Product Safety Assessment

**Divinylbenzene**

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**Names**
- CAS No. 1321-74-0
- Divinylbenzene (DVB)
- Diethenylbenzene
- Divinylbenzene HP (DVB-HP)
- Divinylbenzene 63 (DVB-63)
- Divinylbenzene 55 (DVB-55)

**Product Overview**
- Divinylbenzene (DVB) is a clear yellow liquid with an aromatic odor. DVB is manufactured as a mixture of isomers of divinylbenzene and ethylvinylbenzene (EVB, CAS No. 28106-30-1). Dow manufactures three DVB products: DVB-55, DVB-63, and DVB-HP. For further details, see **Product Description**.
- DVB is an extremely versatile chemical cross-linking agent used to improve polymer properties. DVB is used in the manufacture of adhesives, plastics, elastomers, ceramics, biological materials, coatings, catalysts, membranes, pharmaceuticals, specialty polymers, and ion exchange resins. For further details, see **Product Uses**.
- Eye contact with DVB may cause slight irritation with pain disproportionate to the level of irritation to the eye tissues. Corneal injury is unlikely. Prolonged skin contact may cause irritation with local redness, but is unlikely to result in absorption of harmful amounts. Repeated contact may cause skin burns. At room temperature, vapors are minimal due to low volatility. Vapor from heated material may be hazardous on single exposure. For further details, see **Health Information**.
- Occupational exposure to DVB could occur in manufacturing or formulating operations. Consumers are not likely to contact DVB because it is an industrial chemical used to make other products. For further details, see **Exposure Potential**.
- DVB is a highly reactive chemical whose liquid and vapor are combustible. It is stable under recommended storage conditions, which include maintaining inhibitor concentration and effectiveness. Proper handling and storage precautions must be observed when working with DVB. Exposure to elevated temperatures can cause the material to polymerize or decompose. Avoid contact with oxidizing materials, acids, metal halides, peroxides, brass, and copper. For further details, see **Physical Hazard Information**.

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Manufacture of Product

- **Locations** – Dow produces DVB at facilities in Midland, Michigan.
- **Process** – DVB is manufactured via the catalytic dehydrogenation of diethylbenzene, which results in a mixture of ethylvinylbenzene and divinylbenzene isomers. The final products are purified by distillation. The chemical reaction is as follows:

\[
\begin{align*}
\text{H}_3\text{C} & \quad \text{H}_3\text{C} & \quad \text{H}_3\text{C} & \quad \text{H}_3\text{C} \\
\text{CH}_3 & \quad \text{CH}_3 & \quad \text{CH}_3 & \quad \text{CH}_3 \\
\text{1,3-diethylbenzene} & \quad \text{1-ethyl-3-vinylbenzene} & \quad \text{1,3-divinylbenzene} \\
\text{1,4-diethylbenzene} & \quad \text{1-ethyl-4-vinylbenzene} & \quad \text{1,4-divinylbenzene}
\end{align*}
\]

Product Description

Divinylbenzene (DVB) is a clear yellow liquid with an aromatic odor. DVB is used as a cross-linking agent, meaning it is used to join together individual chains within a polymer. DVB is a mixture of isomers of divinylbenzene and ethylvinylbenzene (EVB, CAS No. 28106-30-1). Dow manufactures three DVB products: DVB-55, DVB-63, and DVB-HP. They contain 56%, 63.5%, and 80% of the active cross-linker, respectively.

Product Uses

DVB is a chemical intermediate used to modify the properties of a wide variety of materials. The primary use for DVB is in the production of cross-linked polystyrene resin beads. These styrene-DVB copolymer beads are chemically modified to produce ion exchange resins. Typical applications for DVB:

- **Adhesives** – improves high-temperature strength of adhesives used to bond aluminum to aluminum, added to caulks and mastics for the construction industry
- **Biological** – improves physical properties of cell culture micro-carrier beads, incorporated into a hydrogel for slow nutrient release fertilizer
- **Catalysis** – used in hydrophobic foam catalyst, serves as a catalyst for hydrolyzing nitriles to amides
- **Ceramics** – improves physical and mechanical properties of fired clay bodies
- **Chromatography** – used in resins for reversed-phase liquid chromatography and ion exchange chromatography packings
- **Coatings** – improves surface properties of rubber goods for biomedical applications, used in photocurable protective coatings for wood, metal, glass, and plastic
- **Combinatorial chemistry** – used to create functionalized copolymers that are useful drug screening tools
- **Composite plastics** – allows higher production rates, enhanced physical properties, exceptional smoothness
- **Elastomers** – increases skid-resistance of some rubber compounds, improves adhesion of rubber to steel
- **Electrochemical** – increases electron sensitivity in electron-beam lithography, improves storage stability of alkaline batteries, improves properties of electrostatic image toners
- **Ion Exchange** – used in the production of resin beads that reduce bead swelling, increase bead strength, improve water retention and capacity
Membranes – used in polymers for electrolysis-diaphragm and piezodialytic-transport membranes
Optical – used in polymers for ophthalmic and photochromic lenses
Pharmaceutical – used in polymers for enzyme and coenzyme mobilization, dental cement, and prosthesis materials
Polymer synthesis – used in polymers for waterproof fabric manufacture, enhanced radiation grafting of polymers, living polymer-polyvinyl aromatic compound coupler
Plastics – used extensively as a cross-linker and to aid in copolymerization
Reprography – used to make copy machine toner resins
Rubber – used as a processing aid in the extrusion of general-purpose synthetic rubbers
Star polymers – used in polymers used as motor-oil viscosity modifiers

Exposure Potential
DVB is used in the production of industrial and consumer products. Based on the uses for DVB, the public could be exposed through:

- **Workplace exposure** – Exposure can occur either in a DVB manufacturing facility or in the various industrial or manufacturing facilities that use DVB. It is produced, distributed, stored, and consumed in closed systems. Those working with DVB 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, ventilation, and safety equipment in place to limit unnecessary DVB exposure. See Health Information.

