Oppanol®
PIB by BASF
The global all-rounder
The result: a reliable partner

Your business is as important to us as our own. For this reason, we are constantly working to create unique value propositions that will help you grow. BASF’s 75 years of experience and proven long-term commitment to PIB ensures consistent product quality and availability, giving you complete peace of mind wherever you operate in the world marketplace.

We secure supply both by adjusting our manufacturing capacities to the growing market needs and by ensuring that all our production units are back-integrated into BASF’s unique Verbund architecture. Technical service is a core part of BASF’s offering, providing a worldwide professional response to your requirements.

As the world’s leading producer of PIB, BASF offers the broadest range of polyisobutenes with different molecular weights. Medium and high molecular weight polyisobutenes are sold under the trade name Oppanol®.

Committed: Polyisobutene (PIB) is a core business for BASF, with deep integration into manufacturing and sales structures
Knowledgeable: BASF has over seventy years of experience in the manufacturing of PIB and in understanding its properties.
Global: With customers spread all over the world, the PIB team acts globally by maintaining strong and caring customer contact across all regions

DISCOVER THE WIDE RANGE OF OPPANOL®
Due to its unique combination of properties, Oppanol® is an ideal component for a variety of formulations. Our customers are using Oppanol® in a wide range of applications:

- Construction: insulating glass sealants and roofing membranes
- Automotive: protection films and acoustic dampening
- Medical: adhesives for plasters and ostomy bags
- Food-related: food packaging and as a component in chewing gum

BASF’s Oppanol® product range is suited to enhance manufacturing processes and product effectiveness in a wide range of different applications.

It works both as a protective barrier and an adhesive. It is flexible yet mechanically stable. It can be used where exposure to sunlight is a potential risk to sealants, or where moisture needs to be kept out.

It can be used in protective films or acoustic barriers within the automotive industry or in roofing membranes within the construction industry.

Wherever it is used, Oppanol® provides quality, certainty, dependability and effectiveness. All backed by BASF’s unrivalled global support network and reputation for customer care.

**ONE PRODUCT FAMILY, MANY APPLICATIONS**

Introducing the Oppanol® product family

**Key properties of Oppanol®**

- Water vapor barrier
- No skin irritation
- Good adhesion to a wide variety of surfaces
- Flexibility at low temperatures
- Electrical insulation

**Moisture barrier meets adhesion**

Vapor barring and low-temperature elasticity are common to all grades of Oppanol®, giving the product several distinctive and practical characteristics.

The resinous Oppanol® grades B 10 – B 15 provide tack (stickiness) and adhesion to formulations. Rubber-like characteristics are provided with increasing molecular weight.

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**Figure 1**

**Figure 2**

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**Table 1**

<table>
<thead>
<tr>
<th>Oppanol®</th>
<th>Molecular weight</th>
<th>Barrier</th>
<th>Tack</th>
<th>Adhesion</th>
<th>Viscosity</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>B10</td>
<td>10,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B12</td>
<td>60,000</td>
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<td></td>
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<tr>
<td>B15</td>
<td>100,000</td>
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<tr>
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<td>500,000</td>
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<td></td>
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<tr>
<td>B100</td>
<td>1,000,000</td>
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<td></td>
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<tr>
<td>B200</td>
<td>5,000,000</td>
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</tbody>
</table>

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**Figure 1**

**Figure 2**
Meets the toughest approvals ratings

Many applications are dominated by approval processes. Approvals are costly, time-consuming and require a consistent quality from the raw materials used. It is here that the quality of our Oppanol® grades adds real value, enabling manufacturers to offer reliable and trouble-free products to the market.

Oppanol® provides excellent tack both on smooth surfaces like glass, plastic material or polished metal and on porous surfaces like corroded metal. Grades B10–B15 are the perfect materials for corrosion protection preparations. Due to its cold flow, it is able to flow into pores without external impact, providing a long-lasting water barrier and repairs itself when damaged.

