Product Safety Assessment
Linear Low Density Polyethylene (LLDPE) Resins

Select a Topic:

Names

- CAS No. 25087-34-7
- CAS No. 25213-02-9
- CAS No. 26221-73-8
- Linear low density polyethylene
- LLDPE
- 1-Butene, copolymer with ethene
- 1-Hexene, copolymer with ethene
- 1-Octene, copolymer with ethene
- DOWLEX™ polyethylene resin

Product Overview

- Linear low density polyethylene (LLDPE) resins are copolymers made from ethylene and an alpha-olefin, either 1-butene, 1-hexene, or 1-octene.[1] LLDPE resins are similar to low density polyethylene (LDPE) resins; both have good clarity, good moisture and gas barrier properties, can be heat-sealed, and are strong and flexible. LDPE has greater clarity and higher gloss and is easier to process. LLDPE has greater tensile and impact strength, better heat-seal properties, and lower cost.[2,3] For further details, see Product Description.
- LLDPE resins are manufactured as odorless white pellets or granules.[4] The pellets are used in industrial fabrication processes such as blown and cast film, extrusion coatings, injection molding, and rotomolding. Products made from LLDPE include industrial containers, trash cans, automotive parts, closures, hot- and cold-water piping, and plastic films. Films made from these resins are extremely tough, as well as puncture- and tear-resistant. Some specific film applications are food and specialty packaging, heavy-duty trash bags, and pallet wrap.[5,6] For further details, see Product Uses.
- Eye contact with polyethylene resins or dusts 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, 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.[7] For further details, see Health Information.
- Because LLDPE resins are used extensively in food packaging and other consumer products, consumer contact is likely. Workplace exposure is also possible.[8] For further details, see Exposure Potential.
- Spilled LLDPE resins can create an industrial slipping hazard. Products made from these resins are plastics that are expected to be inert in the environment.[9] For further details, see Physical Hazard Information.

Back to top

Manufacture of Product[10]

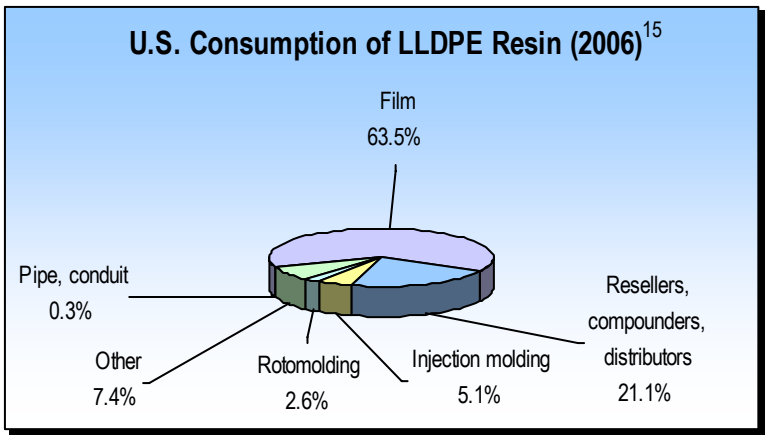
- **Capacity –** Global production of LLDPE in 2006 was estimated at 18.4 million metric tons (40.7 billion pounds). Dow manufactures LLDPE at facilities in Freeport, Texas; Plaquemine, Louisiana; Fort Saskatchewan, Alberta, Canada; Map Ta Phut, Thailand; Schkopau, Germany; Tarragona, Spain; and Terneuzen, The Netherlands.
- **Process –** Dow currently uses two different processes to produce LLDPE. The traditional process reacts ethylene with an olefin comonomer in a hydrocarbon solvent along with a Ziegler 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 then is removed and the remaining copolymer melt is extruded and formed into pellets. In the second process (UNIPOL™ process) ethylene and the comonomer react as gases at low pressure in a continuous "fluidized bed" reactor to form a granular resin, which is mixed with additives and compounded into pellets.

