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VANADIUM [ADVANCE RELEASE]

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VANADIUM

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In 2007, reported vanadium consumption in the United States was 4,970 metric tons (t) of contained vanadium, a 23% increase from that of 2006 (table 1). The United States exported 154 t of FeV, 327 t of V_2O_5, and 626 t of other oxides and hydroxides of vanadium valued at $18.8 million. Total exports of these vanadium-bearing materials decreased by 29% from those of 2006. This decrease is mainly attributed to the 60% decrease of FeV exports. The United States imported 2,220 t of ferrovanadium (FeV), measured in vanadium content, 2,390 t of vanadium pentoxide (V_2O_5), and 42 t of other oxides and hydroxides of vanadium, collectively valued at $129 million. Total imports for consumption of these vanadium materials increased by 11% from those of 2006.

Vanadium was produced in the United States solely by recovery of vanadium from various industrial waste materials, such as vanadium-bearing fly ash, petroleum residues, pig iron slag, and spent catalysts. Fewer than 10 firms, primarily in Arkansas, Ohio, Pennsylvania, and Texas, processed these materials to produce V_2O_5, FeV, and vanadium metal. Metallurgical applications in which vanadium was used as an alloying element with iron, steel, and titanium remained the dominant end use. Catalysts represent the leading nonmetallurgical use for vanadium.

Legislation and Government Programs

In December, the U.S. International Trade Commission initiated sunset reviews of the antidumping duty orders on FeV from China and South Africa. The duty orders cover all FeV regardless of chemistry, form, grade, shape, or size. The review excluded vanadium additives other than FeV, such as nitrided vanadium, vanadium-aluminum master alloys, vanadium chemicals, vanadium oxides, vanadium waste and scrap, and vanadium-bearing raw materials such as boiler residues, fly ash, and slag (U.S. Department of Commerce, International Trade Administration, 2008).

Production

The major vanadium commodities are aluminum-vanadium master alloys, FeV, vanadium-bearing ash, residues and slag, vanadium chemicals, and V_2O_5 and other oxides and hydroxides of vanadium. In 2007, companies in the United States produced all of these materials, with the exception of vanadium-bearing slag, from the manufacture of iron and steel. Vanadium-containing steels can be subdivided into microalloy or low-alloy steels that generally contain less than 0.15% vanadium and high-alloy steels that contain as much as 5% vanadium.

Strategic Minerals Corp. Inc. (Stratcor) announced that an explosion and fire in August had temporarily halted production of vanadium and non-vanadium master alloys at its International Specialty Alloys (ISA) plant in New Castle, PA. Stratcor arranged for alternate vanadium-aluminum master alloy supply to meet customer demand until production could be restored. Stratcor's subsidiary, Vametco Minerals Corp. (South Africa), made alternate arrangements for vanadium-bearing pig iron slag owing to production problems at its normal supplier, Highveld Steel and Vanadium Corp. Ltd. (Ryan's Notes, 2007c, d). In February 2008, ISA restarted the facilities that produce non-vanadium master alloys used in aerospace applications.

Vametco Alloys (South Africa) increased its V_2O_5 production capacity by 25% to about 3,800 t (8.4 million pounds). All additional V_2O_5 production was being used to produce Nitrovan vanadium, Stratcor's proprietary nitrided vanadium product. Vametco is a fully integrated facility from ore production at its Britt Mine to finished vanadium products. Vametco also recovers vanadium from pig iron slag obtained from a nearby steel mill (Ryan's Notes, 2007a).

Consumption

The USGS derived vanadium consumption data from a voluntary survey of domestic consuming companies. For this survey, more than 80 companies were canvassed on a monthly or annual basis. Some industry estimates indicate that actual domestic consumption is much greater than reported consumption.

Metallurgical applications continued to dominate U.S. vanadium use in 2007, accounting for 93% of reported consumption. Nonmetallurgical applications included catalysts, ceramics, electronics, and vanadium chemicals. The dominant nonmetallurgical use was in catalysts. Based on USGS data, reported domestic vanadium consumption in 2007 was 4,970 t, an increase of 23% from that of 2006. This increase in reported vanadium consumption reflected stable demand by steel producers.

Most vanadium is consumed in the form of FeV, which is used as a means of introducing vanadium into steel, in which it provides additional strength and toughness. FeV is available as alloys containing 45% to 50%, or 80% vanadium. The 45%- to 50%-grade FeV is produced by the silicothermic reduction of V_2O_5 in slag or other vanadium-containing materials. Most of the 80%-grade FeV is produced by the aluminothermic reduction of V_2O_5 in the presence of steel scrap or by direct reduction in an electric arc furnace.

