
Product Safety Assessment

High Density Polyethylene (HDPE) Resins

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Names

- CAS No. 9002-88-4
- CAS No. 25087-34-7
- CAS No. 25213-02-9
- CAS No. 26221-73-8
- HDPE
- ASPUN™ Fiber Grade Resin
- CONTINUUM™ Bimodal Polyethylene Resin
- DOW™ High Density Polyethylene Resin
- Ethene, homopolymer
- Ethylene/butene-1 copolymer
- Ethylene/hexene-1 copolymer
- Ethene-1-octene copolymer
- High density polyethylene
- DOWLEX™ IP Polyethylene Resin
- UNIVAL™ High Density Polyethylene Resin

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Product Overview

- High density polyethylene (HDPE) resins are polymers of ethylene or copolymers of ethylene and an alpha-olefin monomer such as 1-hexene, 1-butene or 1-octene. Compared to other polyethylene resins, HDPE resins are characterized by greater toughness, stronger mechanical properties, and higher service temperatures.¹ For further details, see [Product Description](#).
- HDPE resins are manufactured as odorless white pellets or granules.² The pellets are used in industrial fabrication processes such as blow molding, injection molding, and extrusion. The range of plastic containers and other products made with HDPE resins is vast. Examples are liquid food bottles (e.g. milk containers); containers for household cleaning products, pharmaceuticals, and personal-care products; industrial drums and pails; fuel tanks; truck bed-liners; housewares; toys; sporting goods; and pipe and conduit. Major film applications for HDPE are T-shirt sacks and plastic grocery sacks.^{3,4} For further details, see [Product Uses](#).
- Eye contact with polyethylene resins or dusts may cause irritation or corneal injury due to mechanical action. Vapor from the heated resin may cause mild discomfort and redness of the eyes or respiratory irritation. Prolonged skin contact is essentially nonirritating. These resins are often processed as molten polymer at elevated temperatures. Contact with the heated resin may cause burns.² For further details, see [Health Information](#).
- Because HDPE resins are used extensively in food packaging and other consumer products, consumer contact is likely. Resins used for food contact are in compliance with applicable U.S. Food and Drug Administration (FDA) regulations and European Union (EU)

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directives/regulations. Exposure during manufacturing is also possible. For further details, see [Exposure Potential](#).

- Spilled HDPE pellets or granules can create an industrial slipping hazard. Products made from these resins are expected to be inert in the environment.² For further details, see [Environmental](#) and [Physical Hazard Information](#).

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Manufacture of Product⁵

- **Capacity** – The 2007 world production of HDPE was estimated to be 29.8 million metric tones (65.7 billion pounds). Dow manufactures polyethylene resins, including HDPE, at facilities in Freeport and Seadrift, Texas; Plaquemine and Taft, Louisiana (USA); Fort Saskatchewan and Prentiss, Alberta, Canada; Bahia Blanca, Argentina; Map ta Phut, Thailand; Schkopau, Germany; Tarragona, Spain; Terneuzen, and The Netherlands.
- **Process** – Dow currently uses three different processes to produce HDPE. The traditional process reacts ethylene with an olefin comonomer in a hydrocarbon solvent along with a catalyst in a series of two continuous stirred-tank reactors. Product is removed from the second reactor, the pressure is adjusted, and excess ethylene gas is removed. The solvent is then removed and the remaining copolymer melt is extruded and formed into pellets. The second process is similar, however, the final polymer is transferred as a slurry to the final recovery step; the solvent is removed; and the remaining HDPE is recovered as a powder without extrusion. In the third process (UNIPOL™ process), ethylene and a comonomer react as gases at low pressure in a continuous “fluidized bed” reactor to form a granular resin.

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Product Description^{2,6}

HDPE resins are manufactured as odorless white pellets or granules. Dow markets these resins under the trade names UNIVAL™ polyethylene resin, CONTINUUM™ bimodal polyethylene resin, and DOWLEX™ IP polyethylene resin. HDPE polymer is made from ethylene or ethylene and a comonomer alpha-olefin (1-hexene, 1-butene or 1-octene). The addition of comonomer modifies resin properties.