Back to top

Product Description[11,12]

LLDPE resins are manufactured as odorless white pellets or granules. LLDPE polymer is made from ethylene and the comonomer alpha-olefins 1-butene, 1-hexene, or 1-octene. The molecular structure of LLDPE is characterized by a mostly linear copolymer backbone with some short-chain branching. Copolymer properties are determined by the type of olefin comonomer used, the amount of the comonomer in the chain, and the molecular weight. Typical comonomer concentrations are 5 to 12% weight percent. Compared to LDPE, LLDPE has greater tensile and impact strength, better heat-seal properties, and lower cost. LLDPE is often blended with LDPE, high density polyethylene (HDPE), or other polyolefin resins to tailor the physical characteristics for specific products.

Back to top



Product Uses[13,14,15]

LLDPE resins are used in the following industrial fabrication processes:

- ***Film*** (blown and cast) – Applications include food packaging (crackers, cereals, bakery goods, liquid and semisolid foods, meat and cheese, boil-in-bag vegetables, ice bags), nonfood (retail carry-out bags and sacks, heavy-duty trash bags, industrial liners, disposable diapers, medical packaging, newspaper/mailer bags, bundling and overwrap, textile packaging), shrink wrap, and stretch wrap (pallet wrap). Films used for food applications are FDA compliant.
- ***Extrusion coatings*** – coatings for metals for corrosion prevention.
- ***Injection molding*** – industrial containers, trash cans, lawn and garden products, kitchen accessories, luggage and furniture parts, recreational products, medical-related products, toys, sporting goods, and caps and closures (coffee can lids, corks for wine and other bottles, parts for aerosol trigger sprays or pump systems).
- ***Rotomolding*** – backyard play equipment, toys, canoes, kayaks, ducts, automotive parts, outdoor signs, and other products.

- ***Profile extrusion*** – pipes, hoses, and tubing, including weather-resistant drip irrigation tubing and hot and cold water pipes.
- ***Other*** – wire and cable (insulation and jacketing materials for power and telecommunications cable), rigid and flexible sheeting.

Back to top

Exposure Potential

LLDPE resins are not sold directly to consumers, but are used extensively in consumer and industrial products. Based on the uses for LLDPE, the public could be exposed through:

- **Workplace exposure**[16] – Exposure can occur in a manufacturing facility that makes LLDPE resins or in fabrication facilities that use these resins. Those working with LLDPE 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 LLDPE** – LLDPE resins are fabricated into many consumer products. It is likely everyone uses plastic products made with LLDPE or LLDPE blends daily. See Health Information.
- **Environmental releases**[17] – 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. Use appropriate safety equipment. 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. If protective equipment is not available, fight the fire from a protected location or safe distance. Use water fog or fine spray, dry-chemical or carbon-dioxide fire extinguishers, or foam. ***Do not use*** a direct water stream on molten material. Cool surroundings with water to localize the fire zone. Follow emergency procedures carefully. See Environmental, Health, and Physical Hazard Information.

For more information, see the relevant Safety Data Sheet.

Back to top

Health Information[18]

Dow's LLDPE resins used for food-contact applications are U.S. Food and Drug Agency (FDA) and EU-Directive compliant for consumer safety.

Eye and Skin Contact – Eye contact with LLDPE 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.

Environmental Information[19]

LLDPE 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. LLDPE 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.

Back to top

Physical Hazard Information[20]

Spilled LLDPE resins 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 melt temperatures, polymer fragments can be released. Fumes can be irritating. Decomposition products include aldehydes, ketones, alcohols, organic acids, trace amounts of hydrocarbons, and other compounds.

For more information, see the relevant Safety Data Sheet.

Back to top

Regulatory Information

Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of LLDPE. 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.

Back to top

Additional Information

- Safety Data Sheet (http://www.dow.com/webapps/msds/msdssearch.asp)
- Contact Us (http://plastics.dow.com/plastics/na/contact/)
- Borruso, Andrea V., "Linear Low-Density Polyethylene (LLDPE) Resins," *Marketing Research Report: Chemical Economics Handbook*, SRI Consulting, July 2007
- *Profile of the Plastic Resin and Manmade Fiber Industries,* Office of Compliance Sector Notebook Project, U.S. Environmental Protection Agency, Washington, D.C., September 1997 (http://www.epa.gov/Compliance/resources/publications/assistance/sectors/notebooks/resfibsn.pdf)
- *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 LLDPE and other polyethylene resins, visit Dow's Polyethylene web site at http://plastics.dow.com/about/polyethylene.htm.

Back to top

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Back to top

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