A vanadium redox battery (VRB) consists of an assembly of power cells in which two vanadium-based electrolytes are separated by a proton exchange membrane. The main advantages of the VRB are that it can offer almost unlimited capacity simply by using sequentially larger storage tanks, it can be left completely discharged for long periods of time with no ill effects, it can be recharged by replacing the electrolyte if no power source is available to charge it, and the battery suffers no permanent damage if the electrolytes are accidentally mixed.

The extremely large capacities possible from VRBs make them well suited to use in large power storage applications. For example, they can help average out the production of highly variable generation sources, such as wind power. In May, VRB Power Systems (Canada), which has patented the technology, announced that the Australian Government is moving toward deploying VRBs in remote communities across Australia (Holzman, 2007). In Castle Valley, UT, the utility PacifiCorp has used VRBs for the past 3 years to maintain voltage on a 124-mile line that services remote areas.

Besides windfarms, potential VRB markets include off-grid housing complexes and solar powerplants, especially in places like California where there is a large difference in the cost of peak and off-peak power (Holzman, 2007). With growing interest in renewable energy, VRB usage is poised to increase worldwide.

Cellennium Co. (Thailand), a local fuel-cell producer, aims to promote its vanadium fuel cell technology globally after gaining investment capital from MFC Energy Fund. A vanadium fuel-cell bicycle and an energy-saving housing project are some of the small-scale applications tested by Cellennium (Bangkok Post, 2008).

Prices

In 2007, the price for domestic FeV, as published in Metal Bulletin, ranged from $15.25 to $21.00 per pound of contained vanadium, compared with $16.00 to $23.00 per pound reported in 2006. The price averaged about $15.75 per pound in January, gradually increased to about $20 per pound in March through November, and then decreased to about $18.50 per pound in December. The European FeV price ranged from $28.50 to $42.00 per kilogram compared with $33.00 to $49.00 per kilogram in 2005. The European price averaged about $30.80 per kilogram in January, rose to about $39.15 per kilogram in March, averaged about $37.35 per kilogram from June through August, and then rebounded to about $38 in September before drifting down to $35.60 per kilogram in December.

The Metal Bulletin published price for domestic V_2O_5 ranged between $5.71 and $8.30 per pound in 2007, compared with $6.40 and $10.00 per pound in 2006. The price averaged about $5.95 per pound in January, gradually increased to about $8.15 per pound in May, drifted down to about $7.60 per pound in August, and then rebounded to about $7.75 per pound in October before slightly decreasing to $7.50 per pound in December.

World Industry Structure

Nearly all the world's supply of vanadium was from primary sources. Five countries recovered vanadium from ores, concentrates, slag, or petroleum residues (table 7). In four of the five countries, the mining and processing of magnetite-bearing ores was an important source of vanadium production. The leading vanadium-producing nations remained China, Russia, and South Africa. Japan and the United States were thought to be the only countries to recover significant quantities of vanadium from petroleum residues.

Recycling of vanadium-containing alloys for recovery of vanadium was negligible and involved mainly a small quantity of tool steel. Vanadium's major end use was as an alloying-element in iron, steel, and titanium-bearing alloys, from which it is lost to slag and not recovered when those metals are recycled. Only small quantities of vanadium were recovered from recycling vanadium-bearing catalysts and that material was reused to make new catalysts.

The world vanadium reserve base, at more than 38 million metric tons (Mt), is sufficient to meet vanadium demand into the next century at the present rate of consumption. This does not account for the increased recovery of vanadium from fly ash, petroleum residues, slag, and spent catalyst that is expected to extend the life of the reserve base significantly.

World Review

Australia.— Precious Metals Australia Ltd. (PMA) received environmental approvals to proceed with construction and operation of the Windimurra Mine in Western Australia. Process design changes, not included in the original permits from 1998, have been approved. PMA expected that annual FeV production of 6,400 t would commence at Windimurra in the second half of 2008 (Platts Metals Week, 2007b). South Africa-based Drytech International was awarded the contract to design and supply $20 million of high-tech vanadium processing equipment for cost-effective production of FeV. Originally discovered by PMA in 1985, Windimurra reportedly has current minable reserves of 98.2 Mt at a bulk grade of 0.4% V_2O_5, which will underpin an initial mine life of 25 years at the proposed extraction rate of 3.9 million metric tons per year (Mt/yr) (Metals Place, 2007d).

