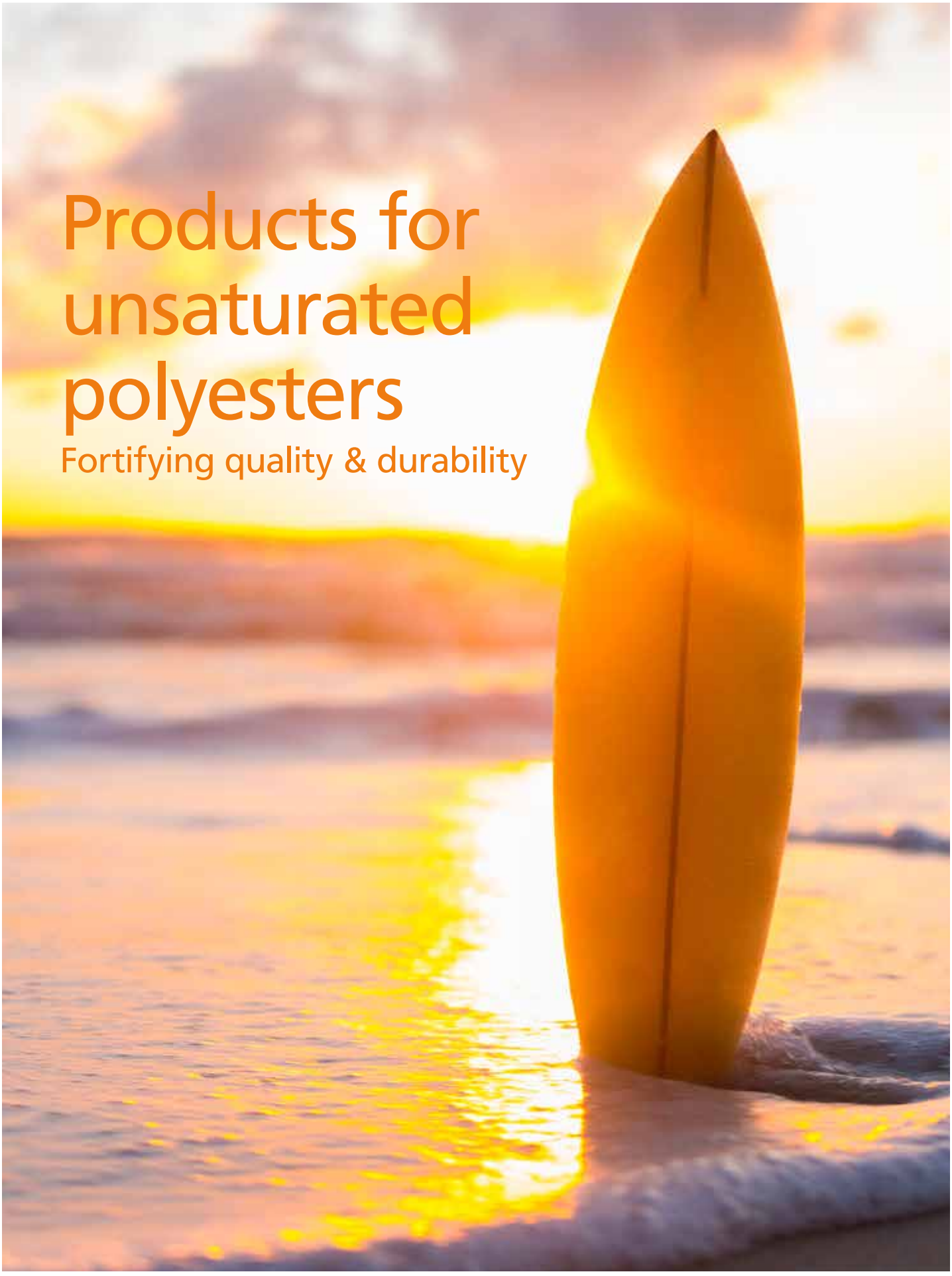


# Products for unsaturated polyesters

## Fortifying quality & durability

Perstorp
WINNING FORMULAS

# The elements of success

You need a partner who can see the big picture when it comes to your products, your processes and your customers. Our experience and expertise in the special niches of organic chemistry, process technology and application development are at your service, providing you with a complete chain of solutions to enhance quality and profitability at every step.

