VANADIUM

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In 2002, steel production, as reported by the International Iron and Steel Institute (IISI), rose by 6.4% to a record 886.7 Mt. This reflected increases in production in every region of the world, with the possible exception of Europe, and included a massive 30.7 Mt (20.3%) increase in China. Consequently, it is estimated that vanadium consumption in 2002 reached a record, equivalent to 80.3 million kg V_2O_5.

Despite this record consumption, prices remained weak. The price of V_2O_5 commenced the year at US$1.13/lb, climbed to US$1.63/lb in midyear, before dropping again to US$1.10/lb in November and recovering to US$1.60/lb by year's end. The price of ferro-vanadium followed a similar trend. It commenced the year at US$6.30/kg, rose to US$8.80/kg by mid-year, before falling to US$6.50/kg in November and rising to US$10.15/kg by the end of the year. The main reason for this dismal price performance was chronic oversupply and, as a result, the vanadium industry, as a whole, had a poor level of profitability in 2002, for the third year in a row.

Supply

South Africa remained the world's leading provider of primary vanadium units and during 2002, was responsible for 41.3% of global supply. In South Africa, recovery of vanadium is obtained either in association with steel-making, or directly from titaniferous magnetite ore. Highveld Steel and Vanadium Corp., the world's leading supplier of primary vanadium units, continued to manufacture vanadium-containing slag, V_2O_5, vanadium chemicals and ferro-vanadium at its plants near Witbank. During the year, Highveld kept its recently-modernised No. 1 kiln idle, owing to the oversupply situation. Highveld's partner, Vanteck (VRB), announced that it had been awarded a further contract to supply a vanadium redox battery to Tasmania. It was also announced that, as a result of delays in obtaining environmental approvals, start-up of the joint venture between Highveld Steel and Vanadium Corp., Nippon Denko and Mitsui, to produce ferro-vanadium at Witbank, had been delayed until June 2003.

Highveld also continued to supply vanadium-containing slag for the manufacture of nitrided vanadium to Vametco, the subsidiary of US company Stratcor, based in Brits. Vametco was reported to have increased production of nitrided vanadium by 10% and to have made provision to increase its production capacity by 25–30%. It also indicated that it was not planning to re-open its mine in the near future.

Xstrata, the other major supplier of primary vanadium units in South Africa, continued to supply V_2O_5 from its Rhovan and Vantech plants, albeit at a lower level than in 2001. The main reason for this reduction was the build up of ferro-vanadium production at Rhovan which consumed V_2O_5, rendering it

unavailable for sale. Xstrata also continued to grow its vanadium chemicals business.

The anti-dumping action filed at the end of 2001 by the US Ferroalloys Association on behalf of a consortium of US producers, resulted in both Highveld and Xstrata having to pay a punitive 116% duty on all imports to the US. Highveld indicated that this duty affected less than 10% of its production but it is believed that the effect on Xstrata was more severe. This anti-dumping action also affected Panzhihua Iron and Steel (Group) Co. in China, which had a duty of 13.03% imposed on all imports to the US.

Primary vanadium production in North America amounted to 11% of world supply. This contrasts markedly with consumption which amounts to 23% of the world total, making North America a net importer of vanadium units. In the US, Stratcor announced the closure of its Al-V master alloy production line at Niagara Falls, and it moved production of these alloys to a new plant operated by its partner, International Speciality Alloys (ISA), in Pennsylvania. Stratcor also sold its 50% holding in CS Metals, a vanadium recycler, to its partner in the venture, CRI Metal Products, citing strategic reasons. Additionally, Stratcor moved the headquarters of its US Vanadium subsidiary from Pittsburgh to Hot Springs, Arkansas. Elsewhere in North America, interest continued to be shown in the Lac Doré project in Québec, Canada, despite the chronic market over-supply of vanadium. The main producers of V_2O_5 in North America remained CS Metals, Gulf Chemical and Metallurgical Corp., and Stratcor. Bear Metallurgical Corp., Masterloy and Metallurg Vanadium (formerly Shieldalloy Metallurgical) continued to be the main producers of ferro-vanadium, and Reading Alloys and the Stratcor / ISA alliance produced Al-V master alloys.

