

# Titanium

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**Lynda Duchesne**

*The author is with the Minerals and Metals Sector,  
Natural Resources Canada.  
Telephone: (613) 992-8226*

## SUMMARY

**T**he year 1995 marks the end of a difficult period for titanium metal producers. Consumption in the early 1990s was lower than the record level achieved in late 1989. More positive results in 1995 can be explained by a recovery in the aerospace industry and by more extensive use of titanium in other fields. In addition, the increase in the cost of the raw materials used in the manufacture of titanium metal has led to an increase in selling prices.

Titanium metal was once reserved almost exclusively for applications in the aerospace field; commercial aviation is still the leading use, with military aviation in second place. This dependency made titanium producers very vulnerable. Numerous titanium ventures came and went over a period of several decades. Other operators have been affected by the drop in demand in the aerospace industry in recent years. To end this dependency and ensure their survival, producers have had to find new market opportunities where the quality-price factor of titanium makes it a choice metal when compared to other metals with similar special characteristics.

## USES

Titanium is a silver-coloured metal that is lightweight but strong, flexible, non-toxic and resistant to shock, corrosion and heat. It does not react at all in salt water, yet it is resistant to most fluids contained in oil and gasoline. Titanium is the ninth most abundant chemical element in the earth's crust. It does not occur in a pure state, but can be found in the form of ilmenite ( $\text{FeTiO}_3$ ), rutile ( $\text{TiO}_2$ ) and anatase, among others. Canada, Australia and South Africa produce mainly ilmenite, the most abundant titanium mineral. Anatase comes from Brazil and rutile comes mostly from Australia, Sierra Leone and South

Africa. Titanium metal is produced mainly from natural rutile and synthetic rutile, which is obtained by enriching ilmenite.

The number of titanium users today is increasing in various fields including the aerospace industry, the petroleum industry, electric power plants, the chemical industry, the automobile industry and medicine. It is also used in shipbuilding and in the manufacture of sporting equipment such as golf clubs, bicycles, skis, tennis rackets, baseball bats and underwater diving knives.

All new products made of titanium take advantage of its known beneficial properties. For example, the armour plates in bullet-proof clothing contain titanium, primarily because of its light weight. Implants of artificial hips and joints are generally made of titanium as it is non-toxic, lightweight and very strong.

The steel industry uses ferrotitanium or titanium scrap for ferroalloys. In some cases, titanium sponge is used, although its price is decidedly higher than that of ferrotitanium and titanium scrap. Price and availability influence the choice of additive in each steel plant.

Since 1992, the United States has been the largest consumer of ferrotitanium, ahead of Japan and Germany. In 1994 the United States consumed 6500 Mt; Japan, 5750 Mt; and Germany, 4500 Mt.

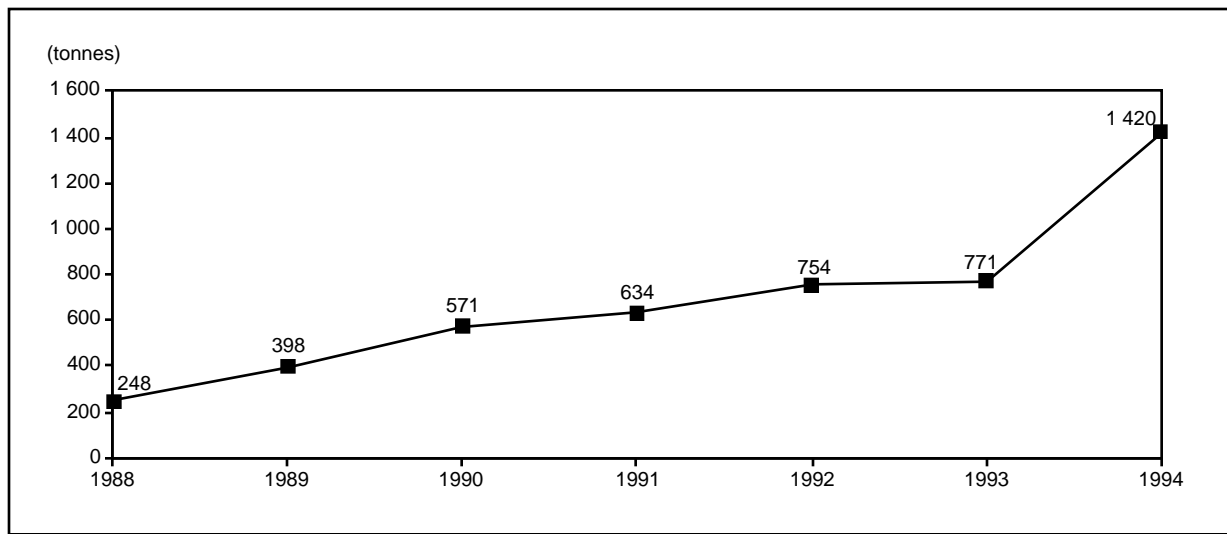
The consumption of ferrotitanium in Canada was remarkably high in 1994 with an 84% increase over 1993. As Figure 1 illustrates, there has been consistent growth in ferrotitanium consumption for titanium alloy production in Canadian steel plants.

