Product Safety Assessment

*DOWEX™* Ion Exchange Resins

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Names

- Ion exchange resin
- *DOWEX™* ion exchange resin
- *DOWEX* anion exchange resin
- *DOWEX* cation exchange resin
- *DOW™* Cholestyramine
- Styrene-divinylbenzene copolymer
- *DOWEX MONOSPHERE™*
- *DOWEX MARATHON™*
- Divinylbenzene, acrylic acid polymer

Product Overview

- *DOWEX™* ion exchange resins are manufactured by Dow and marketed through Dow Water & Process Solutions. Ion exchange is the reversible interchange of ions, usually between a resin and a liquid. Ion exchange resins act as “chemical sponges” for effective removal of contaminants from liquids, especially water.¹ *DOWEX* ion exchange resins are porous spherical beads typically made of styrene-divinylbenzene copolymers. The resins are chemically modified with a variety of functional groups, depending on the intended use.² For details, see Product Description.

- *DOWEX* ion exchange resins are mainly used for commercial and industrial water purification. However, *DOWEX* resins are also used extensively in the food processing and pharmaceutical industries. The type of resin used depends on the application. Because of their versatility, *DOWEX* resins can be used for demineralizing (softening) water, acid or base catalysis in chemical manufacturing, metal recovery or concentration in the nuclear and mining industries, iron removal from hydrochloric acid, nitrate removal from water, silica removal from water, and water removal from organic solvents.³ For details see Product Uses.

- Consumers using cholesterol-lowering medications or other pharmaceuticals based on ion exchange technology are consuming ground ion exchange resins. *DOWEX™* ion exchange resins used for food processing applications have been evaluated for consumer safety by the U.S. Food and Drug Administration (FDA). *DOWEX* resins used for food contact are compliant with the FDA Food Additive Regulation 21 CFR § 173.25.⁴ For details, see Health Information or Physical Hazard Information.

- *DOWEX* ion exchange resins can be used in industrial processes. Worker exposure in the industrial setting is possible. *DOWEX* strong acid cation exchange resins in the (H⁺) form and *DOWEX* (Type I) strong base anion exchange resins in the (OH⁻) form can be dangerous to

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the eyes if contact occurs.\textsuperscript{5,6} Those working with ion exchange resins in manufacturing or industrial operations must be trained in their use and follow appropriate safety measures. For details, see Exposure Potential and Health Information.

- DOWEX\textsuperscript{™} ion exchange resins are stable under recommended storage and use conditions. Exposure to elevated temperatures can cause these products to decompose. Avoid contact with strong oxidizers.\textsuperscript{7,8} For details, see Physical Hazard Information.

**Manufacture of Product\textsuperscript{9,10}**

- **Locations** – DOWEX\textsuperscript{™} ion exchange resins are manufactured at Dow facilities in Midland, Michigan (USA), Stade, Germany, and Fombio, Italy.
- **Process** – DOWEX ion exchange resins are typically produced by batch suspension polymerization using surfactants and mechanical action to create and stabilize the suspension droplets during polymerization. For some DOWEX products, the suspension droplets are created by a proprietary process that creates a very uniform (monodispersed) particle size. The resins are based on styrene copolymerized with divinylbenzene (DVB). The DVB used contains ethylvinylbenzene, which also reacts in the copolymerization. DVB acts as a “cross-linker,” connecting the polymer chains to form a porous network. Because the copolymer is formed as a suspension in water, the result is tiny, independent spherical beads. The beads are then chemically modified with one of several positively or negatively charged functional groups, depending on the application.

**Product Description\textsuperscript{11,12,13}**

DOWEX\textsuperscript{™} ion exchange resins are manufactured by Dow and marketed by Dow Water & Process Solutions. Ion exchange is a reversible chemical reaction in which charged particles, or ions, are exchanged for similarly charged ions attached to an inert, stationary polymer matrix. Ion exchange resins can be thought of as microfiltration systems in which contaminants are selectively removed from liquids based on their ionic charge rather than size. Ion exchange resins can be white, light yellow, tan, or amber in color. They vary from being odorless to an amine-like odor. The beads are very small, ranging in size from 0.3 to 1.2 mm (0.01 to 0.05 inches) in diameter. There are five main classes of ion exchange resins: strong acid, weak acid, strong base (Type I), strong base (Type II), and weak base. There are other resin types for special applications.

**Product Uses\textsuperscript{14,15,16,17,18}**

Ion exchange resins are mainly used for commercial and industrial water purification. The type of resin used depends on the application. A cation exchange resin trades hydrogen (H\textsuperscript{+}) or sodium (Na\textsuperscript{+}) ions for dissolved calcium (Ca\textsuperscript{2+}) ions, or other positively charged metals or ions. An anion exchange resin exchanges negatively charged ions. Trading a hydroxide (OH\textsuperscript{−}) ion for chloride (Cl\textsuperscript{−}) can convert an acidic solution to pure water. Ion exchange resins are selective;
they remove specific types of ions based on resin type. Different resins can be used in sequence or mixed depending on the purification goal. Most industrial applications use fixed-bed ion exchangers. Fixed-bed exchangers are typically cylindrical tanks containing from 1.5 to 3.0 feet of resin. Feedwater enters at the top of the tank and passes through the resin bed. Treated water exits from the bottom. Ion exchange resins must undergo periodic regeneration cycles. Regeneration is the process of returning the resins to their original ionic state. Cation exchange resins are regenerated with acid or brine. Anionic resins are regenerated with sodium hydroxide.

