PASSENGER
FOR SUSTAINABLE AND EFFICIENT RE-FREE MAGNETS

Pilot Action for Securing a Sustainable European Next Generation of Efficient RE-free magnets

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INTELLIGENCE BULLETIN DELIVERED BY
ICAMCyL Foundation
(March 2023)

INTELLIGENCE BULLETIN #6

Strategic Intelligence Bulletins aim to enrich strategic and managerial decisions and to engage stakeholders based on partners networks.

SR. STRONTIUM

Figure 1. Strontium as a chemical element

Human life is surrounded by tools and products created by technology. Meanwhile, their high-level qualities are mainly due to the use of rare and scattered elements. One of them is the alkaline-earth metal Strontium (Fig 1) and its commodity form - Strontium Carbonate.

Strontium is a chemical element that was discovered by Adair Crawford, an English physician and chemist, in 1790. It is named after Strontian, a small town in Scotland.

APPLICATION

Strontium Carbonate is a colourless, odourless white powder employed in various industries and applications, including **Permanent Magnets (PM)**, Human Health, Frit Manufacturing, Novel Nanoparticle, Pyrotechnics, and Ceramics.

Every year, tons of strontium carbonate are consumed worldwide to produce special glass screens for colour televisions, computers, radars, and various displays. The addition of strontium is necessary because it delays X-rays, which are deadly for humans, penetrating through ordinary glass. Each colour TV has up to a kilogram of strontium oxide.

Strontium is used in the production of high-quality ferrites - ceramic magnets needed in electrical engineering for production in the automotive industry. Ferrite magnets, often called ceramics because of their manufacturing process, are the cheapest magnetic materials. Iron oxide, which is the raw material of this magnet, is mixed with strontium or barium and turned into a fine powder. The powder is then mixed with a ceramic binder, and magnets are produced through a compression or extrusion moulding technique followed by a sintering process.

Strontium is widely used in electronics as an additive in the production of barium titanate, which is used to make modern multilayer ceramic capacitors. Also, the addition of strontium increases the hardness of aluminium and copper. In short, strontium is an essential metal for today's high-tech industry.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003914

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MARKET

The principal strontium carbonate market was valued at US$210.12 million., and the total revenue is expected to grow at a CAGR of 2.8% from 2027. According to MMR, the major industry players and regions in depth are North America, Asia Pacific, Europe, Middle East & Africa, and South America (Fig 2).

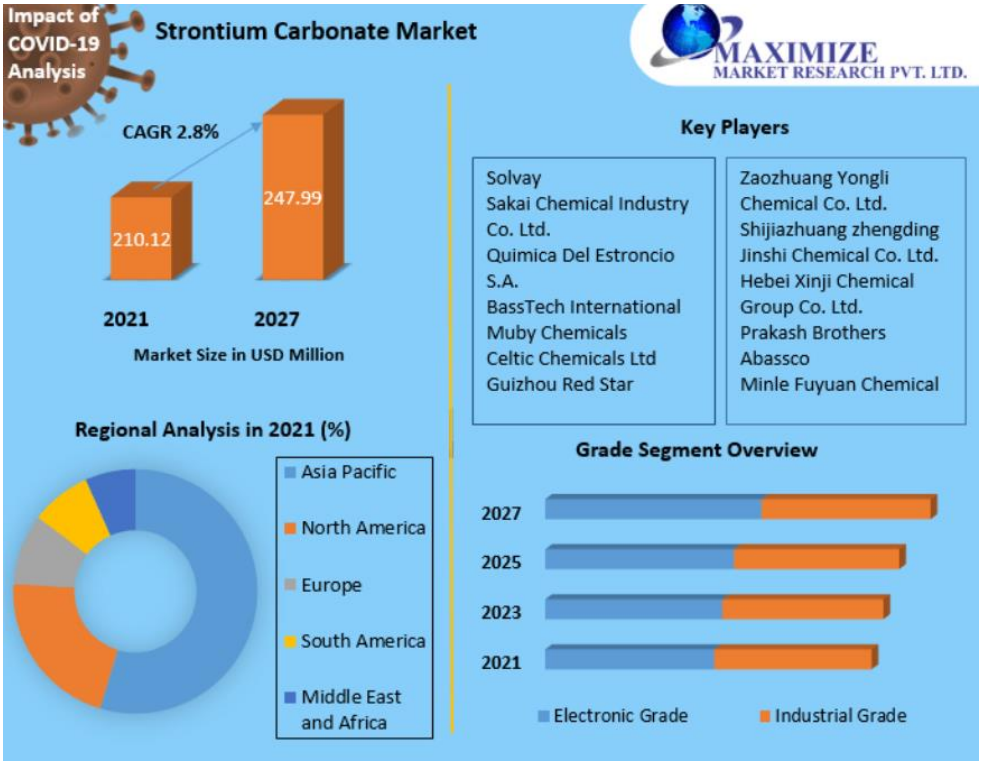

Figure 2: Key region-payers of the Strontium Carbonate Market. Source: The MMR report