Removable without leaving a trace

The well-balanced combination of adhesion and removability makes the use of Oppanol® valuable for protective films (for example applied on new cars when shipped to the dealership).

As a skin irritant-free material with excellent tack, our customers use Oppanol® as an essential ingredient in adhesive applications for plasters or ostomy bags. These products are easily removable without leaving any adhesive residues or skin irritation. For these applications, Oppanol® grades B12–B100 are preferred.

Mix and match to achieve the perfect result

The requirements of different applications can be perfectly met by blending various grades of Oppanol®. For example, the combination of tack to different surfaces and barrier against various media like water vapor makes grades B10–B15 especially suitable for high-end sealant applications for insulating glass. The resulting sealant formulations are easy to apply and ensure long-term stability.

Practical and safe for weather-sensitive applications

In applications like electrical cables, long-term effective moisture protection and electrical insulation are critical. Due to the well-balanced barrier and flow properties, Oppanol® grades B10–B15 provide an excellent solution for these applications.

Weatherability, combined with maximum moisture protection and elasticity at low temperatures, make Oppanol® grades B100 and B150 particularly valuable for membranes used in flat roofs. An example of how long this material survives in service is evidenced by the world’s oldest synthetic membrane roof constructed in 1956 in Leopoldshafen, Germany.

Chewing with long lasting flavor

Chewing gum has been a part of daily life for many years, and is said to offer health and wellness benefits. Oppanol® grades B12–B50 in particular are an essential ingredient of chewing gum, and are mainly responsible for the long lasting flavor and balanced texture.

All Oppanol® grades meet the requirements of food contact regulations. For this reason, they are used for food packaging application where an effective moisture barrier is needed to prevent food from drying.

Medium molecular weight

<table>
<thead>
<tr>
<th>Oppanol®</th>
<th>B10</th>
<th>B12</th>
<th>B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sealants</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Chewing Gum</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Adhesives</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Roofing</td>
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<td></td>
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</tbody>
</table>

High molecular weight

<table>
<thead>
<tr>
<th>Oppanol®</th>
<th>B30</th>
<th>B50</th>
<th>B80</th>
<th>B100</th>
<th>B150</th>
<th>B200</th>
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<tr>
<td>Sealants</td>
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<tr>
<td>Chewing Gum</td>
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<tr>
<td>Adhesives</td>
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<tr>
<td>Roofing</td>
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</tbody>
</table>

Figure 3
Stability test for Oppanol® compounds
TECHNICAL INFORMATION

BASF's Oppanol® grades are pure isobutene homopolymers. The non-polar characteristics lead to chemical inertness and resistance to oxidative attack. The Oppanol® grades are soluble in non-polar solvents, while functioning as solvents themselves for non-polar ingredients like, for example, certain flavor additives for chewing gum.

The Oppanol® grades are supplied in the form of transparent to slightly turbid soft resins or rubbery solids. The color can vary between colorless to slightly yellowish or grey.

### Chemical properties

**Solubility / compatibility**

The various Oppanol® grades are soluble in aliphatic, aromatic, cyclic and halogenated hydrocarbons. Their tendency to swell with alcohols, ethers, esters and ketones increases with the length of the polar solvent’s hydrocarbon chain.

Compatibility with fatty acid esters is limited and hence needs to be tested for specific intended applications. Different Oppanol® grades are compatible with each other.

**Chemical resistance**

Oppanol® is resistant to aqueous acids and alkaline solutions. Exceptions are concentrated sulfuric and nitric acid, which cause degradation of the polymer chain.

### Table 1: Purity

<table>
<thead>
<tr>
<th>Ash content</th>
<th>Heavy metal content (soluble)</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 100 ppm (detection limit)</td>
<td>less than 5 mg/kg (except for iron)</td>
</tr>
</tbody>
</table>

### Table 2: Stabilization

<table>
<thead>
<tr>
<th>Stabilized grades</th>
<th>B 10 N</th>
<th>B 12 N</th>
<th>B 14 N</th>
<th>B 15 N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B 50</td>
<td>B 80</td>
<td>B 100</td>
<td>B 150</td>
</tr>
<tr>
<td>Non stabilized grades</td>
<td>B 10 SFN</td>
<td>B 11 SFN</td>
<td>B 12 SFN</td>
<td>B 13 SFN</td>
</tr>
<tr>
<td></td>
<td>B 30 SF</td>
<td>B 50 SF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BASF’s Oppanol® grades mixed with fillers, plasticizers or tackifying resins provide formulators with various property profiles for their applications.

