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. The ferrophosphorus slag was produced at a mine in Idaho. 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 29%; high-strength low-alloy steel, 25%; full alloy steel, 24%; tool steel, 9%; and other, 13%.


Production:
- Mine, mill W W W W W
- Petroleum residues, recovered basis 1,990 3,730 *2,000 *2,000 NA

Imports for consumption:
- Ash, ore, residues, slag 2,530 2,270 2,950 2,400 2,200
- Vanadium pentoxide, anhydride 547 485 711 847 600
- Oxides and hydroxides, other 36 11 126 33 10
- Aluminum-vanadium master alloys (gross weight) 36 2 11 298 300
- Ferrovanadium 1,950 1,880 1,840 1,620 1,600

Exports:
- Vanadium pentoxide, anhydride 229 241 614 681 700
- Oxides and hydroxides, other 1,010 2,670 385 232 100
- Aluminum-vanadium master alloys (gross weight) 660 310 974 856 500
- Ferrovanadium 340 479 446 579 400

Shipment from Government stockpile 416 201 260 — —
Consumption: Reported 4,650 4,630 4,730 4,390 4,000
Price, average, dollars per pound V2O5 2.80 3.19 3.90 5.47 2.00
Stocks, consumer, yearend 310 286 308 314 300
Employment, mine and mill, number 390 390 400 400 400
Net import reliance1 as a percent of reported consumption 84 31 94 78 80

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 (1995-98): Ferrovanadium: Canada, 47%; China, 15%; Czech Republic, 12%; South Africa, 11%; and other, 15%. Vanadium pentoxide: South Africa, 94%; China, 5%; 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 12/31/99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vanadium pentoxide anhydride</td>
<td>2825.30.0010</td>
<td>10.8% ad val.</td>
</tr>
<tr>
<td>Vanadium oxides and hydroxides, other</td>
<td>2825.30.0050</td>
<td>10.8% ad val.</td>
</tr>
<tr>
<td>Vanadates</td>
<td>2841.90.1000</td>
<td>8.4% ad val.</td>
</tr>
<tr>
<td>Ferrovanadium</td>
<td>7202.92.0000</td>
<td>4.2% ad val.</td>
</tr>
<tr>
<td>Aluminum-vanadium master alloys</td>
<td>7601.20.9030</td>
<td>Free.</td>
</tr>
</tbody>
</table>

Depletion Allowance: 23% (Domestic), 15% (Foreign).

Government Stockpile: Disposal of the vanadium pentoxide held in the National Defense Stockpile was completed in 1997.

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**VANADIUM**

**Events, Trends, and Issues:** Vanadium consumption in the United States in 1999 declined slightly from that in 1998. Preliminary data indicated the following changes among the major uses for vanadium during the first 6 months of 1999: carbon steel decreased 30%; tool steel increased 26%; full alloy steel increased 5%; and high-strength low-alloy steel increased 5%.

Both ferrovanadium and vanadium pentoxide prices declined during 1999. Articles in various industry-related publications attributed the falling prices to a decline in vanadium consumption, combined with an increased supply of material.

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

<table>
<thead>
<tr>
<th></th>
<th>Mine production</th>
<th>Reserves</th>
<th>Reserve base</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1998</td>
<td>1999</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>14,700</td>
<td>14,000</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Russia</td>
<td>9,000</td>
<td>9,000</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>$41,800</td>
<td>$40,000</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. Metals such as columbium, manganese, molybdenum, titanium, and tungsten are to some degree interchangeable with vanadium as alloying elements in steel. 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.

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*Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1Defined as imports - exports + adjustments for Government and industry stock changes.
2See Appendix C for definitions.
3Excludes U.S. mine production.