



Akulon®

# Fresh Solutions

Akulon® The Polyamide 6 for Packaging Applications



# Fresh Solutions with Akulon® Polyamide 6

Polyamide 6 is one of the most versatile materials for food packaging applications. The semi crystalline structure of polyamides results in an excellent combination of properties, particularly a strong barrier to oxygen and aromas, as well as exceptional mechanical strength and durability. Akulon PA6 is an excellent barrier material significantly extending the shelf life of packaged food.

## DSM Engineering Plastics: More than just a Material Supplier

DSM Engineering Plastics is one of the leading global suppliers of Polyamide 6 resins for the film market, with manufacturing facilities worldwide to ensure fast supply and local customer support. DSM is a market leader for several reasons:

**Quality Assurance:** state-of-the-art manufacturing plants produce polymer of the highest consistency with respect to viscosity, low gel count, low monomer content and low moisture content. This polymer consistency ensures trouble-free production in flexible (multilayer) barrier films.

**Research & Development:** continuous investment in product development & innovation.

**Customer Support:** direct support to customers on material, application and processing optimization.

**Raw Material Position:** an integrated and global position in the key raw material, caprolactam.

**Yparex Adhesive Resins:** offering a high performance portfolio of Yparex adhesive resins used together with Akulon PA6 in multilayer structures.

### DSM Eco Responsibility

DSM is a leader in the Dow Jones Sustainability Index, tracking the performance of leading sustainability driven companies worldwide. DSM Engineering Plastics is continuously searching for sustainable solutions and products that meet a durable vision of people, planet, and profit, both within short term and longer term initiatives. DSM is actively elaborating on next generation raw material sources and is already today, enabling material reduction via improved mechanical and barrier properties.

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Akulon® PA6 is an excellent barrier material significantly extending the shelf life of packaged food.



## Akulon® Product Range for Barrier and Specialty Packaging Concepts

With its comprehensive portfolio of Akulon polyamide products, DSM Engineering Plastics is a specialist in materials for barrier and specialty films for the packaging industry.

The Akulon product line consists of:

### **Akulon PA6: high consistency for optimum process performance**

Akulon PA6 offers the right balance of oxygen barrier, excellent processability and mechanical properties, protecting both fresh and processed foods from spoilage, aging and discoloration. Akulon PA6 polymer delivers highest possible consistency with respect to viscosity, low gel count and

moisture content, both within and between batches.

### **Akulon XP: maximum productivity of multilayer and extrusion coating lines**

Akulon XP enables producers to achieve substantial gains in line efficiency, which translates directly into higher productivity and lower costs in co-extrusion processes.

### **Akulon PA66: good mechanical strength at high temperatures in blown film**

With its exceptional viscosity and stability, Akulon PA66 can be used wherever packaging is subject to high mechanical and thermal loads.



Thanks to its high purity, low gel count & high consistency Akulon is meeting the demanding requirements of all major film production processes.

## Akulon® PA6 in Packaging Concepts

The Akulon product portfolio comprises multiple grades that are tailored for cast film, blown film, extrusion coating and BOPA.

**The Cast film** process gives the opportunity to control the crystallization of the polyamide. For that reason cast film is very often used for thermoforming applications when a low chill roll temperature is used; the dimensional stability can be accurately tuned by adjustment of the chill roll temperature.

**Blown film** is suitable for the production of barrier films used for pouches and top films, and also for thermoforming.

**Extrusion coating:** is used for the production of coated boards for liquid packaging, highly demanding in processing with respect to web stability and neck-in.

**Biaxially oriented polyamide (BOPA)** is widely used and can be produced by the cast tenter frame film process or double bubble blown film processes. BOPA films have enhanced barrier properties and higher stiffness than non-oriented PA6. They are used in laminated multilayer structures, e.g. for lidding films.

Thanks to its high purity, low gel count and high consistency Akulon is meeting the demanding requirements of all these film production processes.

Akulon XP and special grades that extend production times due to low die pollution, are delivering additional performance in production.



