

High-Tech Applications of Zircon: Emerging Drivers of Sustainable Growth

EXECUTIVE SUMMARY

Zircon (also known as zirconium silicate, $ZrSiO_4$) is the co-product found after processing heavy mineral sands. It can be used in two forms either as coarse sand or fine powder (zircon flour) after milling. Zircon sand is utilized in casting and foundry, while zircon flour is used in the ceramics industry as an opacifier. The **three main applications for zircon**, namely ceramics, foundry, and refractories, **collectively account for around 80% of total global zircon consumption.**

Zirconium, a derivative of zircon, is a grayish-white metal with **unique properties that make it suitable for a wide range of industrial and scientific applications**, including using it as an alloy in the nuclear power industry. By adding to aluminium alloys and steel, zirconium can improve mechanical properties and corrosion resistance. Meanwhile, crushed zirconia, another derivative, obtained by melting zircon at more than $2,600^{\circ}C$ followed by cooling, is applied to advanced ceramics and biomedical implants.

Among the major applications for zircon, **ceramics is the largest one, as its usage represents close to 50% of zircon produced worldwide.** The opacifying feature and whiteness together with abrasion and moisture resistance make it a key ingredient in ceramic tiles, sanitaryware and tableware.

Regarding **refractory applications, zircon can protect the interior of high-temperature furnaces.** In addition, it can be used in **foundry and precision casting**¹ (also called investment casting) for the **casting of metals and alloys** into various products. These high-temperature applications require the thermal stability, high melting point and abrasion resistance provided by zircon.

Another important application is the production of a broad range of **zirconia chemicals**, which are **gaining popularity in a wide range of applications**, including catalysts, paper coatings, and cosmetics.

Due to their unique and advantageous attributes, zircon and its derivatives have been **increasingly used in a wide array of advanced applications in the high-tech field.** For example, specialist zirconia ceramics are used for electronics such as in induction heaters, oxygen sensors and fuel cells, plus many other electronic components. Since zircon-based advanced materials are biocompatible, so they are often used for medical implants. Zirconium is also used in satellites as a reflective surface agent and in superconductive magnets. The military industry utilizes zirconium sponges² in ignition charges and pyrotechnics.

¹ A manufacturing process in which a wax pattern is used to shape a disposable ceramic mold. A wax pattern is made in the exact shape of the item to be cast. This pattern is coated with a refractory ceramic material

² Cellular structures made with a large volume fraction of pores

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