For outdoor applications, the addition of UV stabilizers like UV absorbers or steric hindered amines is recommended. (See Weather resistance / Thermal stability on page 19)

This makes Oppanol® an important ingredient for adhesive formulations, and also for sealant applications. The ‘self-healing’ properties of Oppanol® based formulations attribute to cold flow as well.

Note: Cold flow decreases with increasing molecular weight.

A low glass transition temperature (Tg ~ −60 °C) allows Oppanol® to remain flexible even at low temperatures, making it ideal for applications such as roofing.
Viscosity

The Oppanol® grades are permanently tacky and high-viscous thermoplastic polymers. Viscosity increases with increasing molecular weight. The change from a high viscous liquid to an elastic solid occurs roughly at the Oppanol® B50 grade.

By combining different Oppanol® grades, viscosity levels can be adapted according to specific requirements.

Flow behavior

Test design
Oppanol® and Oppanol® blends, were applied between two glass plates and the flow behavior was monitored.

Test result
The addition of Oppanol® B15 to Oppanol® B10 increases viscosity and considerably reduces flow, without losing adhesion to the glass surface.

The flow behavior of Oppanol® can be adjusted by combining different grades.
Barrier properties

The Oppanol® grades are highly resistant to penetration by water vapor and gases such as argon. Oppanol® can also be added to other polymer materials to increase their water impermeability.

Figure 7: Water vapor permeability

Permeability [g x 1μm/m²/d]

<table>
<thead>
<tr>
<th>Material</th>
<th>Oppanol® B 15</th>
<th>Oppanol® B 50</th>
<th>Oppanol® B 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oppanol® B 15</td>
<td>45</td>
<td>110</td>
<td>5,500</td>
</tr>
<tr>
<td>Oppanol® B 50</td>
<td>45</td>
<td>110</td>
<td>5,500</td>
</tr>
<tr>
<td>Oppanol® B 100</td>
<td>5,000</td>
<td>10,000</td>
<td>20,000</td>
</tr>
</tbody>
</table>

The data on oxygen and argon permeability is given in table 3.

Typical window sealant formulations consist of 50–70% PIB and 30–50% inorganic fillers. The water vapor permeability of Oppanol® B10- and Oppanol® B15-based compounds is summarized in table 4.

Adhesion properties

Oppanol® grades B 10–B 15 provide excellent tack to various substrates like glass, metal or polymers. Tack decreases with increasing molecular weight, as shown in the adjoining picture.

Figure 8: Cohesion failure

Table 3: Permeability of oxygen and argon [cm³ x 1mm/ (m²*d*bar)]

<table>
<thead>
<tr>
<th>Material</th>
<th>O₂</th>
<th>Ar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oppanol® B 15</td>
<td>550</td>
<td>30,000</td>
</tr>
<tr>
<td>Oppanol® B 100</td>
<td>5,000</td>
<td>40,000</td>
</tr>
</tbody>
</table>

Table 4: Water vapor permeability of compounds

<table>
<thead>
<tr>
<th>Material</th>
<th>Permeability [g x 1μm/m²/d]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oppanol® B 10</td>
<td>67</td>
</tr>
<tr>
<td>Oppanol® B 15</td>
<td>57</td>
</tr>
</tbody>
</table>

All grades of Oppanol® are highly resistant to water or vapor penetration, making them ideal for barrier applications.

Test design

A very good orientation for the adhesive strength gives the peel strength test according to FINAT method FTM 1 measuring the force needed to separate an Oppanol® coated liner from various substrates.