## CANADIAN DEVELOPMENTS

Although Canada is not a producer of titanium metal, its many ilmenite deposits in Manitoba, Alberta and Quebec have attracted growing interest and are currently the target of extensive exploration programs.

In collaboration with Shairco, which holds most of the equity in Cristal (the only manufacturer of pigments in the Middle East), Tiomin Resources Inc. is currently conducting a feasibility study on their project to exploit mineral sands rich in ilmenite near

**Figure 1**  
**Canadian Consumption of Ferrotitanium, 1988-94**



Source: Natural Resources Canada.

Natashquan, Quebec, on the north shore of the St. Lawrence River. If the project goes ahead, the Cristal plant in Saudi Arabia will use most of the synthetic rutile produced at Natashquan. The feasibility study should be completed by the end of the third quarter of 1996.

In Manitoba, Gossan Resources Limited signed an agreement in 1993 with Cross Lake Mineral Exploration Inc., which belongs to the Council of the Cross Lake First Nation, for the purpose of exploring the Pipestone property located about 50 km north of Lake Winnipeg. In addition, Gossan has explored its wholly owned Kiskitto Lake property. The prospecting work seems to indicate substantial  $TiO_2$  mineral resources.

Finally, an American oil company, Solv-Ex Corp., is presently looking into the possibility of extracting oil and many elements, including titanium oxide, from tar sands near Fort McMurray, Alberta. It has developed a technology for the recovery of various minerals contained in the sands.

## MINERAL PRODUCTION

QIT-Fer et Titane Inc. operates the only ilmenite mine in Canada. The deposit, which is located in the Tio Lake region north of Havre-Saint-Pierre, Quebec, contains ore consisting mainly of coarse-grained ilmenite ( $FeO \cdot TiO_2$ ) with fine intrusions of hematite ( $Fe_2O_3$ ). The company produces a  $TiO_2$  slag, which is then used in the manufacture of pigments.

Nord Resources Corp. of the United States and Consolidated Rutile Ltd. of Australia have an equal interest in the largest rutile mine in the world in

Sierra Leone. Production in 1995 was almost nil because of fighting between rebel forces opposed to the military government. According to the Sierra Leone electoral commission, the political climate will be restored with the elections to be held on February 26, 1996. The production capacity of the mining facilities was about 150 000 t/y of rutile and 65 000 t/y of ilmenite. In addition, expansion work was under way to increase production by 50% but, unfortunately, this work was interrupted by the turn of events.

Westralian Sands Ltd. has signed an agreement with the provincial government of Ha Tinh, Vietnam, to resume the production and export of ilmenite. The activities of the Austinh Ltd. joint venture were suspended following a dispute between Westralian Sands Ltd., which holds 60% of the interests, and its Vietnamese partners.

## WORLD DEVELOPMENTS

There are different categories of titanium metal producers: those who produce titanium sponge, manufacturers of ingots, and makers of semi-fabricated products. Titanium sponge is used to make ingots. These can then be transformed into smaller pieces, such as billets, bars or plates, intended for subsequent transformation into finished products.

