

VANADIUM ORE REVIEW

“A diversified international investment firm with a global perspective for global excellence”

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INTRODUCTION

Vanadium is a medium-hard, steel-blue metal. Despite being a lesser-known metal, its malleability, ductility, and corrosion resistance make it highly significant in the manufacturing sector. Vanadium rarely exists as a free element in nature but can be found in about 65 different minerals. The most important minerals for Vanadium include magnetite, vanadinite, carnotite and patronite. Additionally, some crude oils and phosphate rock contain it (Pedersen, 2017). It is thermally insulating and electrically conductive.

WORLD OCCURRENCE AND PRODUCTION

Vanadium is the 22nd most abundant element in the earth's crust, occurring more than 65 minerals. Vanadium resources globally are estimated at 63 million metric tons with the majority located in China, Russia, South Africa, and Australia. North America, Canada, Brazil, Finland, and Madagascar also have vanadium deposits. World vanadium reserves (that part of the identified vanadium resource that meets specified minimum physical and chemical criteria related to current mining and production practices) are estimated at about 15 million metric tons and it is likely sufficient to meet vanadium needs into the next century at the present rate of consumption. More than 95% of global Reserves are in China, Russia, South Africa, and Australia. Titaniferous magnetite ore is mined in South Africa and China and processed for vanadium extraction. Titaniferous magnetite ore is also processed in steelmaking operations in China, Russia, and South Africa

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CHINA

Mine production: 40,000 MT
With an output of 40,000 MT, China was the leading vanadium-producing nation in the world in 2019. That is comparable to the vanadium output level from the prior year. The Asian country produces more vanadium than any other nation by a wide margin., Vanadium is mostly utilized to make steel. Despite a recent fall in steel production, China continues to consume the most vanadium globally.

RUSSIA

Mine production: 18,000 MT
Russia is ranked second, with a total output of 18,000 MT of vanadium ore in 2019—the same as it was in 2018. With 5,000 MT, Russia has the second-largest vanadium reserves in the world. EVRAZ KGOK, a division of EVRAZ (LSE:EVR), is a major role player in vanadium mining in Russia.

SOUTH AFRICA

Mine production: 8,000 MT
South Africa's mining output of vanadium had been increasing in recent years, reaching 13,000 MT of the metal in 2017. However, the vanadium-producing nation's output fell to 7,700 MT in 2018, with a minor increase to 8,000 MT in 2019. Primary output from Bushveld Minerals (LSE:BMN) and Glencore accounts for the majority of South Africa's contributions to the vanadium market (LSE:GLEN,OTC Pink:GLCNF). Three assets in South Africa's Bushveld Complex make up the vanadium mining division.

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BRAZIL

Mine production: 7,000 MT

Last but not least is Brazil, a vanadium-producing nation whose output spiked to 8,400 MT in 2017 before precipitously dropping to 5,500 MT the following year. Brazil's production of vanadium ore increased slightly in 2019 to 7,000 MT. Largo Resources (TSX:LGO,OTCQX:LGORF), which bills itself as the sole pure-play vanadium producer, is largely responsible for Brazil's production. The highest-grade vanadium mine in the world is the Maracas Menchen vanadium project of the firm.

DEMAND

According to an article published on Bushveld minerals' website, the world's consumption of vanadium increased by around 7% from 112,157 mtV in 2020 to 120,067 mtV in 2021. The steel industry accounted for 92 per cent of total vanadium demand in 2021. It is expected to continue underwriting vanadium demand, led by China which accounts for about 60 per cent of global vanadium consumption and whose growing intensity of use of vanadium in its steel sector thus maintaining positive vanadium demand momentum. Despite its regulation-driven growth intensity of use of vanadium, China's vanadium usage intensity, at 63 g/t of crude steel, is still lower than that of the developed economies in Europe, Japan, and North America, where it is 80 g/t. This means that demand will continue to be supported, even though the market anticipates a peak in steel production in 2022. In 2022, consumption of the metal from the steel industry is anticipated to increase by 2.8% to 113,100 mtV. In the long term, the demand for vanadium in the steel market would increase at a CAGR of around 3.1% until 2030, when it is anticipated to reach over 136,000 tonnes.

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Vanadium could have access to a sizable new market thanks to the VRFB industry, becoming a primary energy metal. To produce high-purity vanadium pentoxide or trioxide for battery application, new magnetite greenfield projects may benefit from the development of VRFB. Additionally, demand for vanadium from this industry is anticipated to rise in the upcoming years as the need for energy storage for renewable energy sources grows. While predictions for the energy storage market's growth differ, many predict significant, if not exponential, market growth, which will be fuelled by the switch to cleaner energy. The market penetration of vanadium redox flow batteries (VRFBs) in this industry is also subject to varying projections.

VANADIUM PRICE OUTLOOK

The war outbreak in Ukraine affected the volatility of vanadium market, this affected an already tight market which resulted in the prices of vanadium spiking in an upward trend in March. Global logistical delays that affect the supply chain in 2021 posed difficulties, which in turn contributed to the unpredictability of North American prices in comparison to those in Europe and China. Due to supply interruptions brought on by the Russia-Ukraine conflict in February 2022, Chinese ferrovanadium was purchased more frequently. As a result of this pattern continuing into April, ferrovanadium exports increased to 934 t (gross) in April, up 176% from the same month last year, according to trade data. The Netherlands, Japan, and South Korea have received most of these supplies. Ferrovanadium prices rose rapidly through February and early March, driven by the combination of tight supply and market volatility. European ferrovanadium prices averaged at US$45.3/kgV in Q1 2022, and Chinese ferrovanadium prices averaged at US$46.4/kgV, which was an increase of 41 per cent and 28 per cent on the previous quarter, respectively. These factors hit the North American market most severely, where prices were anomalously high in March at US$73.50/ kgV, representing a premium of over 18 per cent over regions. China’s ongoing battle against COVID-19 and strict lockdowns has led to a weaker macroeconomic outlook, however, even with the reduction in the demand forecast as expected by Wood Mackenzie, a small deficit is expected this year.

