PRODUCT CATALOGUE
LOW DENSITY POLYETHYLENE
Along with petrochemical units of SLOVNAFT, a.s. in Bratislava, TVK Plc. is composing the Petrochemical business in the MOL Downstream Division, which holds leading position in Central Europe’s petrochemical sector and is one of the ten largest polymer producers in Europe.

We can highly lean on the refinery integration benefits in the MOL Downstream Division: the secured feedstock supply, the robust financial background and strong position in the regional markets, together with the high quality products of the optimized production capacities. We keep operational reliability up by regular maintenance programs, carried out at our production units.

Our prime objective is maintaining our petrochemical leadership in the Central and Eastern European polymer markets where the demand growth perspectives exceeds Western European figures.

Our advantageous location in the Central European markets and our competitive portfolio of high quality polyolefin products - optimized in line with customer requirements - provide a firm basis for exploiting the opportunities arising from the surge of demand for polymers in Central and Eastern Europe.

Corporate History

1999 MOL acquired minority stake in TVK Plc.
2001 MOL became majority owner in TVK with a stake over 33.34%
2004 MOL acquired majority stake in TVK (44.31%) and in SLOVNAFT (98.4%)
      MOL Petrochemicals Division established: the product range has been streamlined and the sales channels integrated in order to provide competitive edge to our customers on their markets
2011 Petrochemical business integrated into the Downstream Division of MOL Group

TIPOLEN is the registered trademark for low density polyethylene produced by TVK Plc. BRALEN is the registered trademark of SLOVNAFT, a.s.
LOW DENSITY POLYETHYLENE

General Information

Low density polyethylene (LDPE) is a ductile and flexible material. It is stable in the temperature range from -50 to 85 °C, with the melting point being from 105 to 115 °C. In the absence of oxygen, LDPE is stable up to 290 °C. It decomposes within 290 to 350 °C and thermoplastic products of lower molecular weight are formed. Gaseous products are formed in greater quantities above 350 °C and these gases contain as the main component rather butene than ethylene. In the presence of oxygen, LDPE is less stable. During high-temperature processing of LDPE in the presence of air, thermal oxidation occurs.

During outdoor exposure of LDPE, the photochemical oxidation caused by UV radiation occurs. Due to the oxidation by thermal or light effects on the surface of the products, fine cracks are formed. These may deteriorate the physical and mechanical properties. To eliminate these negative phenomena, light stabilizers are added to LDPE.

Non-oxidizing acids, bases, salts, and their solutions practically have no effect on polyethylene. However, oxidizing chemicals attack polymer. LDPE is insoluble at normal temperature but is soluble at higher temperatures in aliphatic, aromatic, and halogenated hydrocarbons. In the case that articles made of LDPE are exposed to the effect of chemical substances along with mechanical stress, the surface cracks can be formed - this phenomenon is called environmental stress cracking.

LDPE has advantageous properties in permeability. It practically does not permeate water and steam, but it has a good permeability to carbon dioxide and oxygen. These characteristics are specially used in packaging.

LDPE is an excellent insulator with good dielectrical properties and a high volume resistance. The low dissipation factor predetermines LDPE for the use at high frequencies particularly where very low dielectric loss is required.

APPLICATION

The excellent physical and mechanical properties provide the wide range of applications of this polymer. BRALEN and TIPOLEN are available in a number of grades for all processing technologies as follows:

- Films
- Injection Moulding
- Extrusion
- Tubes and Pipes
- Blow Moulding
- Extrusion Coating and Lamination
BRALEN COMMERCIAL GRADES PRODUCED BY ICI AUTOCLAVE REACTOR PROCESS ARE DESIGNATED BY TWO LETTERS AND TWO GROUPS OF DIGITS. THE SIGNIFICATION IS AS FOLLOWS:

The first letter in the code of BRALEN grade indicates the main application area:
- V = injection moulding
- F = film
- R = general purpose (blow moulding, pipe, sheet and profile extrusion)
- N = extrusion coating

The first group of digits indicates the middle value of melt mass-flow rate (MFR) range in g/10 min at 190 °C and 2.16 kg

Designation: MFR:
- 03 = 0.3
- 08 = 0.8
- 2 = 2
- 7 = 8
- 20 = 20

The second letter in the code of BRALEN grade indicates the range of density at 23 °C:
- A = 913 – 917 kg/m³
- B = 918 – 923 kg/m³

To identify TIPOLEN PRODUCTS MANUFACTURED BY LYONDELLBASELL TUBULAR REACTOR PROCESS A CODE OF TWO LETTERS AND FIVE DIGITS IS APPLIED.

