

Linear low-density polyethylene

Linear low-density polyethylene (LLDPE) is a substantially linear polymer (polyethylene), with significant numbers of short branches, commonly made by copolymerization of ethylene with longer-chain olefins. Linear low-density polyethylene differs structurally from conventional low-density polyethylene because of the absence of long chain branching. The linearity of LLDPE results from the different manufacturing processes of LLDPE and LDPE. In general, LLDPE is produced at lower temperatures and pressures by copolymerization of ethylene and such higher alpha olefins as butene, hexene, or octene. The copolymerization process produces an LLDPE polymer that has a narrower molecular weight distribution than conventional LDPE and in combination with the linear structure, significantly different rheological properties.

[edit] Production and properties

The production of LLDPE is initiated by transition metal catalysts, particularly Ziegler or Philips type of catalyst. The actual polymerization process can be done in either solution phase or gas phase reactors. Usually, octene is the copolymer in solution phase while butene and hexene are copolymerized with ethylene in a gas phase reactor. The LLDPE resin produced in a gas phase reactor is in granular form and may be sold as granules or processed into pellets. LLDPE has higher tensile strength and higher impact and puncture resistance than LDPE. It is very flexible and elongates under stress. It can be used to make thinner films, with better environmental stress cracking resistance. It has good resistance to chemicals and to ultraviolet radiation. It has good electrical properties. However it is not as easy to process as LDPE, has lower gloss, and narrower range for heat sealing.

[edit] Processing

LDPE and LLDPE have unique theoretical or melt flow properties. LLDPE is less shear sensitive because of its narrower molecular weight distribution and shorter chain branching. During a shearing process, such as extrusion, LLDPE remains more viscous, therefore harder to process than an LDPE of equivalent melt index. The lower shear sensitivity of LLDPE allows for a faster stress relaxation of the polymer chains during extrusion and therefore the physical properties are susceptible to changes in blow-up ratios. In melt extension, LLDPE has lower viscosity at all strain rates. This means it will not strain harden the way LDPE does when elongated. As the deformation rate of the polyethylene increases, LDPE demonstrates a dramatic rise in viscosity because of chain entanglement. This phenomena is not observed with LLDPE because of the lack of long-chain branching in LLDPE allows the chains to slide by one another upon elongation without becoming entangled. This characteristic is important for film applications because LLDPE films can be downgauged easily while maintaining high strength and toughness. The rheological properties of LLDPE are summarized as "stiff in shear" and "soft in extension". It isn't taken in most curbside pickups in communities. LLDPE can be recycled though into other things like trash can liners, lumber, landscaping ties, floor tiles, compost bins and shipping envelopes.



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