W. R. Grace & Co.-Conn.
Zeolites Product Stewardship Summary

I. Overview

W. R. Grace & Co.-Conn. is a global manufacture of synthetic non-fibrous zeolites that are both distributed as discrete products and are used as a component or raw material in a number of products manufactured by Grace Davison. Synthetic non-fibrous zeolites manufactured and distributed by Grace are available in both powder and bead forms.

II. Chemical Identity- Physical and Chemical Properties

Chemical Identity:

Chemical name:	Zeolites
Structure:	UVCB (chemical substances of unknown or variable composition, complex reaction products and biological materials)
Molecular formula:	M2/nO • Al2O3 • ySiO2 • wH2O
Synonyms:	Molecular sieves, Zeolite A, Zeolite X, Zeolite Y, ZSM-5
CAS#:	1318-02-1
CAS Name:	Zeolites
TSCA status:	Zeolites are considered for TSCA purposes to be mixtures of the substances used to manufacture them. The individual reactant materials used to produce zeolites are required to be listed separately on the Inventory.

Zeolites, often referred to as molecular sieves, are microporous aluminosilicate compounds. They are available as synthetically manufactured substances or as naturally occurring materials that must be mined. Naturally occurring zeolites are extensively mined in many parts of the world finding applications in industry and medicine but often contain a certain amount of crystalline quartz. Approximately 150 types of zeolites have been synthesized. The most widely used synthetic forms are zeolites A, X, Y, and ZMS-5. All zeolites manufactured and distributed by Grace are all synthetically manufactured and in pure powder form, not shaped, contain no quartz.

Zeolites are composed of silica (SiO2 CAS# 7631-86-9) and alumina (Al2O3 CAS# 1344-28-1), in various proportions plus metallic oxides (Na2O CAS# 1313-59-3, ZnO CAS# 1314-13-2, K2O CAS# 1309-48-4, MgO CAS# 1309-48-4, CaO CAS# 1305-78-8).

Zeolites have a porous structure where cations, water and other small molecules may reside. Synthetic zeolites are termed “framework” aluminosilicates, the framework containing the spaces in which the cations, water and other small molecules are located.

Zeolites are described by the US EPA as follows:

“EPA recognizes zeolites as a family of aluminosilicates manufactured from a number of commercial processes and techniques that utilize different proportions of alumina, silica and a variety of sources of different inorganic and organic cations. The final zeolites are characterized by covalently linked AlO4 and SiO4 tetrahedra. Zeolites as a class of substances are considered mixtures under TSCA regardless of the commercial manufacturing processes and reactants utilized to achieve the desired chemical composition of the final zeolite structure. “

Physical and Chemical Properties:

Synthetic non-fibrous zeolites manufactured by Grace are inorganic solids that have a melting point above 1000°C. They are stable at ambient temperature and pressure, largely insoluble in water and organic solvents, nonflammable, are not explosive and have no oxidizing properties. Typical synthetic zeolites are white to off-white in color and have no odor.

III. Applications

Synthetic zeolites have many advantages over their naturally occurring counterparts. Unlike naturally occurring zeolites the synthetic forms can be manufactured in a uniform state and particle size. The use of synthetic zeolites also has many advantages over other (organic) substances performing similar functions. Because of their thermal and chemical stability, they can often be easily recovered and recycled with a minimal loss of activity. Synthetic zeolites have a broad range of industrial, commercial and consumer uses. The three primary applications of synthetic zeolites are as catalysts, desiccants or adsorbents and in detergents.

Zeolites have the ability to selectively adsorb various molecules allows them to be used for water and contaminant removal. Their ability to serve as an ion exchange media has resulted in use in refrigerant systems; they are also sold into cosmetic applications and are used as a filter for odor and toxin removal. Zeolites also can serve as a tool to help clean waste water. Another common use of zeolites is in detergent powders and tablets for water softening during the washing process. One of the largest uses of synthetic zeolites is as a component in fluid catalytic cracking (FCC) catalyst used to refine crude petroleum. However, the use of zeolites as a catalyst or catalyst base is not limited to petroleum refining and these substances are used in a number of other chemical processes.