Our versatile intermediates, an essential element of your winning formula, are specifically designed to add value and enhance end-product performance. Your solution to meeting the increasing demands for safer, lighter, more durable and environmentally friendly end-user products, begins here.

## Innovation in everything we do

Innovation distinguishes every aspect of our business process. Developing smarter and safer solutions creates real value in new chemical applications. Focused innovation instills leadership and purpose in our business activities, improves internal processes and increases application and product competitiveness.

## Delivering our promises globally

Our global presence provides you with reliable solutions and processes, consistent high quality, security of production and supply and delivery with precision. This commitment also means rapid response when product or application support is required and the very best in technical support.

## Putting the care into chemicals

We take our responsibilities to heart and are committed to attentive, sustainable business practices. We minimize risks for our customers, our employees and the environment by working proactively to ensure safe products and processes.

# Fortifying quality & durability

We offer you a wide range of products to enhance your unsaturated polyester applications. Our extensive application development in unsaturated polyesters is in line with market demands for more technically tailored and environmentally sensitive products. Our R&D teams have a history of successful innovations for direct gloss wood coatings and laminating resins using selected polyols. Our innovators are focused on delivering products that enhance important characteristics such as weatherability, gloss retention, water resistance and lower styrene emissions.

Unsaturated polyesters are important as direct gloss wood coating for furniture and musical instruments such as pianos and violins. One layer of high gloss and high build coating with Perstorp additives gives the product a perfect shine that can otherwise only be achieved with a combination of wax, unsaturated polyester and polishing. Our products for unsaturated polyesters are also especially important in the glass fiber reinforced thermosets market. Glass fiber reinforced thermoset products such as pleasure boats, bathtubs, pipes, auto body parts and car repair putties are easily and inexpensively designed, manufactured and maintained.

Our products for gelcoats give objects made from glass fiber reinforced thermosets their essential protective top coat and color. Gelcoats made with our intermediates offer superior performance and protection from weathering and harsh chemicals and give the products an attractive, smooth, hard top layer.

Our vital intermediates enhance glass fiber reinforced thermosets products making them more durable, more attractive and more cost-efficient to produce. Our products help you decrease the environmental impact of your products and make them even more user-friendly and easy to maintain.

## Our products for unsaturated polyesters:

**TMPDE 80 & 90 (Trimethylolpropane Diallyl Ether)**
For superior direct gloss coatings

**BEPD (Butyl Ethyl Propanediol)**
Outstanding water resistance and improved processing

**Neo (Neopentyl Glycol)**
Outstanding durability for high-end products

**MPD (Methyl Propanediol)**
Easy to handle

**PA (Phthalic Anhydride)**
A vital building block for economical production

**HDO (1,6-Hexanediol)**
Improves flexibility

We welcome your questions.
More detailed information and specifications of each product are available on www.perstorp.com or through your Perstorp sales representative.

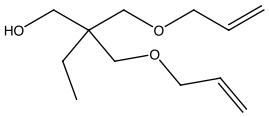
# Unrivaled performance

## TMPDE (Trimethylolpropane Diallyl Ether) – for superior direct gloss coatings

TMPDE is an allylether used in unsaturated polyesters to achieve superior direct gloss coatings with high build and surface hardness. It is also used in putties for automotive repair. As a high gloss wood lacquer it is ideal for wood furniture and instruments such as pianos and violins. TMPDE improves the reactivity of the formulation, protecting these products by improving the coating's scratch resistance and by slowing and reducing the yellowing of the coating as it ages.

