



Product Safety Assessment

DOW™ Modified Methyl Diphenyl Diisocyanate (MDI) Products

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Names

- CAS No. 26447-40-5 (Generic MDI)
- CAS No. 9016-87-9 (Polymeric MDI)
- CAS No. 101-68-8 (4,4'-Methylenediphenyl diisocyanate)
- Methylene diphenyl diisocyanate (MDI)
- 1,1'-Methylenebis[4-isocyanatobenzene]
- Modified MDI
- MDI products
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Product Overview

- This product assessment covers a group of products that share similar chemistry and properties. For information about a specific product, please refer to the particular product [Safety Data Sheet \(SDS\)](#). As used herein, the terms SDS and MSDS (i.e. Material Safety Data Sheet) are interchangeable.
- MDI is the standard abbreviation for methylene diphenyl diisocyanate. "MDI" refers to a mixture of 4,4'-methylenediphenyl diisocyanate and its isomers. DOW™ modified MDI products are made by reacting MDI with materials that have hydroxyl (-OH) groups. Modified MDI products are also called MDI variants.
- DOW modified MDI products are used in customized formulations or blends of chemicals designed for a specific application. Modified MDI products are yellow to brown colored, highly-reactive liquids or semi-solids. For this document, the term "modified MDI products" includes MDI-based prepolymer products as well as MDI-based formulations. Many modified MDI products contain additives such as toluene diisocyanate (TDI), foam blowing agents, flame retardants, surfactants, colorants, and plasticizers. See [Product Description](#).
- There is a potential for workplace exposure to MDI in all industrial, commercial, or manufacturing settings where MDI is present. Each manufacturing facility should have a thorough training program for employees, appropriate work processes and safety equipment in place to limit unnecessary exposure. Dow does not sell MDI for direct consumer use, but it

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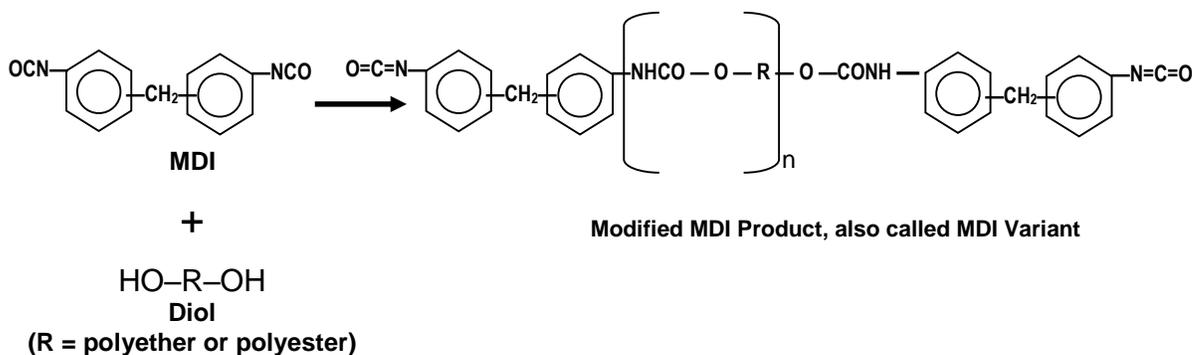
is used as a raw material to make materials that consumers purchase. It is produced, distributed, stored, and consumed in closed systems. See [Exposure Potential](#).

- MDI is a highly reactive hazardous chemical that has the potential to adversely affect or injure the eyes, skin and respiratory tract if appropriate safe handling and use instructions are not followed, or are not employed. Modified MDI products may also contain additives that have additional health risks. Users of these materials should carefully review and follow the instructions and precautions provided in each product's [Safety Data Sheet](#). See [Health Information](#).
- If released to the environment, MDI and modified MDI products will rapidly react with water to form insoluble polyurea solids that are chemically and biologically inert. These polyureas are unlikely to accumulate in the food chain, and are practically non-toxic to fish and other aquatic organisms on an acute basis. See [Environmental Information](#).

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Manufacture of Product^{1,2}

- **Process** – For information about the production of MDI, see [Product Safety Assessment MDI-Based Isocyanate Products](#). DOW™ modified MDI products and prepolymers are manufactured by carefully controlled reactions between MDI and hydroxyl-containing materials. If the number of hydroxyl groups is lower than the number of isocyanate groups, a modified MDI prepolymer is formed. A simplified reaction between MDI and a diol (a dihydroxy material) is shown below.