Thus, in 2020, in accordance with MMR, the top exporters of strontium carbonate were Germany ($37.8M), Mexico ($13.3M), Spain ($2.48M), China ($2.35M), and Belgium ($842k). While, in 2020 the top importers of strontium carbonate were China ($12.7M), South Korea ($8.92M), Japan ($6.85M), United States ($5.46M), and Chinese Taipei ($4.78M). Of course, this is a far-sighted policy that testifies to the economic development of countries and the presence of high technologies in them.

In 2020, Strontium carbonate was the world's most traded product, with a total trade of $58.7M. Between 2019 and 2020, the export value of strontium carbonate decreased by -9.43% from USD 64.8 million to USD 58.7 million. The strontium carbonate industry equals to 0.00035% of the total global market.

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Raw Material Sources

Strontium is extracted from strontium deposits proper, often with an admixture of barium, where the ore is represented by either strontium sulphate - celestine or strontium carbonate - strontianite. Spain, Turkey, Iran, China, Mexico, and Canada have large deposits of celestine with reserves of millions of tons. Strontianite is also mined in southeast Africa, in Malawi.

Per USGS, celestine concentrate was mined (in tons): 165 thousand in Spain; 180 thousand in China; 40 thousand in Mexico; 10,000 in Argentina; 2,500 in Morocco, which is more than 80% of world production. But if Mexico, Spain and the rest countries export strontium concentrate, then China, with its own huge production, reduced exports from 100 thousand tons in 2002 to 44 thousand in 2005 and 20 thousand in 2013. The example of China shows that strontium is the metal of a booming empire.

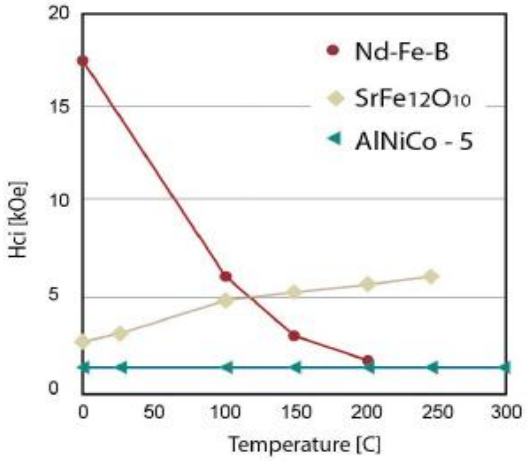

Figure 3. Relation intrinsic coercivity (Hcj) ws Temperature some PM, Source: PASSENGER

PASSENGER

PASSENGER addresses the topic CE-SC5-10-2020 on raw material innovation under the subtopic Pilots on substitution of critical and scarce raw materials in particular to produce PM. The use of rare-earth-based permanent magnets is one of the critical points for developing the current technology. On the one hand, the industry of rare earths is highly polluting due to the negative environmental impact of their extraction, and on the other hand, the sector is potentially dependent on China.

PASSENGER is developing a solution for the EU dependency on rare-earth for permanent magnets, avoiding bottlenecks in the material supply chain and diminishing the environmental impact by applying improved technologies for strontium-ferrite ($SrFe_{12}O_{10}$)

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and manganese-aluminium-carbon (Mn-Al-C) permanent magnets. These RE-free permanent magnet alternatives will substitute bonded NdFeB permanent magnets with good features as, for example, displayed in Figure 3, which are constituted by diverse critical raw materials: REs (Nd and Dy, and Pr in some compositions). In contrast with their good magnetic performance, Nd-Fe-B magnets corrode notoriously. It is also known that the magnetic properties of this type of magnets fall at high temperatures. PASSENGER improved ferrite (based on Sr) magnet at a lower initial magnetic performance shows **a stable improvement in properties with increasing operating temperatures**. This is especially important for motors and electromobility, which have been chosen as the main key-driving sector. The project is implemented under the premise of sustainability and reduced environmental impact.

GREEN DEAL CONTEXT

Clearly, we cannot transition to a green-energy future in the EU comprising transport electrification, power generation and smart facilities based on materials we have no guaranteed access to, such as CRM. Moreover, producing such materials can be opposed to circular economy principles, which are an essential element of the Green Deal. Substitution is only one solution for raw materials to which there is free access, where strontium has a strong position in the European PM industry. The national extraction and use of rare metals are an integral part of the EU development of the PM industry. Among these elements, strontium requires special attention.

Sources: MMR, PASSENGER, USGS

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