Figure 9: Peel strength (contact pressure: 2 kg/1 min)

In comparison to the Oppanol® grades B 10–B 15, Oppanol® B 50 or higher grades provide cohesive strength and result in adhesion failure. Separation occurs between surface and adhesive layer and not within the adhesive layer itself.

The FINAT peel strength test gives an excellent indication of the adhesion properties of the Oppanol® range.
An in-house laboratory method was used to depict the adhesive forces of various Oppanol® blends as the time taken for two metal blocks to separate.

By incorporating higher molecular weight grades, the separation time can be extended dramatically. The incorporation of higher grades than Oppanol® B 15 switches the fraction from cohesion failure to adhesion failure.

The characteristic of adhesive formulations can be adapted to different requirements and optimized by combining Oppanol® grades of different molecular weights.

By incorporating higher molecular weight grades, the separation time can be extended dramatically. The incorporation of higher grades than Oppanol® B 15 switches the fraction from cohesion failure to adhesion failure.

Applications requiring long-term functionality and/or exposure to wide temperature variations require strong stability and temperature resistance. In these applications, the choice of ingredients is an essential influencing factor. The mechanical strength of Oppanol® based formulations can be achieved by the addition of fillers and is fundamentally influenced by the selection of the right molecular weight Oppanol® grade.

By incorporating higher molecular weight grades, the separation time can be extended dramatically. The incorporation of higher grades than Oppanol® B 15 switches the fraction from cohesion failure to adhesion failure.

The use of Oppanol® B 15 extends the stability of the compound remarkably, making it the preferred Oppanol® grade for window sealant formulations.

The in-house laboratory test shown in figure 11 compares the flexural strength of various Oppanol® compounds, with 30 % carbon black. The time was measured for the horizontally fixed sticks to achieve a 70° inclination. The relative results are illustrated in figure 12.

Combining different Oppanol® grades creates different degrees of adhesion, a completely customizable solution.

Selection of the right Oppanol® grade results in compounds with tailor made mechanical properties.

<table>
<thead>
<tr>
<th>Compound characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oppanol® grades B 10 – B 15 provide a high filler intake. The strength of the compounds can be varied by the filler type and its concentration. An example of selected penetration values is given in table 5.</td>
</tr>
</tbody>
</table>

Table 5: Penetration of Oppanol® compounds with 30 % filler at room temperature

<table>
<thead>
<tr>
<th>Filler (Penetration [mm])</th>
<th>Oppanol® B 10</th>
<th>Oppanol® B 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon black</td>
<td>6.1</td>
<td>2.9</td>
</tr>
<tr>
<td>Calcit</td>
<td>9.5</td>
<td>6.0</td>
</tr>
<tr>
<td>Clay mineral</td>
<td>13.0</td>
<td>5.6</td>
</tr>
<tr>
<td>China clay</td>
<td>14.3</td>
<td>5.7</td>
</tr>
</tbody>
</table>

The in-house laboratory test shown in figure 11 compares the flexural strength of various Oppanol® compounds, with 30 % carbon black. The time was measured for the horizontally fixed sticks to achieve a 70° inclination. The relative results are illustrated in figure 12.
The polymer selection essentially influences a formulation’s dimensional stability under heat. The more a polymer keeps its stiffness at increasing temperatures the higher is its heat resistance.

Figure 13 compares the temperature dependence of the storage modulus G’ of Oppanol® compounds resulting from DMTA (Dynamic Mechanical Thermal Analysis). The storage modulus G’ is representative of the material’s stiffness.

Due to their higher G’ values, over a broad temperature range, the Oppanol® B 15 based compounds are stiffer and therefore more heat resistant in formulations.

Oppanol® B 15 based compounds are preferable when mechanical strength and heat resistance are required.

Appropriate Oppanol® grade selection yield heat resistant compounds without compromising dimensional stability.

Weather resistance / Thermal stability

Oppanol® encounters slight degradation over time when exposed to UV light. However by virtue of its chemical backbone it is substantially more stable than other elastomers including butyl rubber.