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Product Description^{1,3}

DOW™ modified MDI products are industrial chemicals manufactured from MDI and are customized formulations or blends of chemicals designed for a specific application. They are liquids or semi-solids that vary in color from clear (water white to yellow to amber to brown), with musty to mild odors depending on other components or additives that are present. Modified MDI products are prepared by reacting MDI's isocyanate groups (-N=C=O) with polyols that have hydroxyl (-OH) groups. These materials are manufactured and formulated according to customer specifications and end-use applications. To tailor the product properties, components may be added to the reaction process. Additives may include foam blowing agents, flame retardants, surfactants, colorants, and plasticizers.

Dow markets these products under different tradenames for different end-use market applications.

Dow tradenames for modified MDI products include but are not limited to:

- AUTOTHANE™ prepolymers
- DELTA-THERM™ isocyanates
- DIPRANE™ isocyanates and prepolymers
- DUOTHANE™ prepolymers
- DURAMOULD™ prepolymers
- DURELAST™ isocyanates
- DYNATHANE™ isocyanates and prepolymers
- ENFORCER™ isocyanates
- ENHANCER™ isocyanates
- HYPERCRETE™ prepolymers
- HYPERKOTE™ isocyanates and prepolymers
- HYPERLAST™ isocyanates and prepolymers
- HYPOL™ isocyanates and prepolymers
- ROTAKOTE™ prepolymers
- SPECFIL™ isocyanates
- SPECFLEX™ isocyanates
- SPECTRIM™ isocyanates
- TRAFFIDECK™ isocyanates and prepolymers
- VORACOR™ isocyanates
- VORALAST™ isocyanates
- VORALUX™ isocyanates
- VORAMER™ isocyanates
- VORASTAR™ isocyanates
- VORATEC™ isocyanates
- VORATRON™ isocyanates
- XiTRACK™ isocyanates

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Product Uses^{2,4,5,6}

Polymeric Modified MDI products are well suited for many industrial, manufacturing, and specialty end-use applications. These applications include appliances requiring insulation like refrigerators and freezers; automotive interior trim and seating; vehicle suspensions and chassis building materials; decorative molding, industrial products, carpet backing; coatings, adhesives, binders, packaging, structural foam, pour-in-place insulation, laminated panel cores, furniture, boats, shoes, and athletic equipment.

Modified MDI is commonly used in the manufacture of the following types of polyurethane foams:

- Rigid and semi-rigid
- Flexible
- Integral skin
- Microcellular

Modified MDI is also used to make the following:

- Elastomers
- Coatings
- Adhesives
- Binders

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Exposure Potential^{3,7,8}

Modified MDI products are used in the production of industrial and consumer products. A potential user of MDI who plans to work with, handle, or use MDI, or who anticipates coming into contact with MDI in a workplace setting should carefully review the information provided in the [Safety Data Sheet](#) specific to the particular MDI product involved and should carefully follow the instructions and precautions provided in that [Safety Data Sheet](#).

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

- **Workplace exposure** – There is a potential for workplace exposure to MDI in all industrial, commercial, or manufacturing settings where MDI is present. Such exposure may be harmful if appropriate safe handling and use instructions are not followed, or if appropriate safe handling and use precautions are not employed. For a very general overview of MDI health information, see [Health Information](#).

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- **Consumer exposure to products containing DOW™ modified MDI products** – Industrial, Comfort & Energy Efficiency (ICEE) products are for industrial use only. Consumers may purchase goods that have been manufactured with modified MDI products; however, by the time these goods reach the consumer, the polyurethane has fully cured (hardened) and risk of exposure to unreacted MDI is very low. See [Health Information](#).
- **Environmental releases** – If released to the environment, MDI and modified MDI products will rapidly (within 48 hours) react with water to form insoluble polyureas which will tend to float on water or sink to become associated with sediments. The polyureas will likely be removed in wastewater treatment facilities by association with biosolids. All spills and leaks should be immediately contained to prevent contamination of soil, surface or ground water. Spills or leaks of MDI and modified MDI products should be contained and cleaned up only by properly trained and equipped personnel – all others should leave the contaminated area.
- **Large release** – Industrial spills or releases are infrequent and are generally contained. If a large spill does occur, the material should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. Local emergency crews and trained personnel should be called to handle large spills. Only properly trained and equipped personnel should attempt to isolate or contain the spill.
- **In case of fire** – Keep people away. Isolate fire and deny unnecessary entry. Stay upwind and out of low areas where gases can accumulate. Water is not recommended but may be applied in large quantities as a fine spray when other extinguishing agents are not available. Use water fog or fine spray, dry-chemical or carbon-dioxide extinguishers, or foam to fight the fire. Alcohol-resistant foams are preferred. A direct water stream may spread the fire. Consider the use of unmanned hose holders or monitor nozzles. Firefighters should wear positive-pressure, self-contained breathing apparatus (SCBA) with an approved full-face mask and protective firefighting clothing. Contain fire water run-off if possible. Fire water run-off, if not contained, may cause environmental damage. Follow emergency procedures carefully.

