VANADIUM

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

Domestic Production and Use: Seven U.S. firms that comprise most of the domestic vanadium industry produced 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 pig iron slag. Metallurgical use, primarily as an alloying agent for iron and steel, accounted for about 95% of the domestic vanadium consumption in 2010. Of the other uses for vanadium, the major nonmetallurgical use was in catalysts for the production of maleic anhydride and sulfuric acid.

Salient Statistics—United States:

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production, mine, mill¹</td>
<td>—</td>
<td>W</td>
<td>W</td>
<td>W</td>
<td>W</td>
</tr>
</tbody>
</table>

Imports for consumption:
- Ferrovanadium
- Vanadium pentoxide, anhydride
- Oxides and hydroxides, other
- Aluminum-vanadium master alloys (gross weight)
- Ash and residues
- Sulfates
- Vanadates
- Vanadium metal, including waste and scrap

Exports:
- Ferrovanadium
- Vanadium pentoxide, anhydride
- Oxides and hydroxides, other
- Aluminum-vanadium master alloys (gross weight)²
- Vanadium metal, including waste and scrap

Consumption:
- Apparent
- Reported
- Price, average, dollars per pound V₂O₅
- Stocks, consumer, yearend
- Net import reliance² as a percentage of apparent consumption

Recycling: Some tool steel scrap was recycled primarily for its vanadium content. The vanadium content of other recycled steels was lost to slag during processing and was not recovered. Vanadium recycled from spent chemical process catalysts was significant and may comprise as much as 40% of total supply.

Import Sources (2007–10): Ferrovanadium: Republic of Korea, 45%; Canada, 26%; Austria, 15%; Czech Republic, 12%; and other, 2%. Vanadium pentoxide: Russia, 46%; South Africa, 33%; China, 20%; and other, 1%.

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

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

Government Stockpile: None.

Prepared by Désirée E. Polyak [(703) 648-4909, dpolyak@usgs.gov]
**VANADIUM**

**Events, Trends, and Issues:** U.S. apparent consumption of vanadium in 2011 decreased by 14% from its 2010 level; however, it was still almost four times higher than its level in 2009. Apparent consumption of vanadium declined dramatically in 2009 from that of 2008 owing to the global economic recession in 2009. Among the major uses for vanadium, production of carbon, full-alloy, and high-strength, low-alloy steels accounted for 15%, 45%, and 34% of domestic consumption, respectively. U.S. imports for consumption of vanadium in 2011 decreased 16% from those of the previous year. U.S. exports decreased 33% from those of the previous year. In 2011, U.S. steel production was expected to increase from that of 2010. Given the increase in steel demand, especially in China, it appears likely that, in the near term, vanadium demand will be strong.

Vanadium pentoxide (V₂O₅) prices continued to slowly increase to a year-to-date high of $7.41 per pound of V₂O₅ in March 2011 before decreasing again in April. In August 2011, V₂O₅ prices averaged $6.65 per pound of V₂O₅, slightly more than average V₂O₅ prices in August 2010. Ferrovanadium (FeV) prices continued to slowly increase to a year-to-date high of $16.00 per pound of FeV in August 2011 before decreasing again in September. In September 2011, FeV prices averaged $14.95 per pound of FeV, slightly less than average FeV prices in September 2010.

**World Mine Production and Reserves:**

<table>
<thead>
<tr>
<th></th>
<th>Mine production</th>
<th>Reserves $^5$ (thousand metric tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2010</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>W</td>
<td>45</td>
</tr>
<tr>
<td>China</td>
<td>22,000</td>
<td>23,000</td>
</tr>
<tr>
<td>Russia</td>
<td>15,000</td>
<td>15,000</td>
</tr>
<tr>
<td>South Africa</td>
<td>19,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Other countries</td>
<td>1,600</td>
<td>1,500</td>
</tr>
<tr>
<td><strong>World total</strong></td>
<td>57,600</td>
<td>60,000</td>
</tr>
</tbody>
</table>

**World Resources:** World resources of vanadium exceed 63 million tons. Vanadium occurs in deposits of phosphate rock, titaniferous magnetite, 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 coal, crude oil, 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 and secondary recovery are adequate to supply a large portion of domestic needs, a substantial part of U.S. demand is currently met by foreign material.

**Substitutes:** Steels containing various combinations of other alloying elements can be substituted for steels containing vanadium. Certain metals, such as manganese, molybdenum, niobium (columbium), 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.

---

$^a$Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; not included in total. — Zero.
$^c$Adjustments made by U.S. Geological Survey.
$^d$Rounded to one significant figure to avoid disclosing company proprietary information.
$^e$Defined as imports – exports + adjustments for Government and industry stock changes.
$^f$See Appendix C for resource/reserve definitions and information concerning data sources.