China.—Chinese exports of V_2O_5 in 2007 increased by 33% year-on-year to reach about 10,500 t. About one-third went to the Republic of Korea, where it was thought to have been converted to FeV, which would bypass China's export tax on FeV. With a number of new vanadium projects currently underway, the Government of China took steps to control the increase in vanadium production by canceling toll trading tax benefits for vanadium on April 26. Companies that toll process vanadium for re-export would be liable for import/export taxes as well as value added taxes unless registered in a tax-free zone prior to the announcement. China was also considering canceling the 5% value added tax rebate on exports of V_2O_5 and possibly imposing an export duty on V_2O_5 to keep more V_2O_5 for domestic use (Metal Bulletin Research, 2007a).

China's top two vanadium product makers in China, Chengde Xinxin Vanadium and Titanium Co., Ltd. and Panzhihua New Steel and Vanadium Co., Ltd., set up a vanadium trading company. The two companies will separately have 51% and 49% of the joint venture. The two companies intend to stabilize domestic vanadium product price and enhance their pricing power (Metals Place, 2007a).

Asian Dragon Group Inc.'s majority-owned China Base Metal Development Company and Funding Mining Development Limited, entered an acquisition agreement for a 70% interest in Lushi Jiashapa (JSP) Vanadium Mine, located in Henan Province, China. Current Chinese reports estimated the ore body within the JSP property contains more than 50,000 t of vanadium (Metals Place, 2007a).

The Panzihihua Iron and Steel Group reached a framework agreement with the local government on building a vanadium-titanium steel production facility in Xichang, Sichuan Province. The company expected the project would produce 3.5 Mt/yr of hot-rolled steel plates and vanadium slag, and 200,000 metric tons per year of vanadium-titanium steel in about 3 years (Metals Place, 2007b).

Japan.—JFE Material Co. Ltd. (Toyama, Japan), continued production of 50% FeV from spent desulfurization catalysts and petroleum residues in 2007 (Ryan's Notes, 2006).

In Japan, V_2O_5 is marketed as a mineral health supplement present in drinking water taken mainly from the slopes of Mount Fuji. The water's V_2O_5 content ranges from about 80 to 130 micrograms per liter. It is marketed as being effective against diabetes, eczema, and obesity, but there is no mention of its potential toxicity (International Alliance of Dietary/Food Supplements Associations, 2008).

South Africa.—Xstrata Alloys Ltd. (Rustenburg, South Africa) agreed to an $80 million, black economic empowerment transaction with the Bakwena Ba Mogopa traditional community. The community owned the property on which Xstrata's Rhovan vanadium facility was located. Under the terms of the transaction, the community would gain 26% participation in the integrated vanadium operation through a shared venture, subject to regulatory approval (Platts Metals Week, 2007c). Plans for a brownfield expansion to increase production capacity at the Rhovan facility by 8.5 million pounds per year of V_2O_5 were expected to be presented to Xstrata's board of directors by the end of 2007 (Ryan's Notes, 2007e).

Production of V_2O_5 at Highveld Steel and Vanadium Corp. Ltd.'s Vanchem facility rose to 2,174 t in the first half of 2007 compared with 1,788 t in the first half of 2006. Similarly, FeV production at Vanchem rose to 4,526 t in the first half of 2007 compared with 3,793 t in the first half of 2006. Highveld scheduled refractory relining of two kilns in the second half of 2007 owing to expected slow sales during the summer, did not expect this to affect the market.

Evraz Group S.A. (Russia) increased its ownership position in Highveld to 79% after purchasing Credit Suisse Global's shares for $219 million (Ryan's Notes, 2007c). In July 2006, Evraz had acquired a 24.9% interest in Highveld and an option to acquire an additional stake once regulatory approval was obtained. The European Commission and South African authorities granted approvals in February and April, respectively, with the stipulation that Evraz divest some of the Highveld assets (Platts Metals Week, 2007a).