For more information, see the relevant [Safety Data Sheet](#) or the [ISONATE™ and PAPI™ Pure, Modified and Polymeric MDI Safe Handling and Storage Guide](#).

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Health Information^{3,8}

Health information for DOW™ modified MDI products are summarized on the relevant [Safety Data Sheets](#). A potential user of modified MDI products who plans to work with, handle, or use modified MDI products, or who anticipates coming into contact with modified MDI products in a workplace setting should carefully review the information provided in the Safety Data Sheet specific to the particular modified MDI product involved and should carefully follow the instructions and precautions provided in that SDS. It is important to note that health risks associated with individual products may vary based on their formulation or intended use. They may also contain minor components or additives that have additional health risks. The [Safety Data Sheet](#) is the preferred source for specific health information. An overview of MDI health information appears below.

Eye contact – May cause moderate eye irritation and slight, temporary corneal injury. Chemical goggles should be used when working with modified MDI products and an eye wash station should be located in the immediate work area.

Skin Contact – Prolonged contact may cause slight skin irritation with local redness. May stain skin. Skin contact may cause an allergic skin reaction. Animal studies have shown that skin contact with isocyanates may play a role in respiratory sensitization.

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Inhalation – At room temperature, modified MDI vapors are minimal due to low volatility. However, certain operations may generate vapor or mist concentrations sufficient to cause respiratory irritation and other adverse effects. Such operations include those in which the material is heated, sprayed or otherwise mechanically dispersed such as drumming, venting or pumping. Excessive exposure may cause irritation to the upper respiratory tract (nose and throat) and lungs. Modified MDI inhalation exposure may cause pulmonary edema (fluid in the lungs). Effects may be delayed. Decreased lung function has been associated with overexposure to isocyanates.

Respiratory sensitization – May cause an allergic respiratory response. Modified MDI concentrations below the exposure guidelines may cause allergic respiratory reactions in individuals already sensitized. Asthma-like symptoms may include coughing, difficult breathing, and a feeling of tightness in the chest. Occasionally, breathing difficulties may be life threatening.

Ingestion – Low acute oral toxicity. Small amounts swallowed incidentally as a result of normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause injury, do not induce vomiting. Good personal hygiene practices must be observed and hands washed before eating. Food should not be stored or consumed where modified MDI is used.

Other – Lung tumors have been observed in laboratory animals exposed to respirable aerosol droplets of MDI/polymeric MDI for their lifetime. Tumors occurred concurrently with respiratory irritation and lung injury. Current exposure guidelines are expected to protect against these effects reported for MDI. MDI has been toxic to the fetus in laboratory animals at doses toxic to the mother. MDI did not cause birth defects in laboratory animals.

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

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Environmental Information^{7,8}

Release of MDI and modified MDI to the atmosphere is unlikely, due to their low volatility. In the aquatic and terrestrial environment, MDI and modified MDI react rapidly (within 48 hours) with water, forming insoluble polyureas that are chemically and biologically inert. This reaction limits the movement of MDI and modified MDI in soil and water.

Although the polyureas are non-biodegradable, they are expected to be removed in wastewater treatment facilities by association with biosolids.

Due to their high molecular weight, the polyureas do not accumulate in the food chain and are practically non-toxic to aquatic organisms on an acute basis (LC₅₀/EC₅₀ > 100 mg/L in the most sensitive species tested).

Due to their low vapor pressures, emissions of MDI and modified MDI vapor to the atmosphere are unlikely. In the event vapors are released, MDI is expected to degrade rapidly. The predominant degradation process is expected to be rapid attack by OH radicals.