Commercial uses for DOWEX™ ion exchange resins include:

- **Water Softening**
  - Demineralization resins
  - Potable water treatment
- **Industrial Water Purification**
  - Condensate polishing/nuclear grade
  - Demineralization resins
  - Ultrapure water
- **Pharmaceutical Applications**
  - Cholesterol-lowering medication
- **Other Applications**
  - Fine mesh, adsorbents, dried resin
  - Non-water specialty
  - Sweeteners
  - Specialty application for water treatment

Ion exchange resins used for therapeutic pharmaceutical applications include cholestyramine. This cholesterol-lowering medication is an anion exchange resin that binds bile in the gastrointestinal tract preventing its conversion to cholesterol.19

### Exposure Potential

Based on the uses for these resins, the public could be exposed through:

- **Workplace exposure** – Exposure can occur either in a manufacturing facility, or in the various industrial or manufacturing facilities that use ion exchange resins. Those working with ion exchange resins in manufacturing operations could be exposed during maintenance, sampling, testing, or other procedures. Each manufacturing facility should have a thorough training program for employees and appropriate work processes and safety equipment in place to limit unnecessary exposure.20,21 See Health Information.

- **Consumer exposure to products manufactured using ion exchange resins** – Resins used for food applications have been evaluated for consumer safety and are compliant with FDA Food Additive Regulation 21 CFR § 173.25 and, where applicable, Kosher standards.22 Resins used for drinking water and softening applications are compliant with NSF/ANSI Standard Nos. 61 and 42, where applicable. Consumers using cholesterol-lowering medications or other pharmaceuticals based on ion exchange technology are consuming ground ion exchange resins. See Health Information.

- **Environmental releases**23,24 – Because they are tiny beads, spilled resin may be a slipping hazard. In the event of a spill, contain material if possible. Prevent resin from entering into soil, ditches, sewers, waterways, or ground water. For small spills, sweep up the material and collect it in suitable and properly labeled containers for disposal. Consult the Safety Data Sheet for information about protective equipment and procedures. See Environmental Information, Health Information, and Physical Hazard Information.

- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill occurs, keep unnecessary and unprotected personnel from entering area. The material should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. Do not dump ion exchange resins into sewers, on the ground, or into any body of water. Follow emergency procedures carefully. In the event of a fire, keep people away. Isolate fire and deny unnecessary entry. Personnel involved in fire fighting should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective fire-fighting clothing or fight the fire from a safe distance. Use water, dry-chemical, or carbon-dioxide extinguishers. Soak the resin thoroughly with water to cool and prevent

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re-ignition. Cool surroundings with water to localize the fire zone. See Environmental Information, Health Information, and Physical Hazard Information.

For more information, see the relevant Safety Data Sheet.

**Health Information**

Health and toxicology information differs based on the type of resin and the applications for which it is used. Because of the ions they are designed to capture, used ion exchange resins may have different hazards than unused resins.

In general, DOWEX™ strong acid cation exchange resins in the (H⁺) form and strong base (Type I) anion exchange resins in the (OH⁻) form can be dangerous to the eyes. Eye contact may cause severe irritation with corneal injury that may result in permanent impairment of vision, even blindness. Chemical burns may occur.

For DOWEX strong acid cations in the sodium (Na⁺) form, weak acid cations, strong base (Type I) anions in the chloride (Cl⁻) form, strong base (Type II) anions, and weak base resins, eye contact may cause slight irritation. Solid or dust may cause irritation or corneal injury due to mechanical action (scratching).

For cation and anion exchange resins in general, prolonged or repeated skin contact is not likely to cause significant irritation or result in absorption of harmful amounts. If skin is abraded or cut, irritation may be more severe.

These resins have very low toxicity if swallowed. Harmful effects are not anticipated from swallowing small amounts. Ingestion of DOW™ cholestyramine binds bile in the gastrointestinal tract preventing its conversion to cholesterol. Lowering blood level of cholesterol and fats may help to prevent heart disease, angina (chest pain), strokes, and heart attacks.²⁷

For more information, see the relevant Safety Data Sheet.

**Environmental Information**

No bioconcentration (accumulation in the food chain) of these DOWEX™ resins is expected because of its high molecular weight. In the terrestrial environment, ion exchange resins are expected to stay in the soil. In the aquatic environment, material will sink and remain in the sediment. Based on information for styrene-divinylbenzene copolymer, surface degradation is expected with exposure to sunlight. However, no appreciable biodegradation is expected. Contact with ion exchange resins is not expected to be acutely toxic to aquatic species and waterfowl. However, ingestion of beads may cause adverse effects in some species.

For more information, see the relevant Safety Data Sheet.

**Physical Hazard Information**

DOWEX™ ion exchange resins are stable at storage temperatures of 35 to 122°F (2 to 50°C). Exposure to elevated temperatures can cause these products to decompose. Ion exchange resins are highly incompatible with strong oxidizing agents, such as nitric acid. The severity of the

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reaction with oxidizing materials can vary from slight degradation to an explosive reaction. Avoid contact with oxidizing materials.

Ion exchange resins typically contain water, and they will not burn until all water is evaporated. Under fire conditions, some components of ion exchange resins may decompose. The smoke may contain unidentified toxic and/or irritating compounds. Hazardous combustion products may include organic amines, nitrogen oxides, hydrogen chloride, sulfur oxides, organic sulfonates, hydrocarbons, carbon monoxide, benzene compounds, and carbon dioxide.

For more information, see the relevant Safety Data Sheet.

Regulatory Information

Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of ion exchange resins. These regulations may vary by city, state, country, or geographic region. Information may be found by consulting the relevant Safety Data Sheet, Product Data Sheet, or Contact Us.

Additional Information

- Safety Data Sheet (http://www.dow.com/liquidseps/prod/msds.htm)
- Contact Us (http://www.dow.com/liquidseps/contact/contact.htm)


References


9 Estimates by The Dow Chemical Company.
18 Estimate by The Dow Chemical Company.
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