APPLICATIONS OF VANADIUM

The Uses of Vanadium in the Iron and Steel Industry

Vanadium is a vital alloying element that is primarily used in the steel industry. In steel production, approximately 85% of metal vanadium is added in the form of iron vanadium and vanadium-nitrogen alloys to improve steel strength, toughness, ductility, and heat resistance. Because vanadium-containing steel has excellent properties such as high strength, toughness, and wear resistance, it is widely used in industries such as machinery, automobiles, shipbuilding, railways, aviation, bridges, electronic technology, and the defence industry. High-strength low-alloy (HSLA) steel, HSLA steel plate, HSLA steel, HSLA strip, advanced high-strength strip, construction threaded steel, high carbon steel wire, rails and tools are examples of vanadium-containing highstrength alloy steels.

The Uses of Vanadium in the Aerospace Industry

Titanium-aluminium-vanadium alloys containing 8-10% vanadium is used in aircraft engines, aerospace cabin frameworks, missiles, steam turbine blades, rocket engine shells, and other applications. Vanadium can be used as a stabilizer and strengthening agent in titanium alloys, giving them ductility and plasticity. Vanadium alloys are also used in magnetic materials, cemented carbide, superconductors, and nuclear reactor materials.

The Uses of Vanadium in the Chemical Industry

Vanadium is primarily used in the chemical industry as a catalyst in the production of sulfuric acid and vulcanized rubber. It is also used to reduce nitrous oxide production in power plants. Other chemical vanadium products are primarily used in catalysts, ceramic colorants, developers, desiccants, and other applications.

APPLICATIONS OF VANADIUM

The Uses of Vanadium in the Field of Vanadium Redox Battery

The vanadium redox battery is a novel type of clean energy storage device that was developed at Australia's University of New South Wales in the 1980s.Vanadium batteries have obvious advantages over other chemical power sources, such as high power, large capacity, high efficiency, long life, fast response, instantaneous charging, high safety, and low cost. As a result, it is the preferred choice for solar energy, wind energy generator supporting energy storage equipment, electric vehicle power supply, emergency power supply system, power station energy storage peak shaving, renewable energy grid-connected power generation, urban power grid energy storage, remote power supply, UPS system, and other applications.

ROLE PLAYERS

There are only three large-scale primary vanadium producers globally –

1. Bushveld Minerals

Bushveld Minerals is a low-cost, vertically integrated primary vanadium producer. With two of the world's four active primary vanadium processing plants, it is one of only three active primary vanadium producers. In the medium term, Bushveld intends to increase production through organic means to about 8,000 mtVp.a. A diverse array of vanadium products owned by Bushveld Minerals is available to meet the demands of the steel, energy, and chemical industries. Through its two main pillars Bushveld Energy, a top provider of energy storage solutions, and Bushveld Vanadium, which mines, and processes vanadium Bushveld Minerals participates in the whole vanadium value chain. Through utilization in vanadium redox flow batteries, Bushveld Energy is committed to expanding and promoting the use of vanadium in the expanding worldwide energy storage sector. Bushveld is listed on the London Stock Exchange.

2. Glencore

Glencore plc is an Anglo-Swiss multinational commodity trading and mining company with headquarters in Baar, Switzerlandour. They own vanadium assets via their majority shareholding stake in the Rhovan-Bakwena Vanadium Venture. Located near Brits, Rhovan is an open-cast mine and smelter complex, which mainly produces ferrovanadium and vanadium pentoxide.

3. Largo Resources

Largo's VPURETM and VPURE+TM products come from one of the highest-grade vanadium deposits in the world at the Company's Maracás Menchen Mine in Brazil. Largo has a long and successful history as one of the world's premier vanadium firms. Largo's strategic business plan is centred on two pillars: 1.) vanadium production from its operations in Brazil and 2.) energy storage business in the U.S. to promote a low-carbon future through its sustainable energy division. Largo produces some of the highest-grade vanadium in the world.

Other role players in the vanadium industry include:

1. Evraz

EVRAZ plc is a UK-incorporated multinational steel manufacturing and mining company part-owned by Russian billionaires. It has operations mainly in Russia as well as the USA, Canada, and Kazakhstan. Is a leading player in the global vanadium market. EVRAZ produces ferrovanadium from slag (a by-product of steel production at EVRAZ NTMK), making the Group one of the lowest-cost vanadium producers in the world.

2. Australian Vanadium

Australian Vanadium Limited (AVL) is a Perth-based company developing the Australian Vanadium Project in Western Australia. AVL intends to create shareholder value by supplying high-grade vanadium to the global steel and energy storage markets. The Australian Vanadium Project is located near Meekatharra, Western Australia and is among the highest-grade vanadium projects in the world. The Project is split into two parts, with the minesite, crushing, milling and beneficiation at Gabanintha near Meekatharra and the vanadium processing to be undertaken at a location near the port city of Geraldton. VSUN Energy is a 100% owned subsidiary of AVL, developing projects with vanadium redox flow batteries.

3. AMG Vanadium

AMG V is the largest recycler of spent catalyst in the world and the largest ferrovanadium producer in North America. Through their proprietary roasting and pyrometallurgical process, AMG V converts spent refinery catalyst and other vanadium bearing residues into ferrovanadium (Ferovan®) and a ferronickel-molybdenum alloy (FeNiMoly®), which are marketed and sold to the carbon and stainless-steel industries.

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