Zinc Oxide

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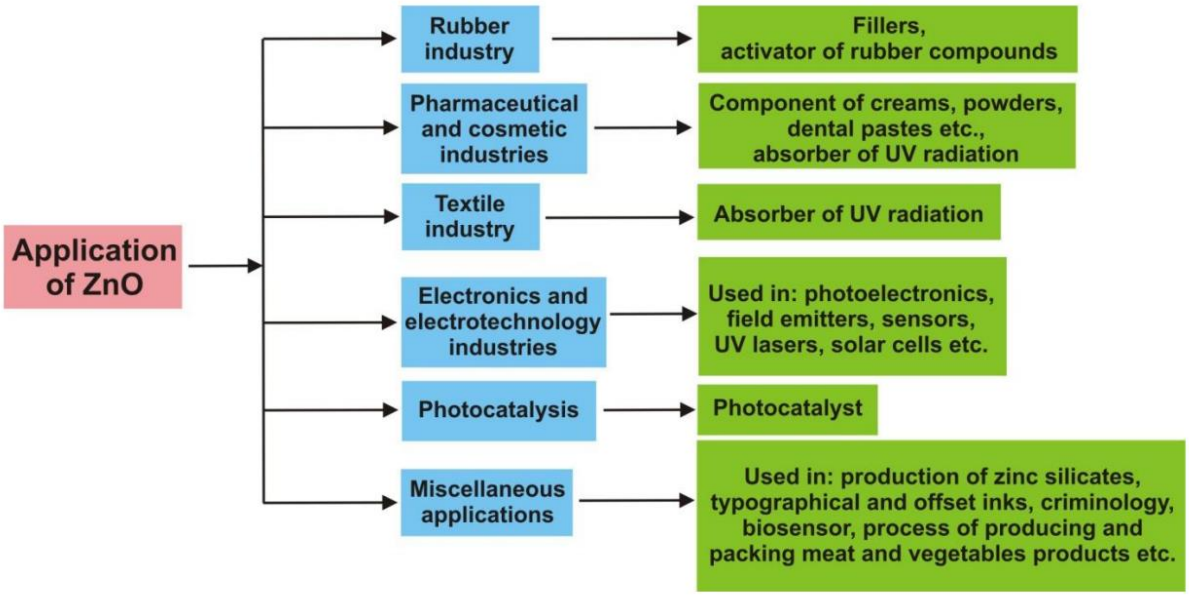
Zinc oxide (ZnO, CAS no. 1314-13-2) is an inorganic compound that occurs naturally under the name zincit. Zinc oxide is an odorless white powder that is insoluble in water. Pure synthetic zinc oxide is colorless, but the incorporation of impurity atoms such as Mn or Fe gives zincit a yellow or red color.

Usage and Exposure

Zinc oxide is widely used in many areas because of its diverse chemical and physical properties. It plays an important role in a variety of applications including agriculture and in the manufacture of tires, ceramics, pharmaceuticals, paints, and chemicals. The following chart presents the main applications of zinc oxide [Kołodziejczak-Radzimska].



Zinc oxide is a unique material that exhibits semiconducting and piezoelectric dual properties, and has the broadest variety of nanostructures of all materials. These unique characteristics make it suitable for a wide variety of applications in optoelectronics, sensors, transducers, and the biomedical sciences [Kumar]. Nanoparticles of zinc oxide have the ability to absorb UV radiation, and are widely used in sun creams.

Zinc oxide fumes are fine, white, odorless particles that are formed when zinc or zinc alloys are heated to high temperatures during welding, galvanizing and smelting [New Jersey].

Routes of Exposure

Inhalation of zinc oxide dust or fumes occurs in industrial settings during production or use of the material. It can also be absorbed when it crosses broken epithelium when zinc oxide is applied to treat burns or wounds [Sullivan].

Zinc is a cofactor for over 200 biologically important enzymes and has a recommended daily adult allowance of 15 mg. The FDA recognizes it as a safe nutrient when used in accordance with acceptable manufacturing practice [CFR 21].

Target Organs

The respiratory system.

Health Hazards

Acute Effects

Zinc oxide dust can block sebaceous glands, resulting in papular or pustular eczema. [Sullivan].

Zinc oxide dust or fumes can irritate the respiratory tract. Exposure to freshly generated zinc oxide fumes from welding galvanized iron often results in metal fume fever. Symptoms of metal fume fever include chills, muscle ache, nausea, fever, dry throat, coughing, lassitude; a metallic taste in the mouth, headache, blurred vision, lower back pain, vomiting, malaise, chest tightness, dyspnea, and rales. The symptoms usually start several hours after exposure. The attack may last 6 to 24 hours [CDC].

No changes in lung function occur between pre- and post-shift values or between early and late workweek values. No long term sequelae are observed. Tolerance is built up rapidly after repeated exposures but is quickly lost again. Consequently, more pronounced manifestation occurs after a short period of non- exposure followed by re-exposure [Sullivan]. Metal fume fever is more likely to occur after a weekend or vacation when workers are away from their job [CDC]. Because of this, the disease is sometimes known as "Monday morning fever".

Chronic Effects

Nanomaterials exhibit novel physicochemical properties that determine their interaction with biological substrates and processes. There is no definitive data regarding the toxicity of zinc oxide nanoparticles. Xia et al. examined zinc oxide in a mechanistic study to elucidate the physicochemical characteristics that determine cellular uptake, subcellular localization, and toxic effects. Zinc oxide induced toxicity leading to oxidant injury, inflammation and cell death [Xia].

Carcinogenicity

There is no evidence for zinc oxide carcinogenicity in humans.

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