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

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Physical Hazard Information^{7,8}

It is important to note that the physical hazard risks associated with individual DOW™ modified MDI products may vary by formulation and application. The individual product [Safety Data Sheet](#) is the preferred source for specific physical hazard information. Modified MDI is stable under recommended storage conditions. However, it can decompose at elevated temperatures. Gas generated during decomposition can cause pressure in closed systems. Pressure build up can be rapid. Modified MDI reacts with water, releasing carbon dioxide gas. The resulting pressure build up can cause closed containers to rupture. Elevated temperatures can accelerate this reaction. Hazardous polymerization of MDI can occur at elevated temperatures. Polymerization can be catalyzed by strong bases and water.

MDI can react with many materials and release heat. Avoid contact with acids, alcohols, amines, water, ammonia, bases, metal compounds, strong oxidizers, and moist air.

During a fire, smoke may contain MDI in addition to toxic and/or irritating compounds. Hazardous combustion products may include, but are not limited to: nitrogen oxides, isocyanates, carbon monoxide, carbon dioxide and hydrogen cyanide.

For more information, see the relevant [Safety Data Sheet](#) or the [ISONATE™ and PAPI™ Pure, Modified and Polymeric MDI Safe Handling and Storage Guide \(Form No.109-01224X-0804P&M\)](#).

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Regulatory Information

Regulations may exist that govern the manufacture, sale, transportation, use and/or disposal of DOW™ modified MDI products. These regulations may vary by city, state, country or geographic region. Information may be found by consulting the relevant [Safety Data Sheet](#) or [Contact Us](#).

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Additional Information

- Safety Data Sheet – Request from the Dow Customer Information Group (<http://www.dow.com/assistance/dowcig.htm>)
- Contact Us (<http://www.dow.com/pusystems/contact/index.htm>)
- Dow's Isocyanates Answer Center, (<https://dow-answer.custhelp.com/app/answers/list/p/452/search/1>)
- *ISONATE™ and PAPI™ Pure, Modified and Polymeric MDI Safe Handling and Storage Guide*, The Dow Chemical Company, Form No. 109-01224X-0804P&M (<http://www.dow.com/productsafety/assess/finder.htm>)
- U.S. Environmental Protection Agency Integrated Risk Information System (IRIS) website – Methylene Diphenyl Diisocyanate (monomeric MDI) and polymeric MDI (PMDI) (CASRN 101-68-8, 9016-87-9): (<http://www.epa.gov/NCEA/iris/subst/0529.htm>)
- U.S. EPA Technology Transfer Network Air Toxics website – 4,4'-Methylenediphenyl Diisocyanate (MDI), Hazard Summary—Created in April 1992, Revised January 2000: (<http://www.epa.gov/airtoxics/>)
- *MDI & TDI: Safety, Health and the Environment*, Dennis Allport, David Gilbert, and Susan Outterside, John Wiley & Sons, 2003

For more business information about DOW™ modified MDI products, visit:

- Dow's Polyurethane Systems website at www.dow.com/pusystems
- Dow's Hyperlast website at www.dow.com/hyperlast/index.htm

- Dow's Polyurethanes website at www.dow.com/polyurethane

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References

- ¹ Dow Polyurethane Systems website – About Us: (<http://www.dow.com/pusystems/about/index.htm>)
- ² Chinn, Henry, *Chemical Economics Handbook (CEH) Marketing Research Report Diisocyanates and Polyisocyanates*, SRI Consulting, March 2009
- ³ *ISONATE™ and PAPI™ Pure, Modified and Polymeric MDI Safe Handling and Storage Guide*, The Dow Chemical Company, Form No. 109-01224X-0804P&M
- ⁴ Dow Polyurethane Systems website – About Us, Products and Markets Overview: (<http://www.dow.com/pusystems/about/overview.htm>)
- ⁵ Dow Polyurethane Systems website – Markets and Applications: (<http://www.dow.com/pusystems/apps/index.htm>)
- ⁶ Dow Hyperlast website – Products: (<http://www.dow.com/hyperlast/product/index.htm>).
- ⁷ *ISONATE™ M 340 modified pure MDI Material Safety Data Sheet*, The Dow Chemical Company
- ⁸ *TRAFFIDECK™ Topcoat PUR Part B Isocyanate Material Safety Data Sheet*, The Dow Chemical Company

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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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