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Global Vanadium Market: Analysis By Production, By Consumption, By Type (Vanadium Pentoxide, Vanadium Ferrovanadium, Aluminium Vanadium Alloys, Vanadium Chemicals, and Others), By Source (Co-production, Primary, and Secondary), By End-User (Steel Alloy, Chemical & Catalyst, Titanium Alloys, and Energy Storage), By Region Size and Trends with Impact of COVID-19 and Forecast up to 2028

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Abstracts

The global vanadium market was valued at US$2.84 billion in 2022. The market value is expected to reach US$3.93 billion by 2028. The global vanadium market production stood at 110.53 thousand tonnes in 2022 and is expected to reach 135.16 thousand tonnes by 2028. Whereas, the global vanadium market consumption stood at 112.19 thousand tonnes in 2022 and is anticipated to grow at a CAGR of approx. 3%. Vanadium is a grey, soft, ductile metal that exists in four ‘oxidation states’ (II, III, IV, and V). It exists naturally as a component of minerals, rather than in its pure form, and as an impurity within hydrocarbons and bauxites.

Vanadium is primarily used as an alloying element in the production of high-strength steel. Steel manufacturers utilize vanadium to enhance the strength, durability, and heat resistance of steel products. The growth in construction, infrastructure development, and automotive industries has resulted in higher steel demand, thereby driving the growth of the vanadium market in the past few years. Additionally, the adoption of renewable energy sources, such as wind and solar power, often requires energy storage systems, including VRFBs, which utilize vanadium, thus driving the demand for

vanadium. The vanadium market is expected to grow at a CAGR of approx. 5% during the forecasted period of 2023-2028.

Market Segmentation Analysis:

By Type: The report provides the bifurcation of the market into five types: Vanadium Pentoxide, Vanadium Ferrovanadium, Aluminium Vanadium Alloys, Vanadium Chemicals, and Others. Vanadium pentoxide held the highest share of the market. Whereas, vanadium ferrovanadium is expected to be the fastest-growing segment in the forecasted period. Vanadium pentoxide is a crucial ingredient in the production of high-strength steel alloys. By adding small amounts of vanadium pentoxide to steel, manufacturers can significantly enhance its strength, toughness, and heat resistance. Additionally, it is used in desulfurization processes to remove sulfur from fossil fuels. Hence, owing to the increasing number of applications of vanadium pentoxide, the market demand has been growing.

By Production: The increased demand for steel translates to a higher demand for vanadium production to meet the requirements of steel manufacturers. For instance, according to GMK Center, China in January-March 2023 increased production of steel by 6.1% compared to the same period in 2022 – up to 261.56 million tons. This indicates faster production growth at large steel plants. Therefore, the increased production of steel would increase the production of vanadium.

By Source: The global vanadium market production can be divided into three segments based on the source: Co-Production, Primary, and Secondary. Co-production held the highest share of the market. Also, it is expected to be the fastest-growing segment in the forecasted period. Iron ore with a higher vanadium content offers more favorable economics for co-production, and in general terms, iron ore from China, Russia, and South Africa is particularly well suited to this approach. The bulk of China and Russia's vanadium production, and therefore global vanadium production, comes from co-production. As mining and extraction technologies improve, it becomes more feasible and cost-effective to extract vanadium as a by-product during the production of other minerals.

By Consumption: India's steel production is set to grow to 300Mt by 2030 from 118Mt in 2021. To add strength to steel, the intensity of use rate for vanadium per tonne of steel in India is about 0.039. So, with this increase in steel production, India's use of vanadium would go from 4,675 tonnes per annum (equivalent to 8,350 V2O5) to around 11,900 tonnes of vanadium (equivalent to 21,200 tonnes of V2O5). Hence, the growing

spending on infrastructure and growing steel production would stimulate the consumption of vanadium in the coming years.

By End-User: The global vanadium market consumption has been analyzed based on the following end-users: Steel Alloy, Chemical & Catalyst, Titanium Alloys, and Energy Storage. Energy storage is expected to be the fastest-growing segment in the forecasted period. VRFB, which uses vanadium ions in different oxidation states to store energy, is considered to be a cost-competitive alternative to lithium-ion technology for large-scale, long-duration energy storage. Hence the use of vanadium is expected to rise in energy storage systems in the coming years.