## Outstanding Barrier Properties and Ease of Processing

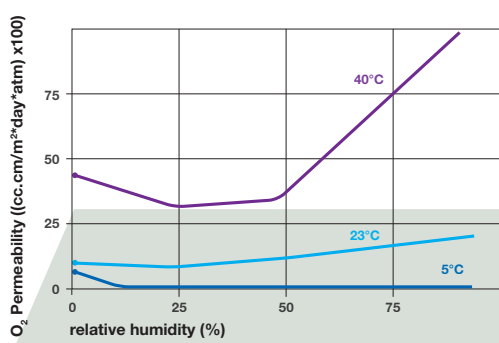
Akulon PA6 is a semi crystalline polymer. Crystallization level largely determines the physical properties of the PA film. The high mechanical strength of Akulon is the key to numerous successful film applications. The material composition and processing of Akulon resin determine the morphology of the film and its application. High crystallinity implies high barrier, stiffness and tensile strength; lower crystallinity leads to flexibility.

Film morphology or crystallinity is influenced by:

- Processing parameters such as chill roll temperature, cooling efficiency (internal bubble cooling, water cooling) and film thickness.
- Additives including nucleating agents such as microtalcum.

Fast cooling or quenching produces a film with a low crystallinity and makes it very suitable for thermoforming. However, crystallization during thermoforming provides good barrier properties. Slower cooling results in a film that has a higher crystallinity and better dimensional stability but is less suitable for thermoforming. With an outstanding product quality Akulon is able to deliver consistent performance under any of these conditions.

Because of their polar character, polyamides interact with moisture. In the dry state, polyamide films are relatively stiff and have excellent oxygen barrier properties. If exposed to humidity, the films absorb moisture, increasing their flexibility and oxygen permeation. When more moisture is absorbed, the glass transition temperature drops below the ambient temperature resulting in increased intermolecular mobility; in this state post crystallization may take place.



◀ This graph shows how the oxygen permeability of Akulon® PA6 increases with temperature and relative humidity.

### Comparison of barrier properties

Permeant	Unit	PA6	LDPE	HDPE
oxygen (dry)	cm <sup>3</sup> *mm/m <sup>2</sup> *day*atm	1.1-1.3	80-180	40-80
oxygen, 85% RH	cm <sup>3</sup> *mm/m <sup>2</sup> *day*atm	1.6-1.8	80-180	40-80
water vapour	gr*mm/m <sup>2</sup> *day	1.5-1.7	0.4-0.6	0.1-0.2

With an outstanding product quality Akulon is able to deliver consistent performance.



Nucleated Akulon® PA6 film (right) shows finer, denser crystalline structure compared to un-nucleated (left).

### Akulon PA6 Coding

The Akulon polyamide 6 coding system, based on oligomer content, relative solution viscosity and additives is described below:

#### Akulon F136-E2

**Akulon** = PA6 or PA66  
**F** = film quality  
**1** = low oligomer content  
**36** = RSV (Relative Solution Viscosity)  
**additives**  
**C** = lubricant  
**E** = lubricant + nucleant

## Dedicated to Innovation: Next Generation Packaging Solutions that create added value

DSM Engineering Plastics is dedicated to deliver innovations that add value to our customers' applications: through demonstrable gains in productivity, process performance and end-product quality. Innovation programs are linking the needs of the entire packaging value chain to our

capabilities (from brand owner to packer to converter to film producer to raw material supplier). As DSM is active in Life Sciences and Material Sciences, Innovation programs are making use of the broad DSM knowledge and are helping our customers to deliver the next generation of food packaging.



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## Wide Range of DSM Products for Packaging Application

Specialty products from DSM Engineering Plastics add value in a wide range of packaging applications. From barrier to breathability, from performance to productivity, we offer the film industry a range of Living Solutions:

### **Arnitel® VT**

Arnitel VT (TPC) for breathable, monolithic film. This tough copolyester offers superior water vapour permeability - eliminating the need for perforations or micro pores. The material has outstanding mechanical properties and offers ease of processing for a range of applications including building and construction membranes, consumer goods like outdoor wear as well as medical gowns.

### **Yparex®**

Yparex extrudable maleic anhydride modified polyolefin. This material can be used as adhesive resin in co-extrusion applications. Yparex acts as a high-performance tie layer in multilayer barrier films for food packaging applications, ensuring optimal adhesion and processing characteristics.



## Contact

At DSM Engineering Plastics, our customers are key. Focusing on the advantages for the end user is essential. If the end user is satisfied, so are our customers. And so are we. We do not settle for ordinary solutions. Instead, we strive to find Living Solutions, working together with customers in a dedicated, resourceful and reliable way.

**Stanyl®**  
**Arnitel®**  
**Akulon®**  
**Arnite®**  
**Xantar®**  
**Xparex®**

If you share our values and are looking for your own Living Solutions, please get in touch.

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