Evraz agreed to sell the Vanchem operations in Witbank, divest its 50% interest in South Africa Japan Vanadium Ltd., and grant access to Highveld's Mapochs Mine and maintain existing vanadium feedstock supply agreements with certain customers. Because Evraz then controlled 54.1% of Highveld, under South African law Evraz had to make a purchase offer to all outstanding Highveld stockholders within 30 days of the date its ownership stake exceeded 35% (Platts Metals Week, 2007a). The sales of these vanadium assets were initially targeted to be finalized by December, but were postponed until January 20, 2008, and it was likely a final decision would not be made until the middle of 2008.

Evraz reported that South African production of vanadium in alloys and chemicals was 3,450 t in the first half of 2007 and that North American production for the first half of the year was 992 t of vanadium in alloys and chemicals (Ryan's Notes, 2007b).

Pinnacle Resources, Inc. entered into an agreement with an Australian mining company that has indicated that planned to develop Pinnacle's South African vanadium-bearing magnetite deposit. Pinnacle's vanadium property comprised a resource of 300 Mt of magnetite to a depth of 200 meters from the surface, which contained an estimated 11 kilograms of V_2O_5 per metric ton of magnetite (Metals Place, 2007c).

Outlook

Despite the European Commission's attempt to prevent Evraz from taking a major share of the vanadium market, Evraz is currently the leading shareholder of vanadium-producing companies in the world.

Ferroniobium can be substituted for FeV in some high-strength steels. In 2005 and part of 2006, this substitution led to a temporary slowdown in the increase in vanadium consumption. As vanadium prices decreased in 2007 and niobium prices increased, the growth trend in vanadium substitution slowed and in some cases reversed. However, a switch to production of higher-strength rebar in China is likely to increase demand for both vanadium and niobium in the future (Bunting, 2007).

Vanadium's primary use was as a hardening agent in steel. Global raw steelmaking capacity is expected to increase steadily to 1.48 billion metric tons (Gt) in 2008 from 1.44 Gt in 2007 (Fenton, 2008). World production of vanadium in 2007 was estimated to be about 59,060 t of contained vanadium, a 2% increase from that of 2006. With the expected growth in steel production for the next 3 to 5 years, strong demand for vanadium was expected to continue.

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TABLE 1
SALIENT VANADIUM STATISTICS[1]

(Metric tons of contained vanadium, unless otherwise specified)

	2003	2004	2005	2006	2007
United States:					
Production, ore and concentrate:					
Recoverable vanadium[2], value thousand dollars	--	--	--	--	--
Vanadium oxide recovered from ore[3]	--	--	--	--	--
Consumption	3,240	4,050	3,910	4,030	4,970
Exports:					
Ferrovanadium	397	285	505 r	389	154
Vanadium pentoxide (anhydride)	185	240	254 r	341	327
Other oxides and hydroxides of vanadium	284	584	899 r	832	626
Imports for consumption:					
Ferrovanadium	1,360	3,020	11,900	2,140	2,220
Ore, slag, ash, residues	3,060	2,350	1,690	997	921
Vanadium pentoxide (anhydride)	474	1,040	1,370	1,920	2,390
Other oxides and hydroxides of vanadium	74	120	186	129	42
Stocks:					
Ferrovanadium	213	320	343	275	253
Oxide	6	6	2	6	22
Other[4]	33	10	26	49	48
World, production from ore, concentrate, slag[e]	47,900	51,900	56,400	56,300	59,200

[e]Estimated. [r]Revised. -- Zero.

[1]Data are rounded to no more than three significant digits.

[2]Recoverable vanadium contained in uranium and vanadium ores and concentrates received at mill, plus vanadium recovered from ferrophosphorous slag derived from domestic phosphate rock.

[3]Produced directly from all domestic ores and ferrophosphorous slag; includes metavanadates.

[4]Consists principally of vanadium-aluminum alloy, small quantities of other vanadium alloys, vanadium metal, and ammonium metavanadate.

TABLE 2

U.S. CONSUMPTION OF VANADIUM, BY END USE AND FORM[1]

(Kilograms of contained vanadium)

	2006	2007
End use:		
Steel:		
Carbon	1,210,000	1,190,000
Full alloy	1,030,000	1,380,000
High-strength low-alloy	1,020,000	1,560,000
Stainless and heat resisting	61,400	61,400
Tool	323,000	379,000
Total	3,650,000	4,570,000
Cast irons	W	W
Superalloys	39,500	43,700
Alloys (excluding steels and superalloys):		
Welding and alloy hard-facing rods and materials	W	W
Other alloys[2]	W	W
Chemical and ceramic uses:		
Catalysts	W	W
Pigments	W	W
Miscellaneous and unspecified	335,000	356,000
Grand total	4,030,000	4,970,000
Form:		
Ferrovanadium	3,410,000	3,780,000
Oxide	264,000	326,000
Other[3]	354,000	860,000
Total	4,030,000	4,970,000

W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified."

