..	215 910
1980	115 261	21 280	12 112	486 251
1981	103 949	2 769	5 043	455 500
1982	59 276	1 759	1 146	356 000
1983	—	1 742	332	359 000
1984	—	4 489	1 499	482 000
1985	39 457	2 370	1 354	447 000
1986	38 846	2 137	1 918	438 000
1987	36 478	16 341	3 211	574 000
1988	17 989	14 075	499	657 000 <sup>r</sup>
1989	96 842	53	39	670 000
1990	100 380	73	8 008	703 000
1991	114 388	—	7 831	726 080 <sup>r</sup>
1992	54 177	..	4 298	829 789
1993	13 796	..	2 372	805 000
1994 <sup>p</sup>	35 974	..	1 750	..

Sources: Natural Resources Canada; Statistics Canada.

— Nil; .. Not available; <sup>p</sup> Preliminary; <sup>r</sup> Revised.<sup>1</sup> Producers' shipments of tantalum ores and concentrates and primary products, Ta<sub>2</sub>O<sub>5</sub> content.<sup>2</sup> Available data as reported by consumers.**TABLE 3. T.I.C.<sup>1</sup> TANTALUM STATISTICS, 1991-94**

	1991	1992	1993	1994 <sup>e</sup>
(000 kg contained Ta <sub>2</sub> O <sub>5</sub> )				
<b>PRIMARY PRODUCTION</b>				
In tin slags containing 2% Ta <sub>2</sub> O <sub>5</sub> or more	298.5	195.6	161.5	64.6
In tantalite and other minerals	359.4	352.5	222.3	283.5
Total	657.9	548.1	383.8	348.1
Equivalent kg Ta	487.3	406.1	284.5	257.6
<b>PROCESSORS' RECEIPTS</b>				
(000 kg contained Ta)				
Primary raw materials (including tin slags)	463.7	540.4	530.4	758.3
Secondary materials (scrap metal, oxides, etc.)	207.8	188.3	256.4	233.3
Total	672.0	728.7	786.8	991.6
<b>PROCESSORS' SHIPMENTS</b>				
Ta <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> TaF <sub>7</sub> and carbides	233.6	201.9	229.1	216.8
Powder/anodes	392.0	409.7	471.4	488.7
Mill products	174.8	186.9	170.4	194.0
Scrap, ingots and other	108.9	107.1	162.2	111.5
Total	909.3	905.6	1 033.1	1 011.0
<b>CONSUMPTION OF TANTALUM CAPACITORS BY REGION</b>				
(millions of units)				
North America	1 425	1 700	2 079	..
Europe	920	940	1 130	..
Japan	3 860	3 095	3 243	..
Rest of world	1 970	2 370	2 688	..
Total	8 175	8 105	9 140	9 650

.. Not available; <sup>e</sup> Estimated from nine-month data.<sup>1</sup> Tantalum-Niobium International Study Center, members' estimate.