The first letter in the code of TIPOLEN grade indicates the main application area:
- F = Film

The second letter shows MFR range in g/10 min at 190 °C and 2.16 kg:
- A = 0.2 – 0.35
- B = 0.6 – 0.9
- C = 1.7 – 2.2
- D = 3.4 – 4.6

The first, second and third digits are internal plant codes

The fourth and fifth digits are indicative of the additives
<table>
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<tr>
<th>Grade/Parameter</th>
<th>Melt Mass - Flow Rate (MFR)</th>
<th>Density (23 °C)</th>
<th>Tensile Strength (MD/TD)</th>
<th>Tensile Strain at Break (MD/TD)</th>
<th>Vicat Softening Temperature</th>
<th>Shore D Hardness</th>
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<th>Recommended Thickness</th>
<th>Application</th>
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<tbody>
<tr>
<td>Units</td>
<td>g/10 min</td>
<td>kg/m³</td>
<td>MPa</td>
<td>%</td>
<td>°C</td>
<td>g</td>
<td>%</td>
<td>mm</td>
<td>Additives</td>
<td>Recommendations</td>
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<td>Test methods</td>
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<td>ISO 1183-2</td>
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<td>ISO 527</td>
<td>ISO 306 (A/120)</td>
<td>ISO 7765-1 method A</td>
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<td>SA(E), AB</td>
<td>0.04-0.08</td>
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</table>

Additives: SA (E) slip agent erucamide, AB antiblocking agent

Notes: 
* Haze, Dart Drop, Tensile Strength and Tensile Strain at Break have been measured on film − thickness of 0.07 mm (MFR = 0.3 g/10 min), and 0.04 mm (MFR more than 0.3 g/10 min), blow up ratio 2:1. 
** Density, Vicat Softening Temperature and Shore D Hardness have been measured on standard pressed specimens (ISO 293), conditioned at room temperature (ISO 291).
<table>
<thead>
<tr>
<th>Grade/Parameter</th>
<th>Melt Mass - Flow Rate (MFR)</th>
<th>Density (23 °C) **</th>
<th>Tensile Strength (MD/TD)</th>
<th>Tensile Strain at Break (MD/TD) *</th>
<th>Vicat Softening Temperature **</th>
<th>Dart Drop*</th>
<th>Shore D Hardness **</th>
<th>Haze *</th>
<th>Additives</th>
<th>Recommended Thickness</th>
<th>Application</th>
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<tbody>
<tr>
<td>Units</td>
<td>g/10 min</td>
<td>kg/m³</td>
<td>MPa</td>
<td>%</td>
<td>°C</td>
<td>g</td>
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<td>ISO 306 method A50</td>
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</tbody>
</table>

Additives:
- AO antioxidant
- UV UV stabiliser
- SA (E) slip agent erucamide
- SA (O) slip agent oleyamide
- AB antiblocking agent
- AS antistatic agent

Notes:
- Values in table are typical values, not be constructed as specifications.
- Users should confirm results by their own tests.
- * Haze, Dart Drop, Tensile Strength and Tensile Strain at Break in MD/TD on film—thickness of 0.07 mm (MFR=0.35 g/10 min), and 0.04 mm (MFR more than 0.35 g/10 min), blow up ratio 2.5:1
- ** Density, Vicat Softening Temperature, Shore D Hardness and Tensile Strength on the injection moulded specimens, prepared in accordance with ISO 1872-2 and measured in accordance with ISO 527-1.3
STORAGE AND HANDLING
Pellets are packed in 25 kg PE-LD bags and transported on shrink-wrapped or stretch-wrapped pallets at eligible load of polymer 1375 kg. We use adhesive between the bags in order to avoid their slipping. Pay attention to this fact during the removing of the bags from the pallets. The preferred method is to lift the bag at first without rotation. Heat treated pallets are available as well. Transportation in a road silo or rail silo is also available. For more detailed information please contact SLOVNAFT and TVK sales representative.

Since polyethylene is a combustible substance, the fire safety rules applicable for combustible materials in warehouses and store rooms should be observed.

If polymer is stored in conditions of high humidity and fluctuating temperatures, then atmospheric moisture can condense inside the packing. If it happened, it is recommended the pellets to be dried before use. During the storage polyethylene should not be exposed to UV radiation and temperatures above 40 °C. Producer does not take responsibility for any damages caused by adverse storage.

REACH STATEMENT
Polymers are exempt of REACH registration. However, their raw materials which mean monomers and relevant additives have been registered. SLOVNAFT, a.s./TVK Plc. is committed to fully respect this legislation and will only use REACH compliant raw materials. At this point in time LDPE BRALEN/TIPOLEN does not contain any substances specifically identified as SVHC at levels greater than 0.1%.

APPLICATION FOR FOODS
Most TIPOLEN and BRALEN grades satisfy the regulations applied by the European countries (EEC). Because several European countries apply restrictive regulations for the allowed migration values of additives in packaging material in contact with food, it is recommended that customers contact TVK and SLOVNAFT for some special information or product licenses for food industry.

SAFETY
Under normal circumstances, polyethylene is not regarded as hazardous material when in contact with the skin or when inhaled. However, any contact with the molten polymer or the inhalation of the released gases should be avoided in processing. It is recommended to install exhaust units over processing machines and to secure good ventilation of the place. For further information see Material Safety Data Sheet.

RECYCLING
Polyethylene resins are suitable for recycling using modern recycling methods. In-house production waste should be kept clean to facilitate direct recycling.
DISCLAIMER
The information provided in this publication has been compiled to the best of our present knowledge. However, in view of the various applications of polyethylene resins and the equipment used, the processing conditions may differ.

The recommendations and data herein are to be construed as informatory only and do not relieve users from carrying out their own tests and experiments prior to processing in order to check suitability for a specific use. It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislation are observed. Our products are under continuous development, therefore we reserve the right to change the information presented in this brochure at our own discretion.

The REACH statement herein does not constitute legal advice. The REACH statement is provided for informational purpose only.