TMPDE works as a chain stopper to improve oxidative drying properties and direct gloss. Incorporating allylethers into the coatings system also increases the production rate and your productivity. This monofunctional unsaturated alcohol contains an average of one hydroxyl group and two double bonds and is a clear colorless liquid. Two grades are available: TMPDE 80 and TMPDE 90.

TMPDE 80
(Trimethylolpropane
Diallyl Ether)



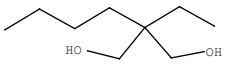

## BEPD (Butyl Ethyl Propanediol) – outstanding water resistance and improved processing

BEPD is an asymmetric, hydrophobic glycol that gives polyester resins and coatings superb hydrolytic stability. This increases the outdoor durability and extends the lives of end products. The superb water resistance that BEPD imparts in gelcoats especially makes it ideal for sailboats, motorboats and other marine applications.

The pendant hydrophobic groups coupled with the glycol structure of BEPD secure a unique balance between the flexibility and hardness of the polyester resin. This also lowers the viscosity of the polyester resin making it possible for formulators to reduce styrene content by as much as 10% and which makes products more environmentally sensitive.

By adding BEPD into the unsaturated polyester formulation, you also facilitate the use of ethylene glycol, which is much cheaper and more readily available than its alternatives. BEPD also makes it much easier to dissolve the polyester in the styrene and increases the shelf life of the unsaturated polyester formulation by reducing recrystallization.

BEPD
(Butyl Ethyl Propanediol)




## Neo (Neopentyl Glycol) – outstanding durability for high-end products

In unsaturated polyesters, mainly gelcoats, Neo imparts improved hydrolytic stability, improving weathering, chemical and water resistance in end products. It is a white crystalline polyhydric alcohol containing two primary hydroxyl groups. Neo is often used in combination with isophthalic acid to make a high performance, unsaturated polyester with even greater chemical resistance. This is ideal for increasing the durability of valuable high end products such as sailboats and motorboats. Neo can be delivered in solid form as flakes, at ambient temperature, in liquid form at elevated temperatures or as Neo 90, a 90% solution in water.

Neo (Neopentyl Glycol)


## Properties of a resin casting without BEPD & with BEPD

| | Without BEPD | 30 mole -% BEPD |
|---|---|---|
| HDT | 80°C | 76°C |
| Tg | 114°C | 105°C |
| Barcol hardness | 43.6 | 39.7 |
| Tensile strength | 75.6 MPa | 74.2 MPa |
| Tensile modulus | 3234 MPa | 2977 MPa |
| Elongation | 3.0% | 4.1% |
| Flexural strength | 123 MPa | 131 MPa |
| Flexural modulus | 3707 MPa | 3361 MPa |
| Water absorption, 28d/23°C | 73 mg | 61.7 mg |
| Water absorption, 28d/23°C | 1.96% | 1.66% |
| Boiling water absorption | 34 mg | 32 mg |
| Boiling water absorption | 0.28% | 0.28% |
| Shrinkage, length | 1.77% | 0.96% |
| Shrinkage, width | 2.37% | 2.14% |

1% Co-octoate (1%) in styrene +
1% of MEK Peroxide, Post curing
5 h in 50°C + 3 h in 80°C

## Outdoor resistance of the gel coat without BEPD & with BEPD

| QUV - A exposure for 500h | Without BEPD | 30 mole -% BEPD |
|---|---|---|
| Gloss 60° original | 90.1 | 88.0 |
| Gloss 60° final | 86.8 | 86.6 |
| Gloss 60° change; absolute/relative | 3.3/3.7% | 1.4/1.6% |
| Yellowing Db | 1.61 | 1.37 |
| Color change DE | 1.62 | 1.39 |