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

[2]Includes magnetic alloys.

[3]Consists principally of vanadium-aluminum alloy, small quantities of other vanadium alloys, vanadium metal, and ammonium metavanadate.

TABLE 3
U.S. IMPORTS AND EXPORTS OF ALUMINUM-VANADIUM MASTER ALLOY
AND VANADIUM METAL, INCLUDING WASTE AND SCRAP[1]

	Aluminum-vanadium master alloy		Vanadium metal, including waste and scrap	
	Quantity, gross weight (kilograms)	Value	Quantity, gross weight (kilograms)	Value
Imports for consumption:				
2006	102,000	$312,000	122,000 r	$5,280,000 r
2007:				
Canada	797,000	1,120,000	--	--
Germany	--	--	838	125,000
Mexico	256,000	677,000	2,520	25,200
Romania	56,400	281,000	--	--
Russia	--	--	263	48,000
United Kingdom	2,380	31,700	--	--
Total	1,110,000	2,110,000	3,620	198,000
Exports:				
2006	17,000,000	54,500,000	491,000	13,200,000
2007:				
Australia	2,920	37,900	--	--
Belgium	201,000	3,350,000	--	--
Brazil	3,670	89,600	165	59,400
Canada	8,300,000	25,500,000	1,800	56,600
China	50,200	230,000	--	--
Columbia	18,100	128,000	--	--
Czech Republic	204	4,840	--	--
France	1,230	15,900	--	--
Germany	7,280	175,000	6,960	132,000
India	4,380	31,600	31,000	2,140,000
Italy	534	12,100	--	--
Japan	275,000	4,440,000	7,730	231,000
Korea, Republic of	29,900	225,000	--	--
Lebanon	--	--	1,070	25,500
Malaysia	7,540	50,800	--	--
Mexico	12,100,000	36,400,000	--	--
Netherlands	3,240	40,700	--	--
Peru	620	8,060	--	--
Singapore	29,700	184,000	--	--
Spain	2,040	25,200	--	--
Sri Lanka	263	3,410	--	--
Switzerland	--	--	114	4,410
Taiwan	9,960	81,100	--	--
United Kingdom	102,000	1,690,000	506	36,000
Venezuela	924	12,000	41	7,420
Total	21,100,000	72,700,000	49,400	2,690,000

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

Source: U.S. Census Bureau.

TABLE 4
U.S. IMPORTS AND EXPORTS OF FERROVANADIUM, VANADIUM PENTOXIDE (ANHYDRIDE), AND OTHER OXIDES AND HYDROXIDES OF VANADIUM[1]

	Ferrovanadium		Vanadium pentoxide (anhydride)[2]		Other oxides and hydroxides of vanadium	
	Quantity, V content (kilograms)	Value	Quantity, V content (kilograms)	Value	Quantity, V content (kilograms)	Value
Imports for consumption:						
2006	2,140,000	$90,500,000	1,920,000	$45,200,000	129,000	$3,370,000
2007:						
Austria	173,000	7,090,000	4,340	122,000	25,200	758,000
Brazil	17,600	610,000	--	--	--	--
Canada	442,000	14,500,000	--	--	--	--
China	15,100	563,000	647,000	14,000,000	--	--
Czech Republic	729,000	28,000,000	--	--	--	--
Germany	3,550	318,000	5,310	154,000	10,900	458,000
Israel	--	--	--	--	5,820	153,000
Japan	4,980	226,000	950	82,600	--	--
Korea, Republic of	806,000	29,000,000	--	--	--	--
Mexico	99	22,800	--	--	--	--
Netherlands	--	--	204	4,950	--	--
Russia	--	--	793,000	11,800,000	--	--
South Africa	7,900	336,000	936,000	20,400,000	--	--
Taiwan	15,700	584,000	7,270	229,000	--	--
United Kingdom	--	--	--	--	12	30,700
Total	2,220,000	81,300,000	2,390,000	46,800,000	41,900	1,400,000
Exports:						
2006	389,000	11,400,000	341,000	7,150,000	832,000	7,780,000
2007:						
Argentina	--	--	500	20,900	--	--
Australia	567	27,700	--	--	--	--
Belgium	--	--	36,000	647,000	27,600	479,000
Brazil	--	--	87	4,080	14,700	197,000
Canada	119,000	4,930,000	--	--	29,100	263,000
China	--	--	2,000	37,000	9,530	139,000
France	--	--	--	--	7,290	111,000
Germany	--	--	11,700	197,000	135,000	1,390,000
India	--	--	45,200	541,000	--	--
Italy	48	2,920	46,700	1,320,000	--	--
Japan	7,760	75,600	--	--	64,600	1,120,000
Korea, Republic of	--	--	84,900	807,000	1,860	17,900
Mexico	18,600	602,000	3,000	69,700	--	--
Netherlands	--	--	20	2,600	14,700	164,000
Romania	7,810	174,000	--	--	--	--
Russia	--	--	38,600	676,000	313,000	3,580,000
Saudi Arabia	--	--	41,700	870,000	--	--
Sierra Leone	--	--	--	--	1,240	11,100
Singapore	--	--	--	--	961	13,900
Spain	--	--	12,100	148,000	4,770	29,300
Trinidad and Tobago	--	--	4,900	113,000	--	--
Turkey	--	--	--	--	359	3,190
United Kingdom	--	--	--	--	910	8,100
Total	154,000	5,810,000	327,000	5,460,000	626,000	7,530,000