By Region: The report provides insight into the vanadium market based on the regions namely, Asia Pacific, North America, Europe, and the Rest of the World. Asia Pacific held the highest share of the market. Many governments in the Asia Pacific region have established renewable energy policies and targets to encourage the deployment of clean energy sources. By incentivizing renewable energy adoption, governments support the growth of the vanadium market.

The global vanadium market production has been further analyzed based on the following regions namely, China, Russia, South Africa, Brazil, and the Rest of the World. China has been the largest producer and consumer of vanadium, with significant vanadium reserves and a strong presence in the steel industry, where vanadium is used as an alloying agent. Russia is the world's second-largest vanadium-producing country. The majority of its output can be attributed to EVRAZ, a vertically integrated steel, mining, and vanadium business.

Furthermore, the global vanadium market consumption has been analyzed based on the following regions: China, North America, Europe, and the Rest of the World. In 2022, vanadium demand in China has been lower than expected as a result of steel production curbs in China enforced due to the Winter Olympics and extended COVID-19 shutdowns. Moreover, China's faltering property sector, and its depressed construction sector together with environmental cuts to production, and limited steel demand & supply led to the fell back of vanadium demand in the country.

Market Dynamics:

Growth Drivers: The global vanadium market growth is predicted to be supported by numerous growth drivers such as increasing steel production, growing construction sector, rapid urbanization, escalating medical devices industry, increasing demand for

electric vehicles, escalating use in the chemical industry, and many other factors. Vanadium is primarily used as an alloying element in steel production. It is added to steel in small amounts to improve its mechanical properties, such as strength, hardness, and toughness. Vanadium-containing steels, commonly known as high-strength or high-performance steels, find applications in various industries, including construction, automotive, machinery, and infrastructure. The growth in steel production directly translates to increased demand for vanadium as an alloying element.

Challenges: However, the market growth would be negatively impacted by various challenges such as price volatility, environmental and regulatory considerations, competition from substitutes, etc. Volatile prices make it challenging to plan production, manage costs, and make long-term investment decisions. This uncertainty can lead to a reluctance to invest in new projects or expand existing operations, thereby hindering the growth of the vanadium market.

Trends: The market is projected to grow at a fast pace during the forecast period, due to various latest trends such as increasing demand for the VRFBs, research and development for new applications, exploration, and development of vanadium deposits, technological advancements, etc. Vanadium redox flow batteries (VRFBs) require a significant amount of vanadium for their operation. The electrolyte in VRFBs consists of vanadium ions in different oxidation states, which allow for the storage and release of electrical energy. As the adoption of VRFBs increases, the demand for vanadium as a key component in the electrolyte will also rise, resulting in increased vanadium consumption.

Impact Analysis of COVID-19 and Way Forward:

The COVID-19 pandemic has led to disruptions in mining operations, production facilities, and supply chains worldwide. Moreover, reduced construction activities, factory shutdowns, and decreased demand for vehicles have led to a decline in the consumption of vanadium-containing products in the initial period of 2020. However, as economies gradually reopened and stimulus measures were implemented, several industries started to recover, leading to increased demand for vanadium-containing products. In the post-COVID era, the recovery of global economies, infrastructure development projects, and the adoption of energy storage technologies would play significant roles in shaping the future market value of vanadium.

Competitive Landscape:

The global vanadium market is fragmented, with several key players operating on a global scale. The key players in the global vanadium market are:

Largo Inc.

Bushveld Minerals Limited

EVRAZ

Glencore Plc

AMG Advanced Metallurgical Group N.V.(AMG Vanadium LLC)

Ferro-Alloy Resources Limited

HBIS Group

Essel Mining & Industries Limited

Western Uranium & Vanadium Corp.

Voyager Metals Inc.

Australian Vanadium Ltd.

VanadiumCorp Resource Inc.

In 2022, Australian Vanadium produces 11,200 tonnes of vanadium pentoxide (V2O5), increasing from 11,022 tonnes in 2021. Also, in June 2023, AVL received US$9.8 million from the Australian government as part of the Modern Manufacturing Initiative. This funding would be used to support the development of AVL's vanadium redox flow battery manufacturing facility in Western Australia. On the other hand, in 2022, AMG Advanced Metallurgical Group N.V. announced the Management Board has approved to build of a Vanadium Electrolyte plant at the company’s subsidiary, AMG Titanium, in Nuremberg, Germany. The target capacity is 6,000 m? vanadium electrolyte.

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