Adding value to your products - worldwide

KURARAY POVAL™, EXCEVAL™, ELVANOL™ and MOWIFLEX™ are the trademarks for polyvinyl alcohols made by Kuraray. Their key characteristics — high binding strength — add real value to your products. Our polymers are water-soluble, highly reactive, crosslinkable and foamable. They have high pigment binding capacity, protective colloid characteristics and thickening effects. The physical and chemical properties of KURARAY POVAL™ make it ideal for a wide variety of applications, ranging from adhesives through paper and ceramics to packaging.

KURARAY POVAL™ is approved and thus suitable for food applications. Ecologically KURARAY POVAL™ is advantageous due to its biodegradability and the fact that it is derived from renewable resources. Our polymers are available in various particle sizes – from granules to powders. Kuraray produces its wide range of KURARAY POVAL™ grades in Japan, Singapore, Germany and the USA. Kuraray's global production and service network make us your partner of choice for innovative high-quality PVOH resins.

KURARAY — Here to Innovate.

Metallised film applications

Metalised film such as PE, PP-coated PET and low barrier metallised BOPP are used in a wide variety of food packaging applications where high barrier appearance is required, for example, in crisp packaging or shelf-packaging. In addition, vacuum-metalised papers are employed for labels or cigarette packaging for pharma- ceutical products, dairy products, confectionery and gift wrapping, as well as label and outer liner for carton.

Pinholes in a metallised substrate are the main pathway for permeation. Pinholes account for the majority of the oxygen permeation but only for about 30% of the water vapour permeation. Most of the water vapour permeation through a metallised layer is due to nano-scale defects on the surface.

The main way to improve the gas barrier properties of such a construction is to perform the metallisation on top of a polymeric barrier layer like EXCEVAL™. With EXCEVAL™ the pinholes will be filled with this polymer’s gas barrier substrate and consequently the overall gas barrier performance of the metallisation increases significantly. Furthermore, the use of EXCEVAL™ as a polymeric gas barrier layer will avoid the necessity of performing a second metallisation process that contributes significantly to the pollution of the atmosphere of the packaging firm.

Many of our partners are food contact approved and thus suitable for food applications. Ecologically KURARAY POVAL™ is advantageous due to its biodegradability and the fact that it is derived from renewable resources. It is available in various particle sizes – from granules to powders. Kuraray produces its wide range of KURARAY POVAL™ grades in Japan, Singapore, Germany and the USA. Kuraray’s global production and service network make us your partner of choice for innovative high-quality PVOH resins.

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EXCEVAL™ – the solution for barrier requirements

EXCEVAL™ is the trademark of Kuraray’s chlorine-free barrier resins, especially designed for the requirements of the barrier coating industry. The new Ethylene-Modified copolymer is a water-soluble, standard polyvinyl alcohol. However, coatings made of EXCEVAL™ absorb significantly less humidity at average temperature conditions.

Therefore, EXCEVAL™ provides coatings with excellent gas barriers, e.g. towards oxygen, nitrogen and carbon dioxide – even at elevated relative humidity. Furthermore, the resulting coatings are highly transparent and glossy, have a strong chemical resistance, and provide good adhesion to metal as well as excellent printability.

EXCEVAL™ enables a barrier of less than 0.01 cm³·m⁻²·day⁻¹·atm⁻¹ (very high oxygen barrier) even at high degrees of relative humidity. EXCEVAL™ can be applied as a solvent-free, chlorine-free and environmental-friendly waterborne coating on numerous substrates and provides superior barrier levels compared to traditional coatings.

Applications devised for your product

EXCEVAL™ – Performance that is simply convincing

Oxygen Transmission Rate of EXCEVAL™ compared to standard polyvinyl alcohol at 20°C, 0%RH

<table>
<thead>
<tr>
<th>Relative Humidity (%)</th>
<th>Oxygen Transmission Rate (cm³·m⁻²·day⁻¹·atm⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>PVA 100</td>
</tr>
<tr>
<td>5</td>
<td>PVDC 100</td>
</tr>
<tr>
<td>30</td>
<td>EVOH 27%</td>
</tr>
<tr>
<td>85</td>
<td>EXCEVAL™</td>
</tr>
<tr>
<td>100</td>
<td>EXCEVAL™</td>
</tr>
</tbody>
</table>

EXCEVAL™ shows outstanding performance as gas barrier layer – even after 20 torsions of the films.