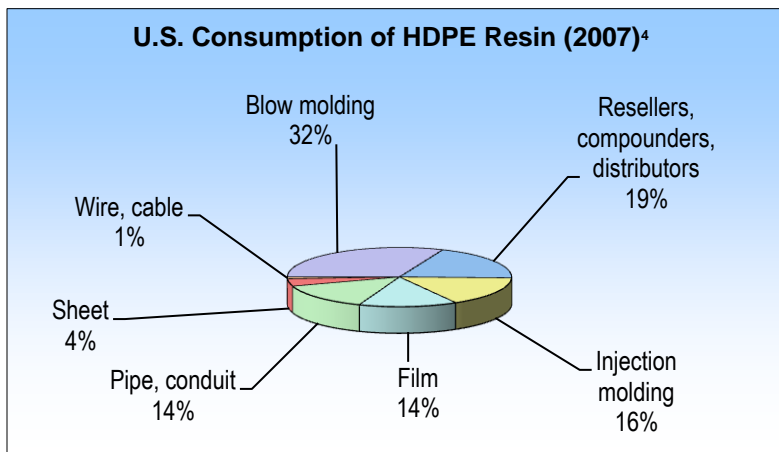
The molecular structure of HDPE is a linear backbone of the repeating unit $(-CH_2-CH_2-)_n$ with a slight degree of branching. Resin properties are determined by the type and percentage of comonomer within the polymer chain and overall molecular weight. Resins are classified by melt index (MI), a function of molecular weight and branching. Compared to low density polyethylene (LDPE) and linear low density polyethylene (LLDPE), HDPE resins have superior mechanical properties, and higher service temperatures (110–130°C). HDPE can be blended with LDPE or other polyolefin resins to tailor the physical characteristics for specific applications.

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Product Uses^{3,7,8}

HDPE resins are used in the following industrial fabrication processes:

- **Blow molding** – applications include liquid food bottles (gallon, half-gallon, and single-serve milk containers, noncarbonated water,



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and juice bottles); household chemical containers (bleach, dishwashing and laundry detergents, insecticides, herbicides, and swimming-pool chemicals); pharmaceuticals, cosmetics, and toiletries, including bottles for hair-care products, talcs and powders, and hand and body lotions, laxative bottles, and bottles for over-the-counter drugs and other medications; industrial drums (5–55 gallon) and tight-headed pails for agricultural products, powders, foodstuffs, and chemicals; fuel tanks for lawn mowers; motor-oil bottles; wide-mouth mayonnaise jars and containers for restaurant and bakery supplies.

- **Injection molding** – shipping pails (5-gallon containers with a separate lid) for chemicals and construction-related materials; crates, trays, and totes used for packaging and distribution for the food and other industries; housewares (butter dishes, cutlery trays, dishracks, dustpans, ice-cube trays, garbage cans, laundry baskets); food containers and tubs for dairy products; toys; sporting goods; caps and closures; shopping carts; medical appliances; lawn and garden products such as wheelbarrow trays, lawn furniture, and flower pots; and jugs and coolers.
- **Film** – T-shirt sacks and grocery sacks; trash-can liners; food packaging (primarily cereal box liners and packaging of snack foods, crackers, and other dry foods); nonfood packaging; garment and produce bags; and plastic envelopes
- **Pipe and conduit** – solid-wall pressure pipe and smooth-wall drainage pipe used for natural gas distribution, potable water and sewage systems, oil and gas production, and industrial and mining applications; corrugated drainage tubing for highway, agricultural, and foundation applications.
- **Sheet** – geomembranes (pond and canal liners, landfill liners and covers, aeration lagoons and chemical storage); dunnage (replacing cardboard and wood in the shipment of large volumes of items to one location—examples include reusable trays, racks, shelves, and pallets); and truck bed-liners.
- **Wire and cable** – foam insulation for telephone communication wire.
- **Resellers, compounders and distributors** – the majority of resins sold through resellers and compounders are consumed in injection molding, blow molding, and corrugated tubing.

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Exposure Potential²

Dow does not sell HDPE resins directly to consumers, but they are used extensively in consumer and industrial products. Based on the uses for HDPE, the public could be exposed through:

- **Workplace exposure** – Exposure can occur in a manufacturing facility that makes HDPE resins or in facilities that use these resins. Those working with HDPE could be exposed during maintenance, sampling, testing, or other procedures. Good housekeeping practices and control of resin dusts are necessary for safe handling of these products. Each facility should have a thorough training program for employees and appropriate work processes and safety equipment in place to limit unnecessary exposure. See [Health Information](#).
- **Consumer exposure to products containing HDPE** – HDPE resins are fabricated into many consumer products. It is likely most everyone uses plastic products or handles packaging made with HDPE or HDPE blends almost daily. Plastics can contain residual or unreacted quantities of monomers and process additives such as antioxidants. These materials are tightly controlled to maintain levels below regulatory limits. The U.S. Food and Drug Administration (FDA) as well as European Union food-contact regulatory authorities, recognizing the potential for small amounts of substances used to make plastics to migrate to food, closely regulate the substances used to make plastic containers and materials like wraps that come into contact with food.⁹ During the approval process, these authorities consider the migration of substances added to regulated plastics and their toxicological properties to assure that the use is well within the margin of safety. The authorities evaluate plastics and the additives used in them at the temperatures under which containers or wraps made from the plastic are likely to encounter during ordinary use. This would include temperatures expected during the use of materials to heat or reheat food in microwave ovens.

