ZIRCONIUM AND HAFNIUM

(Data in metric tons, unless otherwise noted)

Domestic Production and Use: Zircon sand was produced at two mines in Florida and at one mine in Virginia. Zirconium and hafnium metal were produced from zircon sand by two domestic producers, one in Oregon and the other in Utah. Typically, both metals are in the ore in a Zr to Hf ratio of 50:1. Primary zirconium chemicals were produced by the Oregon metal producer and at a plant in New Jersey. Secondary zirconium chemicals were produced by 10 other companies. Zirconia (ZrO₂) was produced from zircon sand at plants in Alabama, New Hampshire, New York, Ohio, and by the metal producer in Oregon. Zircon ceramics, opacifiers, refractories, and foundry applications are the largest end uses for zirconium. Other end uses of zirconium include abrasives, chemicals, metal alloys, welding rod coatings, and sandblasting. The largest market for hafnium metal is as an addition in superalloys.


Production: Zircon (ZrO₂ content) 100,000 100,000 100,000 100,000 100,000

Imports:
- Zirconium, ores and concentrates (ZrO₂ content) 40,600 58,200 37,500 42,400 40,000
- Zirconium, alloys, waste and scrap (ZrO₂ content) 929 1,210 1,160 1,400 1,100
- Zirconium oxide (ZrO₂ content) 4,220 3,900 3,140 3,950 3,300
- Hafnium, unwrought, waste and scrap 8 12 9 11 8

Exports:
- Zirconium, ores and concentrates (ZrO₂ content) 28,800 26,600 45,200 47,400 38,300
- Zirconium, alloys, waste and scrap (ZrO₂ content) 188 216 211 259 280
- Zirconium oxide (ZrO₂ content) 1,970 1,540 1,680 2,100 2,600

Consumption, zirconium ores and concentrates, apparent (ZrO₂ content) W W W W W

Prices:
- Zircon, dollars per metric ton (gross weight):
  Domestic³ 419 320 300 340 350
  Imported, f.o.b.⁴ 445 355 311 396 370
- Zirconium sponge, dollars per kilogram⁵ 20-26 20-26 20-26 20-26 20-26
- Hafnium sponge, dollars per kilogram⁵ 165-209 165-209 165-209 165-209 165-209

Net import reliance⁶ as a percentage of apparent consumption:
- Zirconium W W W W W
- Hafnium NA NA NA NA NA

Recycling: Zirconium metal was recycled by four companies, one each in California, Michigan, New York, and Texas. Most of the zirconium recycled came from scrap generated during metal production and fabrication. Zircon mold cores and spent or rejected zirconia refractories are often recycled. Recycling of hafnium metal was insignificant.

Import Sources (1997-2000): Zirconium ores and concentrates: South Africa, 55%; Australia, 41%; and other, 4%. Zirconium, wrought, unwrought, waste and scrap: France, 68%; Germany, 14%; Japan, 6%; Canada, 4%; and other, 8%. Hafnium, unwrought, waste and scrap: France, 82%; Germany, 7%; United Kingdom, 2%; and other, 9%.

Tariff: Item Number Normal Trade Relations 12/31/01
- Zirconium ores and concentrates 2815.10.0000 Free.
- Germanium oxides and ZrO₂ 2825.60.0000 3.7% ad val.
- Ferrozirconium 7202.99.1000 4.2% ad val.
- Zirconium, waste and scrap 8109.10.3000 Free.
- Zirconium, other unwrought, powders 8109.10.6000 4.2% ad val.
- Zirconium, other wrought, alloys 8109.90.0000 3.7% ad val.
- Unwrought hafnium, waste and scrap 8112.91.2000 Free.

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

Government Stockpile: In addition to 15,726 tons of baddeleyite ore (gross weight) held in the National Defense Stockpile, the U.S. Department of Energy (DOE) held over 500 tons of zirconium in various forms. DOE also maintained a stockpile of approximately 35 tons of hafnium.

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Events, Trends, and Issues: The global supply and demand of zirconium mineral concentrates was largely balanced in 2001. This trend is expected to continue over the next few years. In the long-term, however, supply shortages may occur unless new production sources of zirconium concentrates are developed. U.S. imports of zirconium ores and concentrates were estimated to have decreased 55%, while exports increased 44% compared with those of 2000. A mining operation at Stony Creek, VA, began production of zircon and other heavy minerals in 1998. Initial capacity was expected to include up to 30,000 tons per year of zircon. An expansion at the mine began in 2001 with completion scheduled for 2002. The availability of hafnium continued to exceed supply. Surpluses were stockpiled in the form of hafnium oxide. The demand for nuclear-grade zirconium metal, the production of which necessitates hafnium’s removal, produces more hafnium than can be consumed by the metal’s markets.

World Mine Production, Reserves, and Reserve Base: World primary hafnium production statistics are not available. Hafnium occurs with zirconium in the minerals zircon and baddeleyite.

Zirconium

<table>
<thead>
<tr>
<th>Material</th>
<th>Uncommitted inventory</th>
<th>Committed inventory</th>
<th>Authorized for disposal</th>
<th>Disposal plan FY 2001</th>
<th>Disposals FY 2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baddeleyite</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>17,383</td>
<td>—</td>
</tr>
</tbody>
</table>

World Resources: Resources of zircon in the United States included about 14 million tons associated with titanium resources in heavy-mineral sand deposits. Phosphate and sand and gravel deposits have the potential to yield substantial amounts of zircon as a future byproduct. Eudialyte and gittinsite are zirconium silicate minerals that have a potential for zirconia production. Identified world resources of zircon exceed 60 million tons.

Resources of hafnium in the United States are estimated to be about 130,000 tons, available in the 14-million-ton domestic resources of zircon. World resources of hafnium are associated with those of zircon and baddeleyite and exceed 1 million tons.

Substitutes: Chromite and olivine can be used instead of zircon for some foundry applications. Dolomite and spinel refractories can also substitute for zircon in certain high-temperature applications. Columbium (niobium), stainless steel, and tantalum provide limited substitution in nuclear applications, while titanium and synthetic materials may substitute in some chemical plant uses.

Silver-cadmium-indium control rods are used in lieu of hafnium at numerous nuclear powerplants. Zirconium can be used interchangeably with hafnium in certain superalloys; in others, only hafnium produces the desired or required grain boundary refinement.