EXCEVAL™ – Frequently asked questions

How to dissolve EXCEVAL™?
EXCEVAL™ should be dispersed in cold water and then heated to 95°C (higher temperature and keep there for 2 hours). The solution should be cooled down slowly until warm.

Storage of EXCEVAL™ solutions!
Upon storage at low temperature as EXCEVAL™ solution may gel. Storage at elevated temperature as well as addition of isopropyl alcohol will reduce the gel tendency.

How can possible foaming of EXCEVAL™ be prevented during solving and application?
Adding 10% isopropanol to Exceval will considerably reduce the foam formation in the resulting film. The subsequent addition of IPA reduces the foam formation in the gravure rolls. IPA will also significantly improve the wetting of EXCEVAL™ on the plastic substrates. Furthermore, reducing the viscosity of the EXCEVAL™ solution contributes to a reduction of the foam formation on the gravure rolls. What total solid content can I prepare?
Typically a 10-15% solution should be made.

How to improve the water resistance?
Crystallisation is the driving force behind the barrier performance of EXCEVAL™ any temperature treatment will improve the barrier performance. Storage of the coated film at elevated temperatures (5°C for several days) will allow the improvement of the gas barrier layer.

How much material is required to achieve a high gas barrier layer?
A dry weight of 1 g/m² is enough to achieve a high gas barrier layer (permeation less than 0.01 cm³·day⁻¹·atm⁻¹).

How can I increase the coat weight?
Increasing the coating viscosity will reduce the viscosity. Depending on the coating temperature the total solid content can be increased. By increasing the solids content the drying time can be reduced.

What total solid content can I prepare?
Typically a 10-15% solution should be made.

How do I improve the barrier properties?
Generalisation is the driving force behind the barrier performance of EXCEVAL™ any temperature treatment will improve the barrier performance. A metal bonding complex is preferred in order to combine good water resistance while maintaining the excellent barrier level.

Can I print on EXCEVAL™?
Yes, it has a very good affinity to printing inks.

Does torsion affect barrier performance?
To assess the feasibility of the pass-by-gravure film, the barrier properties are measured before and after mechanical stress (Gelbo-Flex test). Even after 20 torsions EXCEVAL™ shows outstanding demonstrated performance.

The Oxygen Transmission Rate of a PVF film coated with EXCEVAL™ and metalled is analysed at 23°C, 65% RH, in 100% O₂ atmosphere:

<table>
<thead>
<tr>
<th>Relative Humidity (%)</th>
<th>Oxygen Transmission Rate (cm³·m⁻²·day⁻¹·atm⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Initial</td>
</tr>
<tr>
<td>0.01</td>
<td>After 20 Cycles</td>
</tr>
<tr>
<td>Towards O2-Side</td>
<td>+ 0.1</td>
</tr>
<tr>
<td>Towards He-List</td>
<td>+ 0.1</td>
</tr>
</tbody>
</table>

EXCEVAL™ shows outstanding performance as gas barrier layer – even after 20 torsions of the films.
**EXCEVAL™ - The solution for barrier requirements**

EXCEVAL™ is the trademark of Kuraray’s chlorine-free barrier resins, especially designed for the requirements of the barrier coating industry. The unique EVA-type cellular copolymer is water-soluble like standard polyvinyl alcohol. However, coatings made of EXCEVAL™ absorb significantly less humidity at average temperature conditions.

Therefore, EXCEVAL™ provides coatings with excellent gas barriers, e.g. towards oxygen, nitrogen and carbon dioxide - even elevated relative humidity. Furthermore, the resulting coatings are highly transparent and glossy, have a strong chemical resistance, and provide good adhesion to metal as well as excellent printability.

EXCEVAL™ enables a barrier of less than 0.01 cm³·m⁻²·day⁻¹·atm⁻¹ even at high degrees of relative humidity. EXCEVAL™ can be applied as a solvent-free, chlorine-free and environmentally friendly alternative to conventional coating on numerous substrates and provides superior barrier levels compared to traditional coatings.

Because of the need to control gas and water vapour permeation simultaneously while providing mechanical performance, the structure of a packaging film will consist of several layers, each of them contributing to one or several properties of the film construction. A base layer that may be constituted of polyolefin materials, have low water vapour permeation and also providing some mechanical resistance will be combined with an EXCEVAL™ oxygen barrier layer. In such a structure there are also further layers that provide specific functionalities like primers, adhesives, inks, etc.