For more information on the use of plastics in microwave ovens please visit the "[Microwaving with Plastics](#)," section of the Plastics Division of the American Chemical Council's [PlasticsInfo.org website](#).¹⁰ See [Health Information](#).

- **Environmental releases** – Industrial spills or releases are infrequent and generally contained. In the event of a spill, the focus is on containing the spill to prevent contamination of soil, ditches, sewers, waterways, or groundwater. If a large spill does occur, contain the spilled material if possible. Sweep up and collect the recovered material in suitable and properly labeled containers. Spilled material may represent a slipping hazard. Use appropriate safety equipment. See [Environmental](#) 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. If protective equipment is not available, fight the fire from a protected location or safe distance. Use fine water spray or foam. Cool surroundings with water to localize the fire zone. Hand-held dry-chemical or carbon-dioxide extinguishers may be used for small fires. Follow emergency procedures carefully. See [Physical Hazard Information](#).

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

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Health Information²

HDPE resins that are made by Dow and used for food-contact applications are in compliance with applicable U.S. Food and Drug Administration (FDA) regulations and European Union (EU) directives/regulations for consumer safety.

Eye and Skin Contact – Eye contact with HDPE resins or dust may cause irritation or corneal injury due to mechanical action (scratching). Vapor from the heated resin may cause mild discomfort and redness of the eyes. Prolonged skin contact is essentially nonirritating. These materials are often processed as molten polymers at elevated temperatures and skin contact with the heated material may cause burns.

Inhalation – No adverse effects are anticipated from a single exposure to dust. Vapors or fumes released during thermal processing may cause respiratory irritation.

Ingestion – These materials have very low toxicity if swallowed. However, the granules may represent a choking hazard.

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

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Environmental Information²

HDPE resins are expected to be inert in the environment. They float on water and are not biodegradable. They are not expected to bioconcentrate (accumulate in the food chain) due to their high molecular weight. HDPE pellets or granules are not expected to be toxic if ingested, but may represent a choking hazard if ingested by waterfowl or aquatic life.

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

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Physical Hazard Information²

Spilled HDPE pellets and granules can create an industrial slipping hazard. Pneumatic conveying and other mechanical handling operations can generate combustible dust. Prolonged exposure to

elevated temperatures can cause these resins to decompose. At temperatures exceeding the melt temperature, polymer fragments can be released. Fumes can be irritating. Decomposition products can include aldehydes, alcohols, organic acids, trace amounts of hydrocarbons, and other compounds.

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

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Regulatory Information

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

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Additional Information

- Safety Data Sheet ([Safety Data Sheet](#))
- Technical Data Sheet (<http://www.dow.com/polyethylene/> – select the desired geographic area and the relevant product using the product finder)
- Contact Us (<http://plastics.dow.com/plastics/na/contact/>)
- Borruso, Andrea V., “High Density Polyethylene Resins,” *Marketing Research Report: Chemical Economics Handbook*, SRI Consulting, April 2008
- *Understanding Plastic Film: Its Uses, Benefits and Waste Management Options*, Headley Pratt Consulting for the American Plastics Council, December 1996 (http://www.americanchemistry.com/s_plastics/bin.asp?SID=6&DID=4603&CID=&VID=178&DOC=File.PDF)

For more business information about HDPE and other polyethylene resins, visit Dow’s Polyethylene website at <http://www.dow.com/performanceplastics/>.

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References

- ¹ Borruso, Andrea V., “High Density Polyethylene Resins,” *Marketing Research Report: Chemical Economics Handbook*, SRI Consulting, April 2008, page 16.
- ² UNIVAL™ DMDH-6400 NT 7 High Density Polyethylene Resin Material Safety Data Sheet, The Dow Chemical Company, ID No. 80362/1001
- ³ Dow Plastics North America – Dow High Density Polyethylene Resins web page: (<http://www.dow.com/polyethylene/>).
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