Polymer degradation by UV light can be prevented by adding stabilizer systems consisting of UV stabilizers (steric-hindered amines HALS) and UV absorbers. Combination with antioxidants like organophosphites or phenols are also advantageous.

Recommended concentrations are 0.1–0.5 % per stabilizer, depending on the combination and the requirements that have to be met.

<table>
<thead>
<tr>
<th>UV stabilizer</th>
<th>HALS</th>
<th>Antioxidant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinuvin® 326</td>
<td>Tinuvin® 770</td>
<td>Irgafos® 126</td>
</tr>
<tr>
<td>Chimasorb® 2020</td>
<td>Tinuvin® 770</td>
<td>Irgafos® 126</td>
</tr>
<tr>
<td></td>
<td>Chimasorb® 2020</td>
<td>Irganox® 1010</td>
</tr>
</tbody>
</table>

Table 6: UV stabilization systems

Long-term thermal stability has been simulated by an accelerated aging test storing Oppanol® B 10 SFN at 150 °C over four months and monitoring the Staudinger Index. (Fig. 14)

When elevated temperatures are applied over a long period, inert conditions are recommended for the SFN grades resp. the addition of stabilizers. Stabilized grades are not affected.

Increasing molecular weights reduce the sensitivity to degradation.

Stabilizer systems can prevent Oppanol® from the impact of UV radiation.
PROCESSING

Processing conditions

Oppanol® is a thermoplastic and can be processed with conventional machinery used in the rubber industry, including kneaders, roll-mills and single- or twin-screw extruders. Sigma-bladed mixers are widely used and, depending on the viscosity range, even Banbury mixers.

For blending purposes a high viscosity component is recommended as the starting material. The mixing time to get homogenous mixtures in kneaders may vary between 0.5–2.0 hours. The greater the difference between the molecular weight of the components, the longer it takes to achieve homogenous mixtures.

<table>
<thead>
<tr>
<th>Oppanol®</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>B 10–B 15</td>
<td>120–150 °C</td>
</tr>
<tr>
<td>B 30–B 150</td>
<td>130–200 °C</td>
</tr>
</tbody>
</table>

Table 7: Typical processing temperatures in kneaders

In order to achieve the optimum filling level of the mixing unit, the dependence of the density on temperature needs to be considered.

Oppanol®, in particular grades B 10–B 15, fluidizes substantially when temperature is increased. The influence of temperature on viscosity is illustrated in figure 4 in the “Viscosity” section (page 12).

Figure 15: Density versus temperature

As a thermoplastic, Oppanol® can be processed in conventional rubber processing machines.
Processing stability

Stabilizer-free Oppanol® grades degrade when severely kneaded and sheared in contact with air. The tendency to degrade increases with higher molecular weight.

![Graph showing processing stability](image)

Fig. 16 and 17 compare the shear stability of unstabilized Oppanol® B 50 SF with the stabilized Oppanol® B 50.

![Graph showing processing stability](image)

Stabilizers like BHT at a level of approximately 500 ppm prevent degradation during processing. In absence of stabilizers inert conditions are recommended.

Packaging

Oppanol® grades B 10 – B 15 and B 30 – B 50 are available in 20 kg cardboard boxes with an inner silicone release coating.

Oppanol® B 10 – B 15 is also available in 100 lbs (45.4 kg) all-fiber drums lined with silicone coated nylon.

Oppanol® B 80 – B 200 grades are packed in 20 kg bags. In addition to a standard PE bag, an easy-peel version is also available.

Stabilized Oppanol® grades may be preferred for harsh processing and application conditions.

Shelf life under dry storing conditions at ambient temperatures

Box, bag: 2 years from date of production
Drum: 3 years from date of production
(< 30 °C, no sun-light, dry)
GENERAL REMARKS

Food and Food Contact Information

Oppanol® polymers fulfill some of the requirements of European and respective national legislations regarding chewing gum and food contact. For details please contact your sales representative or refer to www.basf.com/pib

REACH

Oppanol® is compliant with EC Regulation 1907/2006 (REACH).