**Applications devised for your product**

**EXCEVAL™ - Performance that is simply convincing**

<table>
<thead>
<tr>
<th>Oxygen Transmission Rate of EXCEVAL™ compared to standard barrier coating materials at 20 °C, cm³·20µm·m⁻²·day⁻¹·atm⁻¹</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01</td>
<td>EXCEVAL™</td>
</tr>
<tr>
<td>0.1</td>
<td>EXCEL™</td>
</tr>
<tr>
<td>1.0</td>
<td>EVOH 27 %</td>
</tr>
<tr>
<td>10.0</td>
<td>PVDC</td>
</tr>
<tr>
<td>100</td>
<td>PAN</td>
</tr>
</tbody>
</table>

**The Oxygen Transmission Rate of a PE film coated with EXCEVAL™ and metallised is analysed at 23 °C, 65 % RH, in 100 S Oxygen atmosphere:**

<table>
<thead>
<tr>
<th>Oxygen-Transmission Rate of EVA coating after 20 Cycles</th>
<th>Initial</th>
<th>After 20 Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Towards O-Side</td>
<td>&lt; 0.1</td>
<td>&lt; 0.1</td>
</tr>
<tr>
<td>Towards In-Side</td>
<td>&lt; 0.1</td>
<td>&lt; 0.1</td>
</tr>
</tbody>
</table>

EXCEVAL™ shows outstanding performance as gas barrier layer - even after 20 torsions of the film.

Storage of EXCEVAL™ solutions!
- Upon storage at low temperature an EXCEVAL™ solution may gel. Storage at elevated temperature as well as addition of lipophilic additives will reduce the gel tendency.

**How can I improve the barrier properties?**
- Cryomilling will improve the water resistance. Therefore, the coating process will reduce the barrier performance. A metal binding complex is preferred in order to combine good water resistance while maintaining the excellent barrier level.
- Can I print on EXCEVAL™?
- Yes, it has a very good affinity to form a film.

**How much material is required to achieve a high gas barrier level?**
- A dry weight of 1-2µm is enough to achieve a high gas barrier level (permeation less than 0.01 cm³·day⁻¹·atm⁻¹).

**How do I improve the barrier performance?**
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**EXCEVAL™ frequently asked questions**

<table>
<thead>
<tr>
<th>How to dissolve EXCEVAL™?</th>
<th>EXCEVAL™ should be dispersed in cold water and then be heated to 95 °C shown temperature and kept there for 2 hours. The solution should be cooled down slowly to ambient temperature.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage of EXCEVAL™ solutions!</td>
<td>Upon storage at low temperature an EXCEVAL™ solution may gel. Storage at elevated temperature as well as addition of lipophilic additives will reduce the gel tendency.</td>
</tr>
<tr>
<td><strong>How can I increase the coat weight?</strong></td>
<td>Increasing the coating weight will reduce the viscosity. Depending on the coating temperature the total solid content can be increased by increasing the solid content the drying time can be reduced.</td>
</tr>
<tr>
<td><strong>Can I prepare?</strong></td>
<td>Yes, it has a very good affinity to form a film.</td>
</tr>
<tr>
<td><strong>Does torsion affect barrier performance?</strong></td>
<td>To accelerate the dissolution of the polyvinyl alcohol film, the barrier properties are evaluated before and after mechanical torsion (Gelbo-Flex test). Even after 20 torsions EXCEVAL™ barriers demonstrate outstanding performance.</td>
</tr>
</tbody>
</table>

**Oxygen Transmission Rate of EXCEVAL™ compared to standard polyvinyl alcohol at 20 °C, cm³·4µm·m⁻¹·day⁻¹·atm⁻¹**

<table>
<thead>
<tr>
<th>Relative Humidity (%)</th>
<th>PVA</th>
<th>EXCEL™</th>
<th>EXCEVAL™</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>1</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>100</td>
<td>1000</td>
</tr>
<tr>
<td>10</td>
<td>100</td>
<td>1000</td>
<td>10000</td>
</tr>
<tr>
<td>100</td>
<td>1000</td>
<td>10000</td>
<td>100000</td>
</tr>
</tbody>
</table>