- **Consumer exposure to products containing DVB** – Dow does not sell DVB for direct consumer use. DVB is a chemical intermediate (building block) used to manufacture other products. See Health Information.

- **Environmental releases** – In the event of a spill, the focus is on containing the spill to prevent contamination of soil, ditches, sewers, waterways, or groundwater. Soak up small spills with sand or Imbiber Beads® (Trademark of Imbibitive Technologies Corporation). Do not use absorbent sweeping compounds such as clay, vermiculite, or Zorball because they may promote polymerization. See Environmental, Health, and Physical Hazard Information.

- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, dike the area to contain the spill. Isolate the area, keeping upwind of the spill. Keep unnecessary personnel from entering the area. Ventilate the area. Eliminate all sources of ignition immediately. Respiratory protection should be worn when there is a potential to exceed the exposure limit requirements or guidelines. Pump water into area. Pump off DVB to be burned or recovered. See Environmental, Health, and Physical Hazard Information.

- **In case of fire** – Keep people away and deny unnecessary entry. Firefighters should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective firefighting clothing. Use water fog or fine spray, dry-chemical or carbon-dioxide extinguishers, or foam. General-purpose synthetic foams or protein foams are preferred. Fight the fire from a protected location or safe distance. Consider the use of unmanned hose holders or monitor nozzles. Do not use a direct water stream as it may spread fire. Follow emergency procedures carefully. See Environmental, Health, and Physical Hazard Information.

For more information, see the Safety Data Sheet.

Health Information

Eye and Skin Contact – Eye contact with DVB may cause slight irritation with pain disproportionate to the level of irritation to the eye tissues. Corneal injury is unlikely. Prolonged skin contact may cause slight irritation with local redness, but is unlikely to result in absorption of
harmful amounts. Repeated contact may cause skin burns. Symptoms may include pain, severe local redness, swelling, and tissue damage.

**Inhalation** – At room temperature, vapors are minimal due to the material’s low volatility. Vapor from heated material may be hazardous on single exposure. Excessive exposure may cause irritation to the nose, throat, and lungs. Symptoms of excessive inhalation may be lethargy and anesthetic or narcotic effects such as dizziness or drowsiness.

**Ingestion** – This material has low toxicity if swallowed. Swallowing small amounts incidental to normal handling operations is not likely to cause injury; however, swallowing larger amounts may cause injury. Aspiration into the lungs may occur during ingestion or vomiting, resulting in rapid absorption and injury to other body systems.

**Carcinogenicity and Reproductive Toxicity** – Animal test results were insufficient to classify this material as a probable animal carcinogen. In animal studies, effects on reproduction were seen only at doses that produced significant toxicity to the parent animals.

For more information, see the [Safety Data Sheet](#).

**Environmental Information**

DVB has a low vapor pressure and is poorly soluble in water. If released to water, DVB will have a tendency to evaporate slowly. DVB has a moderate potential to bind to soils and sediments.

Based on laboratory tests, DVB cannot be considered readily biodegradable. However, these results do not necessarily mean the material is not biodegradable under environmental conditions. DVB shows moderate potential for bioconcentration (tendency to accumulate in the food chain), and is moderately to highly toxic to aquatic organisms on an acute (single, high dose) basis.

For more information, see the [Safety Data Sheet](#).

**Physical Hazard Information**

DVB liquid and vapors are highly reactive and combustible. Proper handling and storage precautions must be observed when working with DVB. Polymerization is generally the greatest concern during shipment and storage. Under certain conditions (increased heat, low inhibitor concentration, and low oxygen content) rapid, runaway polymerization may occur with potentially serious consequences, such as excessive heat and pressure build-up. Those working with DVB must follow handling instructions carefully.

DVB contains an inhibitor to suppress polymerization, but the inhibitor requires that oxygen be present to work properly. Be sure to maintain an aerated vapor space in storage areas.

Avoid contact with oxidizing materials, acids, metal halides, peroxides, brass, and copper.

Proper handling instructions are available in the *Divinylbenzene (DVB) Product Stewardship Manual*. Additional physical hazard information is available on the [Safety Data Sheet](#).
Regulatory Information
Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of DVB. These regulations may vary by city, state, country, or geographic region. Information may be found by consulting the relevant Safety Data Sheet, Product Information, or Contact Us.

Additional Information
- Safety Data Sheet (http://www.dow.com/webapps/msds/msdssearch.asp)
- Contact Us (http://www.dow.com/specialtymonomers/index.htm)


References
10. Dow Answer Center: DVB – Typical Applications
NOTICES:

As part of its 2015 Sustainability Goals, Dow has committed to make publicly available safety assessments for its products globally. This product safety assessment is intended to give general information about the chemical (or categories of chemicals) addressed. It is not intended to provide an in-depth discussion of health and safety information. Additional information is available through the relevant Safety Data Sheet, which should be consulted before use of the chemical. This product safety assessment does not replace required communication documents such as the Safety Data Sheet.

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