Shelf life

Storage at ambient temperatures and protection from light and moisture provided a shelf life (‘best before’ date) of two years from the date of production for all grades, whether packed in boxes or in bags. The ‘best before’ date for grades in drums is three years from the date of production. Damage to packaging must be strictly avoided while in storage or during handling.

Specifications, Material Safety Data Sheets and Certifications

Detailed product data can be found at the end of the brochure. A full range of MSDS, actual certificates (ISO, Kosher, HACCP for MM and HM (B30/B50) PIB) and samples of CoA are listed and available at www.basf.com/pib or through your local BASF representative.

OPPANOL® GRADES AND CHARACTERISTICS AT A GLANCE
### Oppanol® B

<table>
<thead>
<tr>
<th>Stabilizer [ppm] (average concentration)</th>
<th>10 SFN</th>
<th>11 SFN</th>
<th>12 SFN</th>
<th>13 SFN</th>
<th>14 SFN</th>
<th>15 SFN</th>
<th>30 SF</th>
<th>50 SF</th>
<th>80</th>
<th>100</th>
<th>150</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 N</td>
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<td>no</td>
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</table>

### Specification

**Staudinger Index Jo** [cm³ / g]

| Jo  | 27.5–31.2 | 30.7–36.0 | 34.5–39.0 | 39.0–43.0 | 45.9–51.6 | 76.5–93.5 | 113–143 | 178–236 | 241–294 | 416–479 | 551–661 |

### Typical characteristics

**Average molecular weight Mₐ (viscosity average):**

| Average molecular weight Mₐ (weight average) | 40,000 | 47,000 | 55,000 | 65,000 | 73,000 | 85,000 | 200,000 | 400,000 | 800,000 | 1,110,000 | 2,600,000 | 4,000,000 |

**Average molecular weight Mₚ (weight average):**

| Average molecular weight distribution Mₚ/Mₐ | 4.0    | 4.0    | 4.0    | 4.0    | 5.0    | 5.0    | 5.0    | 5.0    | 5.0    | 5.0    | 5.0    |

**Volatiles, 150 °C, 4h, 150 mbar [%]:**

| Volatiles [%] | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | <0.1  | <0.1  | <0.1  | <0.1  | <0.1  |

**Fluorine [ppm]:**

| Fluorine [ppm] | <5    | <5    | <5    | <5    | <20   |

**Chlorine [ppm]:**

| Chlorine [ppm] | <5    | <10   |

**Ash content [ppm]:**

| Ash content [ppm] | <100 |

### Typical properties

**Appearance:**
- transparent to slightly turbid
- clear to whitish

**Color:**
- colorless to slightly yellow
- colorless to light brown

**Glass transition temperature [°C]:**

| Glass transition temperature [°C] | −64 |

**Specific heat [kJ/(kg*K)]:**

| Specific heat [kJ/(kg*K)] | 2.0 |

**Heat conductivity [W/(m*K)]:**

| Heat conductivity [W/(m*K)] | 0.19 |

**Relative Permittivity (100 Hz, 1mm, RT):**

| Relative Permittivity (100 Hz, 1mm, RT) | 2.7 |

**Specific resistance [Ωcm]:**

| Specific resistance [Ωcm] | 10¹⁶ |

**Shear viscosity:**

Details upon request

**Packaging:**
- B10–B15: box, drum
- B30–B50: box
- B80–B200: bag/bag easy peel

**Shelf life**: Box: 2 years from date of production. Drum: 3 years from date of production.

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*The Staudinger Index Jo represents the viscosity of Oppanol® solutions in isooctane at 20 °C.

**Dry storing conditions, ambient temperatures, no direct sunlight.
Note

This version (EVO1545) supercedes version EVO1418.

The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect the processing and use of our product, these data do not relieve processors of the responsibility to carry out their own inspections and tests, neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights etc. given herein may change without prior notice and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient to ensure that all proprietary rights, laws and legislation are observed. (07/2015)

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