The US Ferroalloy Association, in addition to the anti-dumping action against South African and Chinese producers, also filed a petition with the US Commerce Department seeking an anti-circumvention enquiry against Russian producers. It was alleged that V_2O_5 of Russian origin was being converted into ferro-vanadium in Belgium, the Czech Republic and the UK, and that this contravened an anti-dumping order issued by the US International Trade Commission, seven years previously. The petition was subsequently withdrawn by the Ferroalloys Association.

In Western Europe, primary vanadium production amounted to less than 3.0% of the world supply. This supply was obtained from spent catalysts and other residues. The only producer of primary vanadium units in Western Europe was Orbit Metallurgical in the UK. Eastlink-Lanker in the UK, Nikom in the Czech Republic, Sadaci in Belgium and Treibacher Industrie AG in Austria, all continued to manufacture ferro-vanadium, although the amount produced by Sadaci was significantly lower than in previous years. GFE, the Metallurg subsidiary in Germany, continued to manufacture vanadium metal, vanadium chemicals and Al-V master alloys.

The Russian Federation was responsible for 17% of the world supply of primary vanadium units in 2002, this supply being based almost entirely on

recovery associated with steel-making. The steelworks at Nizhny Tagil and Chusovskoi remained the main producers of vanadium-containing slag. Chusovskoi and Vanady Tula (Eastlink-Lanker's partner in Russia), were the main producers of vanadium-containing products. Towards the end of the year, it was reported that both producers were having operational difficulties of one kind or another.

Australasia, including Australia, China and Japan, were responsible for 28% of the primary vanadium units manufactured in 2002. These units were recovered in association with steel-making, directly from ore, or from spent catalysts and residues. In Australia, the Xstrata subsidiary, Vanadium Australia, produced V_2O_5 at its mine at Windimurra. However, towards the end of the year, rumours began to circulate about the impending closure of the mine as a result of world over- capacity, poor prices and the ending of an agreement with Swiss-based Glencore to take a proportion of output at attractive prices. In China, both Panzhihua Iron and Steel (Group) Co. and Chengde Iron and Steel Co. produced vanadium slag, V_2O_5, ferro-vanadium and vanadium chemicals. In Japan, small quantities of V_2O_5 were recovered from spent catalysts by Taiyo Koko, and ferro-vanadium was manufactured by Nippon Denko and Taiyo Koko. New Zealand Steel continued to produce vanadium slag while Full Yield, in Taiwan, recovered small quantities of V_2O_5 from residues.

Uses of vanadium

The main use for vanadium continued to be as an alloying element in the steel industry, and this accounted for about 85%, or more, of vanadium consumed. Vanadium was used in a very wide range of steels, from low-carbon, flat-rolled products to tool steels. The main reasons for this wide use of vanadium in steel included:

- relative ease of continuous casting vanadium micro-alloyed grades, with crack-free surfaces;
- ability to use low, energy efficient temperatures for reheating for rolling;
- realisation of low rolling loads during rolling;
- relative insensitivity of mechanical properties to changes in rolling parameters, especially finish rolling temperature;
- capability of realising good grain refinement, as well as precipitation strengthening, thus improving both strength and toughness;
- freedom from strain aging, especially that due to nitrogen;
- enhanced wear resistance in tool steels;
- and good weldability.

Vanadium was also widely used as a β-phase stabiliser in Ti-Al-V alloys for aerospace applications. Its use in the vanadium redox battery continued to grow in a slow, but steady, manner, the most recent application being, as already noted, a battery in Tasmania. Vanadium was also used in a number of other applications including catalysts and pigments.

Vanitec, the vanadium industry's technical committee, continued to support work on a wide range of applications. Recent projects include examination of the role of vanadium in hard materials, grain-refining mechanisms,

conventional and laser welding, reinforcing bar steels for cold climates, line-pipe steels, tool steels, high- temperature crack susceptibility and hot rolling. In addition, Vanitec supported student projects in China and a major demonstration project involving the use of vanadium-containing steel in the US.