The limited number of titanium sponge producers are in the United States, Japan, China and the Commonwealth of Independent States (C.I.S.). The following companies are the main producers:

- In Kazakstan, Ust-Kamenogorsk has a production capacity of between 35 000 and 40 000 t/y. Its

production reached 27 200 t in 1994, of which 9000 t were used for domestic purposes.

- In Russia, AVISMA has a capacity of 39 000 t/y. Its production in 1995 was double that of 1994. About 40% of this production is exported.
- In the United States, Titanium Metals Corp. of America (Timet) dominates the market with a capacity of 22 700 t/y, while Oregon Metallurgical Corporation (OREMET) has a production capacity of about 7000 t/y. Timet is a joint venture held 75% by Tremont Corp. and 25% by Union Titanium Sponge Corp. of Japan.
- In Japan, Sumitomo Sitix Corp. and Toho Titanium Co. Ltd. have a combined capacity in excess of 25 000 t/y.

However, RMI Titanium Co. in the United States, Deeside Titanium in the United Kingdom, and Showa Titanium Co. in Japan, all producers of titanium sponge, closed their plants permanently in 1992, 1993 and 1994 respectively. Consequently, Western Europe no longer has any titanium sponge production capacity.

While the number of titanium sponge producers is small, there are several ingot producers and a greater number of by-product producers. In 1994, for example, the United States had 2 producers of titanium sponge, 11 producers of ingots, and about 30 by-product producers.

In October, Timet and IMI plc agreed to merge. While an agreement in principle was signed, there are still a number of stages to go through before the merger is officially completed. IMI plc, based in England, is the largest titanium producer in Western Europe with an annual capacity of 12 million lb of ingots that primarily serves the European market. According to the proposed agreement, Tremont Corp. could hold 45% of the equity in the new organization, with 40% belonging to IMI plc and 15% to Union Titanium Sponge Corp. If the merger goes ahead, it is expected that Timet will supply titanium sponge to IMI plc's plants, which currently fill their needs with imports from Japan and the C.I.S.

## ANTI-DUMPING DUTIES IN THE UNITED STATES

The United States has undertaken a review of the orders imposing anti-dumping duties on imports of titanium sponge from the C.I.S. These duties of 83.96% have been in effect since August 28, 1968. In fact, the U.S. Department of Commerce had intended to rescind this anti-dumping action in 1991. However, because of objections raised by RMI Titanium Co., Oregon Metallurgical Corporation and Titanium Metals Corp. of America, the duties were maintained.

In 1995, discussions resumed concerning maintenance of the current duties, their increase, their reduction or their revocation. The charges do not apply when the imported titanium sponge is transformed in the United States and then re-exported.

## PRICES

Natural rutile concentrate containing at least 95% TiO<sub>2</sub> sold early in the year at prices between US\$460 and \$480/t. The price for synthetic rutile of the same grade was between US\$420 and \$440/t. With the substantial rise in prices (between 41% and 67% for natural rutile and between 31% and 48% for synthetic rutile), the price for natural rutile at year-end varied between US\$650 and \$800/t, while the latter sold for between US\$550 and \$650/t.

The price of titanium sponge was between US\$3.00 and \$4.00/lb in early 1995 and between US\$4.40 and \$4.80/lb in late December, for an average increase of 31%, largely due to the higher cost of the raw materials, such as magnesium, used by producers.

## OUTLOOK

According to the forecasts, the titanium metal industry will experience a period of growth during the final years of the 20th century and in the early years of the 21st century. In fact, titanium consumption by the aerospace sector has resumed, and its use in other fields continues to increase. The development of new titanium-based products on the market is predicted, and it is expected that the price of titanium sponge will continue to rise in 1996. However, because of the substantial growth in demand and a reduction in inventories, customers will have to expect longer delays in having their orders filled.

The consumption of ferrotitanium should also increase nationally and internationally given that titanium alloys are increasingly in demand. Since ferrotitanium production capacity exceeds current demand, producers will easily meet this growth in demand.

