VANADIUM

(Data in metric tons of vanadium content, unless otherwise noted)

Domestic Production and Use: Eight firms make up the U.S. vanadium industry. These firms process material such as ferrophosphorus slag, petroleum residues, spent catalysts, utility ash, and vanadium-bearing iron slag to produce ferrovanadium, vanadium pentoxide, vanadium metal, and vanadium-bearing chemicals or specialty alloys. Metallurgical use, primarily as an alloying agent for iron and steel, accounts for more than 95% of the vanadium consumed domestically. Of the other uses for vanadium, the major nonmetallurgical use was in catalysts for the production of maleic anhydride and sulfuric acid. With regard to total domestic consumption, major end-use distribution was as follows: carbon steel, 38%; high-strength low-alloy steel, 20%; full alloy steel, 19%; tool steel, 10%; and other, 13%.

Production:
- Mine, mill
- Petroleum residues, recovered basis 2,830 1,990 3,730 NA NA
Imports for consumption:
- Ash, ore, residues, slag 1,900 2,530 2,270 2,950 5,000
- Vanadium pentoxide, anhydride 294 547 485 711 1,000
- Oxides and hydroxides, other 3 36 11 126 60
- Aluminum-vanadium master alloys (gross weight) 38 36 2 11 50
- Ferrovanadium 1,910 1,950 1,880 1,840 1,700
Exports:
- Vanadium pentoxide, anhydride 335 229 241 614 400
- Oxides and hydroxides, other 1,050 1,010 2,670 385 100
- Aluminum-vanadium master alloys (gross weight) 1,030 660 310 974 1,400
- Ferrovanadium 374 340 479 446 500
Shipments from Government stockpile — 416 201 260 —
Consumption: Reported 4,280 4,650 4,630 4,730 4,700
- Apparent W W W W W
Price, average, dollars per pound V₂O₅ 2.95 2.80 3.19 3.90 4.00
Stocks, producer and consumer, yearend 1,110 1,100 1,070 1,000 300
Employment, mine and mill, number 400 390 390 400 400
Net import reliance1 as a percent of apparent consumption W W W W W

Recycling: Some tool steel scrap was recycled primarily for its vanadium content, and vanadium was recycled from spent chemical process catalysts, but these two sources together accounted for only a very small percentage of total vanadium used.

Import Sources (1994-97): Ferrovanadium: Canada, 40%; Russia, 18%; China, 12%; Czech Republic, 11%; and other, 19%. Vanadium pentoxide: South Africa, 89%; China, 6%; Russia, 4%; and other, 1%.

Tariff: Ash, residues, slag, and waste and scrap enter duty-free.

<table>
<thead>
<tr>
<th>Item</th>
<th>Number</th>
<th>Normal Trade Relations (NTR)</th>
<th>Non-NTR2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>12/31/98</td>
<td>12/31/98</td>
</tr>
<tr>
<td>Vanadium pentoxide anhydride</td>
<td>2825.30.0010</td>
<td>12.8% ad val.</td>
<td>40% ad val.</td>
</tr>
<tr>
<td>Vanadium oxides and hydroxides,</td>
<td>2825.30.0050</td>
<td>12.8% ad val.</td>
<td>40% ad val.</td>
</tr>
<tr>
<td>other</td>
<td>2841.90.1000</td>
<td>9.5% ad val.</td>
<td>40% ad val.</td>
</tr>
<tr>
<td>Vanadates</td>
<td>7202.92.0000</td>
<td>4.2% ad val.</td>
<td>25% ad val.</td>
</tr>
<tr>
<td>Ferrovanadium</td>
<td>7601.20.9030</td>
<td>Free</td>
<td>10.5% ad val.</td>
</tr>
</tbody>
</table>

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Prepared by Robert G. Reese, Jr. [(703) 648-4981, rreese@usgs.gov, fax: (703) 648-7757]
VANADIUM

**Government Stockpile:** None.

**Events, Trends, and Issues:** Vanadium consumption in the United States in 1998 was essentially unchanged from that in 1997. Although total consumption was essentially unchanged, preliminary data indicated the following changes among the major uses for vanadium during the first six months of 1998: carbon steel increased 7%; full alloy steel increased 14%; high-strength low-alloy steel increased 5%; and tool steel decreased 37%.

**World Mine Production, Reserves, and Reserve Base:**

<table>
<thead>
<tr>
<th></th>
<th>Mine production</th>
<th>Reserves&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Reserve base&lt;sup&gt;3&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1997</td>
<td>1998&lt;sup&gt;e&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>W</td>
<td>W</td>
<td>45,000</td>
</tr>
<tr>
<td>China</td>
<td>8,000</td>
<td>7,000</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Russia</td>
<td>11,000</td>
<td>11,000</td>
<td>5,000,000</td>
</tr>
<tr>
<td>South Africa</td>
<td>17,000</td>
<td>16,000</td>
<td>3,000,000</td>
</tr>
<tr>
<td>Other countries</td>
<td>1,100</td>
<td>1,000</td>
<td>—</td>
</tr>
<tr>
<td>World total (may be rounded)</td>
<td>^37,100</td>
<td>^35,000</td>
<td>10,000,000</td>
</tr>
</tbody>
</table>

**World Resources:** World resources of vanadium exceed 63 million tons. Vanadium occurs in deposits of titaniferous magnetite, phosphate rock, and uraniferous sandstone and siltstone, in which it constitutes less than 2% of the host rock. Significant amounts are also present in bauxite and carboniferous materials, such as crude oil, coal, oil shale, and tar sands. Because vanadium is usually recovered as a byproduct or coproduct, demonstrated world resources of the element are not fully indicative of available supplies. While domestic resources are adequate to supply current domestic needs, a substantial part of U.S. demand is currently met by foreign material because of price advantages.

**Substitutes:** Steels containing various combinations of other alloying elements can be substituted for steels containing vanadium. Among various metals that are to some degree interchangeable with vanadium as alloying elements in steel are columbium, manganese, molybdenum, titanium, and tungsten. Platinum and nickel can replace vanadium compounds as catalysts in some chemical processes. There is currently no acceptable substitute for vanadium in aerospace titanium alloys.

<sup>1</sup>Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

<sup>2</sup>Defined as imports - exports + adjustments for Government and industry stock changes.

<sup>3</sup>See Appendix B.

<sup>4</sup>See Appendix D for definitions.

<sup>5</sup>Excludes U.S. mine production.