-- Zero.

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

[2]May include catalysts that contain vanadium pentoxide.

Source: U.S. Census Bureau.

TABLE 5

U.S. IMPORTS FOR CONSUMPTION OF VANADIUM-BEARING ASH, RESIDUES, AND SLAG[1]

	2006		2007	
Material and country	Quantity, V_2O_5 content (kilograms)	Value	Quantity, V_2O_5 content (kilograms)	Value
Ash and residues:				
Canada	1,130,000	$1,110,000	714,000	$1,130,000
Mexico	637,000	7,320,000	931,000	9,750,000
United Kingdom	11,500	21,600	--	--
Total	1,780,000	8,450,000	1,640,000	10,900,000
Slag, from the manufacture of iron and steel[2]	360,000	808,000	370,000	924,000

-- Zero.

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

[2]Slag imports from China and South Africa; data adjusted by the U.S. Geological Survey.

Source: U.S. Census Bureau.

TABLE 6

U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS VANADIUM CHEMICALS[1, 2]

	2006		2007	
Material and country	Quantity, V content (kilograms)	Value	Quantity, V content (kilograms)	Value
Sulfates:				
China	--	--	80,200	$775,000
India	16 r	$25,800	11	7,370
Total	16 r	25,800	80,200	783,000
Vanadates:				
Austria	299	5,370	--	--
China	--	--	34,400	1,140,000
Germany	23,300	935,000	7,540	316,000
Japan	2,220	42,500	44,500	237,000
Korea, Republic of	4,640	25,500	--	--
Netherlands	2,460	78,600	--	--
Russia	--	--	7	5,600
South Africa	75,400	2,180,000	116,000	1,810,000
United Kingdom	6,690	68,200	8,070	47,400
Total	115,000	3,330,000	211,000	3,550,000

rRevised. -- Zero.

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

[2]Comprises vanadium ore and miscellaneous vanadium chemicals.

Source: U.S. Census Bureau.

TABLE 7

VANADIUM: ESTIMATED WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons of contained vanadium)

Country	2003	2004	2005	2006	2007
Production from ores, concentrates, slag:[3]					
Australia	160 [4]	150 [4]	100	-- [r]	--
China[5]	13,200	16,000	17,000	17,500	19,000
Kazakhstan	1,000	1,000	1,000	1,000	1,000
Russia	5,800	10,900	15,100	15,100	14,500
South Africa	27,172 [4]	23,302 [4]	22,601 [r, 4]	23,780 [r, 4]	24,000
Total	47,300	51,400	55,800	57,400 [r]	58,500
Ash spent catalysts, Japan	560	560	560	560	560
Grand total	47,900	51,900	56,400	57,900 [r]	59,100

[r]Revised. -- Zero.

[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]In addition to the countries listed, vanadium is also recovered from petroleum residues in Germany and several other European countries, but available information is insufficient to make reliable estimates. Table includes data available through June 1, 2008.

[3]Production in this section is credited to the country that was the origin of the vanadiferous raw material.

[4]Reported figure.

[5]Estimated 40% of vanadium recovered from vanadiferous slag.