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

I. Overview

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

II. Chemical Identity - Physical and Chemical Properties

Chemical Identity:

Pure cobalt molybdate is a light green inorganic odorless powder that is water soluble. It is a stable substance that is non-flammable and non-explosive. Commercial material is usually dark grey or black in color.

Chemical Name	Cobalt Molybdate
Chemical Category (if applicable)	Inorganic metal compound
Synonyms	Cobalt molybdenum oxide; cobalt(2+) dioxido(dioxo)molybdenum; molybdic acid, (H_2MoO_4), cobalt(2+) salt (1:1)
CAS Number	13762-14-6
CAS Name	Cobalt molybdate
EC Number	237-358-4
Chemical Formula	$CoMoO_4$
Molecular Weight	220.82
Melting point	> 1100 °C
Density	4.32 g/cm³ at 20°C

III. Applications

Cobalt molybdate has applications as a chemical intermediate for catalytic purposes (e.g. for cobalt containing hydroprocessing catalysts). 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 needed 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. Typically, a combination of transition metal oxides like molybdenum together with elements of the iron-platinum group such as cobalt is used along with other forms of hydroprocessing catalysts.

IV. Manufacturing Processes

Hydroprocessing catalysts are prepared at Grace by supporting necessary elements (e.g. Molybdenum, Tungsten, Cobalt, or Nickel) in their oxide state on an alumina carrier material. The process of introducing the elements onto the alumina carrier occurs either by a pre or post-impregnation step. Cobalt is obtained by Grace from suppliers as either cobalt carbonate or cobalt acetate. Molybdenum is obtained by Grace from suppliers as molybdenum oxide. During the impregnation step cobalt molybdate is converted into a soluble form. A second conversion takes place during a hardening step that occurs in the presence of oxygen. Hydroprocessing catalysts are typically supplied as extrudates or structured shapes such as asymmetric quadrilobes and spheres. The hydroprocessing catalysts supplied by Grace are not highly reactive, flammable or explosive, and can be termed pre-catalysts because they must be sulfided to become active.

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 both animals and humans. It is therefore critical that foodstuffs contain adequate quantities of cobalt. In humans cobalt is important because it is part of vitamin B12, which is essential to maintain human health and been used as a treatment for anemia.

Molybdenum is an element that is present in very small amounts in the body. It is involved in many important biological processes, possibly including development of the nervous system, waste processing in the kidneys, and energy production in cells. Molybdenum is used to treat rare inherited metabolic diseases, such as Wilson's disease in which the body cannot process copper.

Cobalt molybdate is an eye irritant and is toxic if ingested. It may cause respiratory or skin sensitization upon repeated or prolonged exposure. The inhalation of cobalt molybdate powder can also result in asthma, shortness of breath, and decreased pulmonary function. Cobalt molybdate is classified as possibly carcinogenic and mutagenic, and is defined as being a reproductive toxin and a hazard to unborn children.

Inhalation during catalyst production, distribution and use is the primary route of occupational cobalt exposure. Occupational exposure is controlled by the use of engineering controls, process design and the use of both general and local ventilation. Work practice controls such as the establishment of restricted areas along with the use of personal protective equipment are also routinely employed.

Public exposure to the cobalt molybdate manufactured by Grace is expected to be limited. Release of cobalt molybdate 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 molybdate is present coupled with the procedures and systems used during transportation.

VI. Environmental Effects

While molybdenum is involved in many important biological processes, the concentration of molybdenum in the environment must be controlled to protect marine organisms, plants and higher animals. Cobalt molybdate is very soluble in water, and is both acutely and chronically toxic to aquatic life. Due to these hazards controls need to be established to prevent the substance from entering waterways. Because Grace manufactures hydroprocessing catalysts under controlled industrial conditions and Grace refining customers using hydroprocessing catalysts are located in regulated industrial settings, the risk of exposure to the environment is low.

VII. Conclusion

The primary risk of worker exposure to cobalt molybdate is by dust inhalation and by dermal contact. Exposure potential is controlled in industrial settings by use of process enclosures, ventilation, strictly controlled conditions and personal protective equipment. Workplace exposure limits exist for cobalt compounds in worksite safety programs. The primary risk for environmental impact from cobalt molybdate would be if the substance comes into contact with water and this risk is limited during manufacture and use of Grace hydroprocessing catalysts. The risk of exposure for the general public is low because Grace hydroprocessing catalysts are only used under strictly controlled conditions in industrial settings, and there is no use of the cobalt molybdate manufactured by Grace in consumer products.

VIII. W. R. Grace Contacts

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

Brett Jurd Brett.Jurd@grace.com
Juergen Nolde Juergen.Nolde@grace.com

IX. References, Literature and Other Sources of Information

Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Department of Health and Human Services, ATSDR ToxFAQs: Cobalt (http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=372&tid=64)

ATSDR (Agency for Toxic Substances and Disease Registry). 2004. Toxicological Profile for Cobalt. Department of Health and Human Services, ATSDR.

European Chemicals Agency registered substances webpage: http://echa.europa.eu/web/guest/information-on-chemicals/registered-substances

IPCS (International Programme on Chemical Safety). 2006. Cobalt and inorganic cobalt compounds. Geneva (CH): World Health Organization. (Concise International Chemical Assessment Document 69). Jointly sponsored by the United Nations Environment Programme, the International Labour Organization, and the World Health Organization, and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals.

National Library of Medicine, National Institute of Health Hazardous Substances Databank Number: 239 http://www.nlm.nih.gov/pubs/factsheets/hsdbfs.html

National Institute for Occupational Safety and Health NIOSH), Centers for Disease Control: http://www.cdc.gov/niosh/topics/cobalt/

Nagpal, N. K., 2004. Technical report, water quality guidelines for cobalt, Water Protection Section Water, Air and Climate Change Branch. Ministry of Water, Land and Air Protection. British Columbia, Canada.