In summary, the titanium industry will continue to grow. However, there are no plans to enlarge existing plants or build new facilities in the near future. On one hand, the market still seems uncertain; on the other hand, the plants currently in operation have the necessary production capacity to respond to stronger demand from consumers.

*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 December 31, 1995.*

## TARIFFS

Item No.	Description	Canada			United States	EU	Japan <sup>1</sup>
		MFN	GPT	USA	Canada	MFN	MFN
2614.00	Titanium ores and concentrates	Free	Free	Free	Free	Free	Free
2823.00	Titanium oxides	5.8% BPT-Free	Free	2%	1.2%	5.5%	4.6%
32.06	Pigments and preparations based on titanium dioxide						
3206.11	Pigments and preparations based on titanium dioxide, containing 80% or more by weight of titanium dioxide calculated on the dry weight	6% BPT-Free	Free	Free	Free	6-6.5%	3.6-4.5%
7202.91	Ferrotitanium and ferrosilico-titanium	8.8%	5%	Free	Free	4.5%	3.5%
8108.10.10	Unwrought titanium, not alloyed; powders, not alloyed	3.5%	Free	Free	Free	5%	4.7-5.8%
8108.10.20	Unwrought titanium, alloyed; waste and scrap; powders, alloyed	7.3%	4%	Free	Free	5%	4.7-5.8%
8108.90	Other titanium				1.1-3%	Free-7%	5.8%
8108.90.10	Anodes, coated, whether or not attached to a metal base, to be employed in the production of chlorine, sodium hydroxide or sodium chlorate	Free	Free	Free			
8108.90.90	Other	7.3%	4%	2%			

Sources: Customs Tariff, effective January 1996, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1996; The "Bulletin International des Douanes," Journal Number 14 (17th Edition), European Union, 1994-1995, "Conventional" column; Custom Tariff Schedules of Japan, 1995.

BPT British Preferential Tariff.

n.e.s. Not elsewhere specified.

<sup>1</sup> GATT rate is shown; lower tariff rates may apply circumstantially.

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

Item No.	1993		1994		1995 <sup>p</sup>	
	(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)
<b>PRODUCTION</b> (shipments)						
Titanium dioxide, slag	x	x	x	x	x	x
<b>EXPORTS</b>						
2614.00						
Titanium ores and concentrates						
United States	66 271	3 739	43 751	3 204	88 469	7 128
Other countries	x	x	x	x	x	x
Total	66 271 <sup>a</sup>	3 739 <sup>a</sup>	43 751 <sup>a</sup>	3 204 <sup>a</sup>	88 469 <sup>a</sup>	7 128 <sup>a</sup>
2823.00						
Titanium oxides						
United States	8 360	16 447	10 113 <sup>r</sup>	21 602 <sup>r</sup>	8 562	18 948
United Kingdom	145	387	203	552	480	1 115
Other countries	—	—	94	252 <sup>r</sup>	148	472
Total	8 505	16 835	10 410 <sup>r</sup>	22 408	9 189	20 537
3206.10						
Pigments and preparations based on titanium dioxide						
United States	39 794	88 581	59 964 <sup>r</sup>	128 875 <sup>r</sup>	78 598	179 069
Japan	308	685	199	429	133	336
Other countries	1 226	2 376 <sup>r</sup>	315	641	117	360
Total	41 328	91 647 <sup>r</sup>	60 478 <sup>r</sup>	129 948 <sup>r</sup>	78 848	179 769

TABLE 1A (cont'd)