The unique properties of zeolites have led to the development of a broad range of Grace Davison synthetic non-fibrous zeolite adsorbent products such as zeolite beads, powders, polymer desiccants, mono and miniliths, drying bars and castor oil paste.

Grace zeolite bead products are sold into the insulating glass industry, used for natural gas purification, and petrochemical drying.

IV. Manufacturing Processes

Synthesis of zeolites is important because it allows the manufacturer to prepare a zeolite with properties to match its intended end use. The specific composition of the reaction mixture is of vital significance for the synthesis process along with temperature, degree of agitation and pH. Composition is usually expressed as the oxide ratio 2/nO*(Al2O3)a*(SiO2)b*(H2O)c, in which M represents cations (e.g., sodium, potassium) with charge n. The production of synthetic zeolites can be carried out continuously or by batches, although batch production is the most common method.

The conditions used to manufacture synthetic zeolites are comparable to those that led to formation of natural zeolites, i.e., by the mineralizing effects of water and OH– ions on reactive sources of silica and alumina in the presence of cations. Manufacturing occurs via hydrothermal treatment of either a solid aluminosilicate or of a gel. A crystallization of aluminum hydroxide, sodium hydroxide and sodium silicate (waterglass) under carefully controlled conditions yields the required structure. The formed zeolite crystals can then be ion exchanged to adjust the pore size. After drying the molecular sieve crystals can be processed to an activated zeolite powder. To prepare zeolite beads a small quantity of binder, such as kaolin clay, is added and the substance is then dried and calcined.

V. Health Effects

Synthetic non-fibrous zeolites are inorganic solid substances that pose limited physical or chemical hazards. They are considered to be stable at ambient temperatures and pressure but when adsorbing water or other polar substances, zeolites can cause the solution being dried to heat up to a point where it can burn skin.

Synthetic non-fibrous zeolites are not irritating to the skin and are slightly to non-irritating to the eyes. The powder of the substance may cause reactions in eyes due to mechanical friction. There is no evidence that synthetic non-fibrous zeolites are sensitizing by skin contact and there is no indication that synthetic non-fibrous zeolites can induce respiratory hypersensitivity. Testing has indicated that there are no serious effects upon repeated exposure to synthetic non-fibrous zeolites, nor adverse effects on fertility or reproduction. Synthetic non-fibrous zeolites have not been identified as mutagenic or carcinogenic substances. It should be noted that certain naturally occurring fibrous zeolites, namely erionite, have been classified as carcinogenic, but no natural zeolites are present within the Grace product portfolio. The quartz present in Grace molecular sieve bead products originates from the natural binders which are necessary for shaping the beads. The quartz content of molecular sieves is in direct correlation to the binder systems used. The typical quartz content of binders used by Grace is less than 5 % and thus less than 1 % in the finished product.

VI. Environmental Effects

Acute toxicity testing in fish, invertebrates and algae of synthetic non-fibrous zeolites indicate a low order of toxicity. Synthetic non-fibrous zeolites are inorganic substances and therefore are not amenable to biodegradation and they are not expected to be photo-degraded. If discharged as a wastewater the substances have no COD or BOD impact on effluents. The diluted material will decompose to become silica and alumina that is no different than their natural counterparts. Synthetic non-fibrous zeolites do not bioconcentrate up the food chain. When released to the environment synthetic non-fibrous zeolites would not be anticipated to have any recognizable environmental impact. Zeolites are not regulated under the Environmental Protection Agency's Clean Air Act Risk Management Program, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or as a section 302 or 313 substance under The Emergency Planning and Community Right-to-Know Act (EPCRA).

VII. Conclusion

Synthetic non-fibrous zeolites have wide application in industry and consumer products. They are generally classified as safe, low risk chemicals and have existing regulatory approval for use in a broad number of applications. Synthetic non-fibrous zeolites would not be expected to bioaccumulate within living organisms and therefore have not exhibited secondary toxicity such as carcinogenosis nor reproductive toxicity. When released into the environment, the substance becomes indistinguishable from naturally occurring analogs silicates, which are fundamental components of the earth's crust. Based on its chemical and physical properties and combined with its toxicological and ecotoxicological profile, synthetic non-fibrous zeolites do not pose a risk to the environment or to consumers.

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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