**Viscosity of low viscous EXCEVAL™ grades Viscosity (cP) concentration (%)**

<table>
<thead>
<tr>
<th>Relative Humidity (%)</th>
<th>IPA</th>
<th>Water</th>
<th>IPA</th>
<th>Water</th>
<th>IPA</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.001</td>
<td>0.01</td>
<td>0.001</td>
<td>0.01</td>
<td>0.001</td>
<td>0.01</td>
</tr>
<tr>
<td>1</td>
<td>0.01</td>
<td>1</td>
<td>0.01</td>
<td>1</td>
<td>0.01</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>10</td>
<td>0.1</td>
<td>1</td>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>100</td>
<td>10</td>
<td>100</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

**How can I print on EXCEVAL™?**
- Yes, it has a very good affinity to form a film.
EXCEVAL™ is the trademark of Kuraray’s chlorine-free barrier resins, especially designed for the requirements of the barrier coatings industry. The new Ethylene-Modified copolymer is water-soluble like standard polyvinyl alcohol coatings, thereby avoiding the usualuries of these coatings. The new Ethylene-Modified chlorine-free barrier resin, especially designed for your product, absorbs significantly less humidity as well as excellent printability.

EXCEVAL™ enables a barrier of less than 1 cm³·m²·day·atm (very high oxygen barrier layer). In such a combination of polyolefin materials, have low water vapour permeation simultaneously while providing mechanical performance, the structure of a packaging film will consist of several layers, each of them contributing to one or several properties of the film construction. A base layer that may be constitued of polyethylene materials, has low water vapour permeation and also providing some mechanical resistance will be combined with an EXCEVAL™ oxygen barrier layer. In such a structure there are also further layers that provide specific functionalities like primers, adhesives, inks, etc.

EXCEVAL™ enables a barrier of less than 1 cm³·m²·day·atm (very high oxygen barrier layer) even at high degrees of relative humidity. EXCEVAL™ can be applied as a solvent-free, chlorine-free and environmental-friendly waterborne coating on numerous substrates and provides superior barrier level compared to traditional coatings. Because of the need to control gas and water vapour permeation simultaneously while providing mechanical performance, the structure of a packaging film will consist of several layers, each of them contributing to one or several properties of the film construction. A base layer that may be constituted of polyethylene materials, has low water vapour permeation and also providing some mechanical resistance will be combined with an EXCEVAL™ oxygen barrier layer. In such a structure there are also further layers that provide specific functionalities like primers, adhesives, inks, etc.

EXCEVAL™ is the solution for barrier requirements

Applications devised for your product

Applications devised for your product

EXCEVAL™ - Performance that is simply convincing

EXCEVAL™ - Frequently asked questions

How can I increase the coat weight?

Increasing the coating weight will reduce the viscosity. Depending on the coating temperature the total solid content can be increased by increasing the solid content of the drying process, the barrier properties will improve. To estimate the flexibility of the packaging film, the barrier properties are evaluated before and after mechanical torsion testing. The crosslinking ratio and the solid content of the coating determine the mechanical properties. The crosslinking ratio and the solid content of the coating determine the mechanical properties. The crosslinking ratio and the solid content of the coating determine the mechanical properties. The crosslinking ratio and the solid content of the coating determine the mechanical properties.

How to improve the water resistance?

Crystallisation is the driving force behind the barrier performance of EXCEVAL™. Any temperature treatment will improve the barrier performance. Storage of the coated film at elevated temperatures (50°C for several days) will allow the improvement of the gas barrier level.

How to improve the water resistance?

Crystallisation is the driving force behind the barrier performance of EXCEVAL™. Any temperature treatment will improve the barrier performance. Storage of the coated film at elevated temperatures (50°C for several days) will allow the improvement of the gas barrier level.

How can I print on EXCEVAL™?

Yes, it has a very good affinity towards gravure rolls. IPA will also significantly improve the wetting of the substrate. Furthermore, reducing the viscosity of the EXCEVAL™ solution contributes to a reduction of the foam formation on the gravure rolls. What total solid content can I prepare?

 Symfony is a 30-10% solution should be made. At what temperature do I need to dry?

No specific temperature is needed as EXCEVAL™ solutions are forming a film upon drying. In contrast, PVDC needs elevated temperatures to enable particle coagulation to form a film.

Oxygen Transmission Rate of EXCEVAL™ compared to standard barrier coating materials at 20 °C, (cm³·2µm·m²·day·atm)

EXCEVAL™ shows outstanding performance as gas barrier layer - even after 25 torsions of the film.

How do I improve the barrier properties?

Crystallisation is the driving force behind the barrier performance of EXCEVAL™. Any temperature treatment will improve the barrier performance. Storage of the coated film at elevated temperatures (50°C for several days) will allow the improvement of the gas barrier level.