Item No.	1993		1994		1995P		
	(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)	
<b>EXPORTS (cont'd)</b>							
8108.10	Unwrought titanium; waste and scrap; powders						
	United States	186	584	215	515	349	1 275
	United Kingdom	76	93	45	86	78	223
	Japan	–	–	1	25	1	89
	Total	262	677	260	627	428	1 588
8108.90	Titanium and articles thereof, n.e.s.						
	United States	52	2 125	55 <sup>r</sup>	1 851 <sup>r</sup>	64	2 296
	Japan	–	–	–	–	48	1 735
	France	..	39	–	–	24	623
	Other countries	19	162	5	208	11	511
	Total	70	2 330	60 <sup>r</sup>	2 062 <sup>r</sup>	147	5 171
<b>IMPORTS</b>							
2614.00	Titanium ores and concentrates						
	Australia	10 320	5 472	15 010	8 181	10 337	6 176
	United States	749	544	779	614	4 488	3 278
	India	2 713 <sup>r</sup>	1 360	18 161	1 272	18 054	1 331
	Other countries	..	857	1 012	677	717	670
	Total	13 782 <sup>r</sup>	8 235	34 963	10 746	33 596	11 460
2823.00	Titanium oxides						
	Italy	4 610	5 599	15 068	18 628	18 639	29 832
	Spain	–	–	12 865	15 354	14 996	23 471
	France	399	1 071	4 466	5 719	8 142	13 254
	United Kingdom	11	38	2 319	2 918	7 126	11 105
	Germany	2 549	4 039	1 604	2 640	965	2 948
	Other countries	736	1 724	492	1 829	772	2 059
	Total	8 306	12 475	36 814	47 091	50 639	82 673
3206.10	Pigments and preparations based on titanium dioxide						
	United States	34 473	71 881	49 981	104 742	47 605	112 800
	Germany	2 208	4 647	5 435	9 937	2 846	6 887
	France	2 439	3 905	2 625	4 544	2 292	5 301
	Finland	1 167	2 595	846	1 995	637	1 786
	United Kingdom	4 405	6 035	2 191	3 482	567	1 392
	Other countries	16 746	23 353	13 406	19 150	1 736	3 794
	Total	61 439	112 420	74 485	143 856	55 683	131 966
7202.91	Ferrotitanium and ferrosilico-titanium						
	United States	296	1 527	677 <sup>r</sup>	2 512	437	1 891
	France	–	–	50	261	122	696
	Other countries	65	203	134	733	200	1 079
	Total	361	1 731	861 <sup>r</sup>	3 508	759	3 669
8108.10	Unwrought titanium; waste and scrap; powders						
	United States	595	5 181	266	2 121	497	4 999
	People's Republic of China	–	–	..	3	124	2 187
	Other countries	36	461	110	973	13	310
	Total	631	5 643	377	3 099	635	7 498
8108.90	Titanium and articles thereof, n.e.s.						
	United States	853	28 382	1 292 <sup>r</sup>	42 202 <sup>r</sup>	954	36 146
	United Kingdom	114	3 110	66	1 959	189	8 481
	Italy	–	–	1	53	167	5 349
	Norway	–	–	–	–	13	922
	Other countries	175	4 812	107	3 084	80	2 822
	Total	1 142	36 310	1 466 <sup>r</sup>	47 304 <sup>r</sup>	1 402	53 729
<b>CONSUMPTION<sup>1</sup></b>							
	Ferrotitanium, gross weight	771	..	1 420	..	..	..

Sources: Natural Resources Canada; Statistics Canada.

– Nil; .. Not available; ... Amount too small to be expressed; n.e.s. Not elsewhere specified; P Preliminary; r Revised; x Confidential.

<sup>a</sup> Total represents exports only to the United States. Exports to other countries are confidential and are not included in the total.<sup>1</sup> Available data as reported by consumers.

