W. R. Grace & Co.-Conn.
Cobalt Oxide Product Stewardship Summary

I. Overview

Cobalt oxide is a component in Grace hydroprocessing catalysts used globally by the petroleum industry for the refining of crude oil fractions like naphtha, kerosene and diesel under elevated pressure and temperature. These catalysts are usually composed of oxides of Mo (Molybdenum), Co (Cobalt), Ni (Nickel), and W (Tungsten) on a matrix or carrier of alumina, silica or silica and alumina. Grace does not manufacture or supply pure cobalt oxide and all uses of this substance as supplied by Grace are limited to industrial applications.

II. Chemical Identity - Physical and Chemical Properties

Chemical Identity:

Cobalt is a hard, lustrous, gray metal that is a naturally occurring. It is found in rocks, soil, water, plants, animals and humans. Cobalt oxide is an olive green to red inorganic odorless powder or crystal that is moisture sensitive but is largely insoluble in water. It is a stable substance that is not volatile, flammable or explosive. Commercial material is usually dark grey or black in color.

Chemical Name	Cobalt Oxide
Chemical Category (if applicable)	Inorganic metal compound
Synonyms	Cobalt(II) oxide, Cobalt(2+) oxide, Cobaltous oxide, Cobalt monoxide, Monocobalt oxide
CAS Number	1307-96-6
CAS Name	Cobalt oxide
Chemical Formula	CoO
Molecular Weight	74.9326
Melting point	1935 F
Density	5.7-6.7 depending on preparation

III. Applications

Cobalt is a very important metal finding uses in pigments, paints, surgical implants, catalysts, batteries, corrosion and heat-resistant alloys, animal feed additives, fertilizers, magnets and cutting tools. It can function as a binder, is used as an oxidation catalyst for oil drying, and is used as both a pigment and as a drying agent in paint and inks. All the cobalt oxide manufactured by Grace is present in its hydroprocessing catalysts that are used for industrial applications.

Hydroprocessing catalysts are used in the refining industry within process reactors at industrial locations to upgrade heavy oils into lighter, more useful products by removing impurities such as nitrogen, sulfur and heavy metals, allowing less expensive feedstock to be used in the petroleum refining process. Hydroprocessing is an important process necessary to remove pollutants like sulfur, nitrogen and heavy metals from fuel oils.

The purpose of removing sulfur (hydrodesulfurization) is to reduce the sulfur dioxide (SO_2) emissions that result from using those fuels in vehicles, aircraft, ships, gas and oil burning power plants, furnaces and other forms of fuel combustion. The level of allowed sulfur content in fuels is regulated and can only be achieved by using such hydroprocessing catalysts. The desulfurization reaction takes place in a closed fixed-bed reactor at elevated pressure and temperature.

IV. Manufacturing Processes

Hydroprocessing catalysts are prepared at Grace by supporting cobalt in combination with other metals on a carrier material. The process of introducing these elements onto the carrier is known as impregnation. Cobalt is typically obtained by Grace from its suppliers as cobalt carbonate and is converted into a soluble form together with other ingredients. After impregnation and other processing the cobalt is present in the catalyst as an oxide.

Hydroprocessing catalysts are typically supplied as extrudates or structured shapes such as asymmetric quadrilobes and spheres. The hydroprocessing catalysts supplied by Grace can be termed pre-catalysts because they must be sulfided to become active. Hydroprocessing pre-catalysts as supplied by Grace are not highly reactive, flammable or explosive. Release of cobalt and cobalt oxide during the manufacture of hydroprocessing catalysts is mitigated by the use of engineering controls, process and equipment design, work practices and pollution control equipment.

V. Health Effects

Cobalt, like many substances, has both beneficial and harmful health effects. Cobalt is an essential element that is required for good health in humans and many animals. It is therefore critical that foodstuffs contain adequate quantities of cobalt although the amount required for good health is small. In humans cobalt is important because it is part of vitamin B12. Cobalt is also used as a treatment for anemia.

Cobalt oxide is toxic if ingested and may cause skin sensitization upon repeated or prolonged exposure. The inhalation of cobalt particles can result in asthma, shortness of breath, and decreased pulmonary function. Cobalt oxide is also considered possibly carcinogenic to humans.

Inhalation during its production, processing and storage is the primary route of occupational cobalt exposure. Interstitial lung disease caused by metallic cobalt-containing particles is an occupational lung disease generally referred to as hard metal lung disease. Occupational exposure is limited by the use of engineering controls to include isolating the source of exposure, process design along with the use of general and local ventilation. Work practice controls such as housekeeping and establishment of restricted areas, and the use of personal protective equipment are also routinely employed to control worker exposures.

Public exposure to the cobalt oxide manufactured by Grace is expected to be limited. Release of cobalt and cobalt oxide during the manufacture and use of hydroprocessing catalysts is mitigated by the use of engineering controls, process and equipment design, work practices and pollution control equipment. Public exposure scenarios resulting from accidental releases are unlikely due to the form of the catalyst in which the cobalt oxide is present coupled with the controls used during transportation

VI. Environmental Effects

Cobalt and other inorganic cobalt compounds are non-volatile and are released into the atmosphere in particulate form. Cobalt that is released into the atmosphere is deposited on soil, and cobalt released into water may either adsorb to particles and settle into sediment or adsorb directly to sediment.

Cobalt oxide can enter the environment from both human activities and from natural sources since cobalt occurs naturally in soil and water. Natural sources include seawater spray, volcanic eruptions, and forest fires and from runoff and leaching when rainwater washes through soil and rock containing cobalt. Human sources include runoff and dust from soils near mined ore deposits and ore smelting facilities, and smaller amounts from

vehicular exhaust, from coal-fired power plants and the production and use of cobalt chemicals.

Cobalt oxide is both acutely and chronically toxic to aquatic life based on toxicity data associated with cobalt and other cobalt compounds. Due to this hazard the release of cobalt to the aquatic environment must be controlled. Data regarding the toxicity of cobalt to terrestrial systems is limited but there is little evidence of cobalt toxicity to plants as a result of elevated cobalt concentrations in the soil. In addition, studies show that plants can only accumulate very small amounts of cobalt from the soil therefore consumed plants and animals will generally not contain high amounts of cobalt.

VII. Conclusion

The hydroprocessing catalysts in which the cobalt oxide supplied by Grace is found are important to refining industry because they are used to remove pollutants like sulfur, nitrogen and heavy metals from fuel oils. The primary risk of worker exposure to cobalt oxide is by dust inhalation and by dermal contact. This exposure potential is controlled by use process enclosures, ventilation, work practices and personal protective equipment. Because Grace hydroprocessing catalysts containing cobalt oxide are manufactured and used in controlled industrial settings the risk of exposure to the general public and to the environment is largely limited to that which may occur in accidental situations.

VIII. W. R. Grace Contacts

Please feel free to contact one of the following Grace representatives should you desire additional information or have questions.

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IX. References, Literature and Other Sources of Information

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