Perfect food comes in perfect packaging

Packaging materials are of decisive importance for food quality and shelf-life. Many sophisticated packaging solutions have been developed to prevent rapid deterioration caused by oxygen, light and bacteria or by foreign odour and taste substances that come into contact with the product.

Foodstuff manufacturers have to choose suitable packaging designs and materials while also complying with legal requirements on packaging materials.

For example, they have to examine how to protect the product against quality deterioration from microbial growth, oxidation or dehydration.

Other factors that play a role in the decision include the barrier properties of the packaging against oxygen, light and volatile substances, the water vapour transmission rate, transparency, sealing ability, anti-fogging properties, microwaveability and price.
Various material properties combined

Packaging materials used with all forms of modified atmospheres (with the exception of fruit and vegetables) should have high barrier characteristics. Polymers used include polyester, polypropylene, polystyrene, polyvinyl chloride, nylon, ethylene vinyl acetate and ethylene vinyl alcohol polymers. These are usually laminated or coextruded with polyethylene, which comes into direct contact with the food and is the heat-sealing medium.

**Permeability ratio**

\[
\text{N}_2 : \text{O}_2 : \text{CO}_2 = 1 : 5 : 25
\]

**Permeability of various basic materials**

Permeability H$_2$O [g/(m$^2$/d)] at 40 °C/90 % r.H.

Permeability according to film thickness 25 μm

Permeability O$_2$ [ml/(m$^2$/d/bar)] at 23 °C/75 % r.H.
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Basic materials</th>
<th>Primary function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al</td>
<td>Aluminium</td>
<td>High barrier</td>
</tr>
<tr>
<td>APET</td>
<td>Amorphous polyester</td>
<td>Rigidity, gas barrier</td>
</tr>
<tr>
<td>CPET</td>
<td>Crystallised polyethylene terephthalate</td>
<td>Rigidity, high temperature resistance, gas barrier</td>
</tr>
<tr>
<td>EVA</td>
<td>Ethylene-vinyl acetate</td>
<td>Sealing layers</td>
</tr>
<tr>
<td>EVOH</td>
<td>Ethylene-vinyl alcohol</td>
<td>Gas barrier</td>
</tr>
<tr>
<td>HDPE</td>
<td>High density polyethylene</td>
<td>Moisture barrier, rigidity, microwave capability, sealing layers</td>
</tr>
<tr>
<td>LDPE</td>
<td>Low density polyethylene</td>
<td>Sealing layers</td>
</tr>
<tr>
<td>OPA</td>
<td>Oriented polyamide</td>
<td>Gas barrier</td>
</tr>
<tr>
<td>OPET</td>
<td>Oriented polyethylene-terephthalate</td>
<td>High temperature resistance, flexibility, puncture resistance</td>
</tr>
<tr>
<td>OPP</td>
<td>Oriented polypropylene</td>
<td>Moisture barrier, flexibility, puncture resistance</td>
</tr>
<tr>
<td>PA</td>
<td>Polyamide (nylon)</td>
<td>High temperature resistance, flexibility, toughness, partial gas barrier</td>
</tr>
<tr>
<td>PAN</td>
<td>Acrylonitrile</td>
<td>Gas barrier</td>
</tr>
<tr>
<td>PET</td>
<td>Polyethylene terephthalate (polyester)</td>
<td>Rigidity, partial gas barrier</td>
</tr>
<tr>
<td>PP</td>
<td>Polypropylene</td>
<td>Moisture barrier, rigidity, microwave capability</td>
</tr>
<tr>
<td>PS</td>
<td>Polystyrene</td>
<td>Rigidity</td>
</tr>
<tr>
<td>PVC</td>
<td>Polystyrene</td>
<td>Rigidity, gas barrier</td>
</tr>
<tr>
<td>PVdC</td>
<td>Polyvinylidene chloride</td>
<td>Moisture barrier, gas barrier</td>
</tr>
</tbody>
</table>

Research focuses on developing materials that can be produced and disposed of in an environmentally friendly way, as well as on optimising the packaging material, so that the amount of material is minimised. One development is the use of foamed materials in trays for more attractive presentation. Another development is the use of re-sealable packets for sliced ham, cheese and similar products. The table above shows a list of some typical materials used for product packaging. The exact composition of the film is adapted to the individual product and to the type of package required. To ensure that a modified atmosphere will be retained during the lifetime of the package, several different plastic materials are often combined into a multilayered structure, each layer having its own function. Different plastic materials can therefore be chosen and combined to achieve:

- mechanical strength
- water vapour barriers to prevent weight loss and dehydration
- gas barrier
- gas permeability
- anti-fogging properties (the inside of the material should have a surface that does not allow the formation of water droplets, which reduce transparency)
- sealing properties, i.e. capable of sealing into a tight package while retaining material properties even along the package seal.
Examples of materials used with certain food products

<table>
<thead>
<tr>
<th>Food</th>
<th>Material Bottom</th>
<th>Material Top</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red meat, processed meat, poultry, fresh fish</td>
<td>OPET/PE/EVOH/PE</td>
<td>OPP/PE/EVOH/PE</td>
</tr>
<tr>
<td></td>
<td>XPP/EVOH/PE</td>
<td>OPET/PE/EVOH/PE</td>
</tr>
<tr>
<td></td>
<td>EPS/EVOH/PE</td>
<td>OPA/PE</td>
</tr>
<tr>
<td></td>
<td>(XPP and EPS are injection-moulded materials)</td>
<td></td>
</tr>
<tr>
<td>Sausages</td>
<td>PA/PE</td>
<td>PA/PE</td>
</tr>
<tr>
<td>Pizza, pasta, cheese</td>
<td>OPA/PE</td>
<td>OPA/PE</td>
</tr>
<tr>
<td>Dry products, coffee, milk powder</td>
<td>Metalised PET/PE</td>
<td>OPP PS/PE</td>
</tr>
<tr>
<td>Chopped lettuce leaves</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Typical multi-film structure

![Diagram showing PE, EVOH, and OPET layers](image)

Packaging of salad with flow-pack machine