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

TABLE 1B. CANADA, TITANIUM PRODUCTION, TRADE AND CONSUMPTION, 1990-92

Item No.		1990		1991		1992	
		(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)
<b>PRODUCTION</b> (shipments)							
	Titanium dioxide, slag	x	x	x	x	x	x
<b>EXPORTS</b>							
2614.00	Titanium ores and concentrates						
	United States	29 197	2 554	50 192	8 644	32 414	2 041
	Other countries	x	x	x	x	x	x
	Total	29 197 <sup>a</sup>	2 554 <sup>a</sup>	50 192 <sup>a</sup>	8 644 <sup>a</sup>	32 414 <sup>a</sup>	2 041 <sup>a</sup>
2823.00	Titanium oxides						
	United States	5 266	8 907	5 305	9 213	8 394	14 787
	United Kingdom	102	276	145	417	247	753
	Other countries	301	886	157	386	39	174
	Total	5 669	10 074	5 607	10 018	8 680	15 716
3206.10	Pigments and preparations based on titanium dioxide						
	United States	41 558	80 406	42 388	84 622	43 351	89 803
	Japan	123	305	48	112	191	403
	Other countries	603	1 710	107	274	67	206
	Total	42 285	82 430	42 542	85 011	43 610	90 417
7202.91	Ferrotitanium and ferrosilico-titanium						
	France	2	8	—	—	4	16
	United States	—	—	—	—	1	5
	Total	2	8	—	—	5	22
8108.10	Unwrought titanium; waste and scrap; powders						
	United States	228	945	190	737	250	613
	United Kingdom	45	168	92	232	31	60
	Japan	—	—	—	—	2	55
	Total	274	1 113	281	969	283	728
8108.90	Titanium and articles thereof, n.e.s.						
	United States	718	20 833	391	10 721	148	4 380
	Indonesia	27	1 591	—	—	—	—
	Other countries	8	358	3	86	5	332
	Total	754	22 786	394	10 809	153	4 717
<b>IMPORTS</b>							
2614.00	Titanium ores and concentrates						
	Australia	25 166	18 936	31 153	15 855	6 397	3 517
	United States	1 347	1 217	811	703	567	405
	Other countries	1 010	831	11 340	6 162	23	11
	Total	27 523	20 985	43 304	22 721	6 988	3 934
2823.00	Titanium oxides						
	Germany	586	1 402	950	2 126	2 407	5 245
	France	578	1 413	2 848	5 322	1 073	2 028
	United States	2 242	4 887	2 422	4 642	418	1 157
	United Kingdom	237	642	2 149	4 091	600	1 033
	Netherlands	10	17	56	129	391	993
	Other countries	302	737	1 355	2 501	117	326
	Total	3 957	9 105	9 781	18 817	5 007	10 785
3206.10	Pigments and preparations based on titanium dioxide						
	United States	13 852	30 147	18 592	35 564	23 891	44 354
	United Kingdom	115	286	347	826	3 773	6 252
	Spain	18	47	91	198	2 393	3 879
	Finland	26	90	75	188	1 515	3 306
	France	102	271	910	1 872	1 721	2 975
	Other countries	159	643	734	1 693	2 150	4 677
	Total	14 272	31 486	20 750	40 346	35 444	65 448

TABLE 1B (cont'd)

Item No.	1990		1991		1992		
	(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)	
<b>IMPORTS (cont'd)</b>							
7202.91	Ferrotitanium and ferrosilico-titanium						
	United States	328	2 656	229	1 584	159	1 005
	Belgium	6	56	—	—	60	393
	Other countries	180	1 069	77	323	110	348
	Total	514	3 781	306	1 908	329	1 748
8108.10	Unwrought titanium; waste and scrap; powders						
	United States	875	10 612	598	6 618	584	5 429
	United Kingdom	32	486	—	—	8	80
	Other countries	1	16	—	—	2	39
	Total	908	11 115	598	6 618	595	5 551
8108.90	Titanium and articles thereof, n.e.s.						
	United States	1 320	49 780	934	33 735	629	22 888
	United Kingdom	83	2 462	36	2 199	17	851
	Germany	2	194	2	151	9	482
	Japan	166	4 771	22	480	20	400
	Other countries	51	7 036	28	2 378	8	349
	Total	1 622	64 246	1 022	38 946	684	24 975
<b>CONSUMPTION<sup>1</sup></b>							
	Ferrotitanium, gross weight	571	..	634	..	754	..

Sources: Natural Resources Canada; Statistics Canada.

— Nil; .. Not available; n.e.s. Not elsewhere specified; x Confidential.

<sup>a</sup> Total represents exports only to the United States. Exports to other countries are confidential and not included in the total.<sup>1</sup> Available data as reported by consumers.

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