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 produce ferrovanadium, vanadium pentoxide, vanadium metal, and vanadium-bearing chemicals or specialty alloys by processing materials such as petroleum residues, spent catalysts, utility ash, and vanadium-bearing iron slag. Metallurgical use, primarily as an alloying agent for iron and steel, accounts for about 90% 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.

Production, mine, mill
W W — — —
Imports for consumption:
- Ash, ore, residues, slag 2,400 1,650 1,890 1,670 2,000
- Vanadium pentoxide, anhydride 847 208 902 600 400
- Oxides and hydroxides, other 33 — 14 1,080 100
- Aluminum-vanadium master alloys (gross weight) 298 1,210 16 10 100
- Ferrovanadium 1,620 1,930 2,510 2,550 2,600
Exports:
- Vanadium pentoxide, anhydride 681 747 653 71 60
- Oxides and hydroxides, other 232 70 100 63 200
- Aluminum-vanadium master alloys (gross weight) 856 514 677 363 600
- Ferrovanadium 579 213 172 70 100
Consumption, reported 4,380 3,620 3,520 3,210 3,300
Price, average, dollars per pound $5 5.47 1.99 1.82 1.37 1.40
Stocks, consumer, yearend 336 348 303 246 300
Employment, mine and mill, number 400 400 400 400 400
Net import reliance as a percentage of reported consumption 78 76 100 100 100

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 (1998-2001): Ferrovanadium: South Africa, 29%; Canada, 24%; China, 20%; Czech Republic, 11%; and other, 16%. Vanadium pentoxide: South Africa, 98%; and other, 2%.

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Number</th>
<th>Normal Trade Relations 12/31/02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vanadium pentoxide anhydride</td>
<td>2825.30.0010</td>
<td>7.6% ad val.</td>
</tr>
<tr>
<td>Vanadium oxides and hydroxides, other</td>
<td>2825.30.0050</td>
<td>7.6% ad val.</td>
</tr>
<tr>
<td>Vanadates</td>
<td>2841.90.1000</td>
<td>6.6% 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: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

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**VANADIUM**

**Events, Trends, and Issues:** Preliminary data indicate that U.S. vanadium consumption in 2002 was essentially unchanged from the previous year. Among the major uses for vanadium, production of carbon and full alloy steels accounted for 27% and 23% of domestic consumption, respectively.

Both ferrovanadium and vanadium pentoxide prices remained low during 2002. Articles in various industry-related publications attributed the low prices primarily to an increased supply of material.

**World Mine Production, Reserves, and Reserve Base:** Reserves and reserve base estimates for China have been significantly increased based on new information from that country.

<table>
<thead>
<tr>
<th></th>
<th>Mine production</th>
<th>Reserves</th>
<th>Reserve base</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2001</td>
<td>2002*</td>
<td>45,000</td>
</tr>
<tr>
<td>United States</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>30,000</td>
<td>39,000</td>
<td>5,000,000</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>18,000</td>
<td>18,000</td>
<td>3,000,000</td>
</tr>
<tr>
<td>Other countries</td>
<td>1,000</td>
<td>1,000</td>
<td>NA</td>
</tr>
<tr>
<td>World total (may be rounded)</td>
<td>58,000</td>
<td>67,000</td>
<td>13,000,000</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 (niobium), 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. — Zero.
1Prepared by Robert G. Reese, Jr.
2Defined as imports - exports + adjustments for Government and industry stock changes.
3See Appendix C for definitions.