Oxygen Transmission Rate of EXCEVAL™ compared to standard polyvinyl alcohol at 20 °C, (cm³·4µm·day·atm)

Storage of EXCEVAL™ solutions! Upon storage at low temperature as EXCEVAL™ solutions may gel. Storage at elevated temperature as well as addition of lipophilic alkyl alcohols will reduce the gel tendency.

Oxygen Transmission Rate of EXCEVAL™ compared to standard barrier coating materials at 20 °C

EXCEVAL™ should be dispensed in cold water and then be heated to 95°C show temperature and kept there for 2 hours. The solution should be cooled down slowly.

How do I dissolve EXCEVAL™?

How can I print on EXCEVAL™?

http://www.KURARAY-POVAL.com

www.KURARAY-POVAL.com

EXCEVAL™ Performance that is simply convincing

EXCEVAL™ Frequently asked questions

EXCEVAL™ - frequently asked questions

How几个月 is required to achieve a high gas barrier level?

A dry weight of 1-2µm is enough to achieve a high gas barrier level (permeation less than 1 cm³·day·atm). How much material is required to achieve a high gas barrier level?

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Adding value to your products – worldwide

Metalised film applications

Packaging films preserve a wide range of various foods. Typically, 2-layer constructions of PE, PP, PET and PB are used in the food industry, e.g. for milk cartons, bread, frozen meat products, rice and cereal products. Most of these materials are supplied as finished films with lamination or coating. A thin layer of EXCEVAL™ of less than a few µm is coated directly with or without primer on these different substrates. In order to protect EXCEVAL™ from humidity, EXCEVAL™ can be top-coated or laminated with substrates that have low water vapour permeation. PB is mainly used as a lamination layer in this construction. Other typical applications of transparent barrier films are, for example, lids to closed food traps.

Metalled film such as PET, PB-coated PET and low high-barrier metalised BOPP are used in a wide variety of food packaging applications where high barrier performance against gases and moisture is required. For example, in crisp packaging (BOPP) or coffee packaging. In addition, vacuum-metalized papers are employed for cigars packaging, packaging for pharma-ceutical products, dairy products, confectionery and gift wrapping, wet glue label and outer liner for carton.

EXCEVAL™, DIAMONDEX™ and PRIMEMET™ are the trademarks for polyvinyl alcohol made by Kuraray. Their key characteristics – outstanding film forming properties and high binding strength – add real value to your products. Our polymers are water-soluble, highly reactive, crosslinkable and foamy. They have high pigment binding capacity, protective colloid characteristics and thickening effects. The physical and chemical properties of KURARAY POVAL™ make it ideal for a wide variety of applications, ranging from adhe-sives through paper and ceramics to packaging.
Adding value to your products - worldwide

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Kuraray — Here to Innovate.

Metallised film applications

Metalised film such as PET, SB-coated PET and low high-barrier metallised BOPP are used in a wide variety of food packaging applications where transparency and barrier appearance is required, for example, in crisp packaging or coffee packaging. In addition, vacuum-metallized papers are employed to retain the elegance, packaging for pharmaceutical products, dairy products, confectionery and gift wrapping, wet glue label and outer liner for cartons.

Pinholes in a metallized substrate are the main pathway for permeation. Pinholes account for the majority of the oxygen permeation but only for about 20% of the water vapour permeation. Most of the water vapour permeation through a metallised layer is due to nanoscale defects on the surface.

The main way to improve the gas barrier properties of such a construction is to perform the metallisation on top of a polymeric gas barrier layer like EXCEVAL™. While EXCEVAL™ in loose powder form will be filled with this polymeric gas barrier substrate and consequently the overall gas barrier performance of the metallisation increases significantly. Furthermore, the use of EXCEVAL™ as a polymeric gas barrier layer will avoid the necessity of performing a second metallisation process that contributes significantly to the deterioration of the flexibility of the packaging film. Many of our products are food contact approved and thus suitable for food applications. Ecologically, Kuraray POVAL™ is advantageous due to its biodegradability and the fact that combustion does not generate residues. It is available in various particle sizes — from granules to powders. Kuraray produces its wide range of metallised BOPP grades in Japan, Singapore, Germany and the USA. Kuraray’s global production and service network make us your partner of choice for innovative high-quality PVOH resins.

Keeping it crisp and aromatic: EXCEVAL™ coatings provide excellent protection for fresh food.