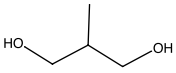
| Florida exposure for 2 years | | |
|---|---|---|
| Gloss 60° original | 90 | 91 |
| Gloss 60° 12/24 months | 75/4.6 | 88/3.8 |
| Da 12/24 months | 0.03/-0.1 | -0.01/-0.1 |
| Db 12/24 months | 0.57/4.6 | 0.56/3.9 |
| DE 12/24 months | 0.57/4.4 | 0.58/4.0 |

# Designed to endure

## MPD (Methyl Propanediol) – easy to handle

MPD secures satisfactory overall performance in general-purpose unsaturated polyester and improves the weatherability of end products. MPD is a liquid diol with two primary hydroxyl groups, and since it is a liquid at room temperature, handling the product is easy. In some cases it is a good alternative to propylene glycol.

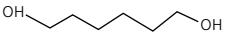
MPD
(Methyl Propanediol)




## HDO (1,6 hexanediol) – for improved flexibility

For unsaturated polyester resins (UPRs) and gelcoats HDO due to it linear structure enhances flexibility and high impact resistance at low temperature. By combining HDO with our other glycols a good balance between chemical resistance, hydrolytic stability and flexibility can be found.

1,6-Hexanediol




## PA (Phthalic Anhydride) – vital building block for economical production

This acid is one of the most basic building blocks for the economical production of unsaturated polyesters and gelcoats. In the production of general-purpose orthophthalic unsaturated polyester both for lamination and for gelcoats our PA is essential.

PA
(Phthalic Anhydride)


## Product data summary

| Allylethers for high gloss coatings | | | |
|---|---|---|---|
| Product | Appearance | Reactive group | Boiling point °C |
| TMPDE 80[1] | Liquid | 1 hydroxy, 2 allyl | 135 |
| TMPDE 90[1] | Liquid | 1 hydroxy, 2 allyl | 135 |

| Glycols | | | | | | |
|---|---|---|---|---|---|---|
| Product | Appearance | Reactive group | OH-value mg KOH/g | Molecular weight g/mol | Melting point °C | Boiling point °C |
| BEPD[2] | Semi-crystalline | 2 hydroxyl | 695 | 161.0 | 44 | 262 |
| Neo[3] | Flakes | 2 hydroxyl | 1077 | 104.2 | 129 | 210 |
| MPD[4] | Liquid | 2 hydroxyl | 1230 | 90.8 | Liquid | 212 |
| HDO[5] | Solid | 2 hydroxyl | 950 | 118.2 | 43 | 253-260 |

| Aromatic anhydrides | | | | |
|---|---|---|---|---|
| Product | Appearance | Color hazen max. | Purity % min. | Molecular weight g/mol |
| PA[6] | Flakes | 30 | 99.8 | 148.1 |

1 Trimethylolpropane Diallyl Ether
2 Butyl Ethyl Propanediol
3 Neopentyl Glycol
4 Methyl Propanediol
5 1,6-Hexanediol
6 Phthalic Anhydride



# Your winning formula

The Perstorp Group, a trusted world leader in specialty chemicals, places focused innovation at your fingertips. Our culture of performance builds on over 125 years of experience and represents a complete chain of solutions in organic chemistry, process technology and application development.

Matched to your business needs, our versatile intermediates enhance the quality, performance and profitability of your products and processes. Present in the aerospace, marine, coatings, chemicals, plastics, engineering and construction industries, they can also be found in automotive, agricultural, food, packaging, textile, paper and electronics applications.

Our chemistry is backed by reliable business practices and a global commitment to responsiveness and flexibility. Capacity and delivery security are ensured through strategic production plants in Asia, Europe and North and South America, as well as sales offices in all major markets. Likewise, we combine product and application assistance with the very best in technical support.

As we look to the future, we strive for the development of safer products and sustainable processes that reduce environmental impact. This principle of innovation and responsibility applies not only to our own business, but also to our work with yours. In fulfilling it, we partner with you to create a winning formula that benefits your business – as well as the people it serves.

Discover your winning formula at **www.perstorp.com**





Perstorp
WINNING FORMULAS