Additive Solutions from: Arkema Technical Polymers

By

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Arkema Introduction
Pebax Antistatic Product range
Pebax for Active Molecule Carrier
Kynar for Polymer Processing Aid
Functional Polyolefins for Compounds and MB
Thanks
The new Arkema: a global producer of specialty chemicals

- Sales of €7.5 bn*
- 19,000 Employees
- 137 Industrial plants
- 13 R&D centers

2014 sales by segment*

- Acrytics / Coating Solutions: 26%
- High Performance Materials: 44%
- Specialty polyamides: 30%

*2014 proforma sales
Arkema with only 3 other French industrial group ranked in the Top 100 Global Innovators for the 4th consecutive year, 200 patents filed on average every year.
# Pebax® Antistatic Product Range

**11 Grades Available**
- A wide set of technical solutions
- Different levels of performance
- A large range of processing temperatures
- Compatibility with numerous matrices: HDPE, LDPE, LLDPE, PP, ABS, PS, PC blends, PMMA, etc.

<table>
<thead>
<tr>
<th>MV Series</th>
<th>MH Series</th>
<th>MF Series</th>
<th>Bio-based Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV 1074 SA 01</td>
<td>MH 1657</td>
<td>MF 5010</td>
<td>30 R 51 SA 01</td>
</tr>
<tr>
<td>MV 1074 SP 01</td>
<td>MH 2030</td>
<td>MF 5020</td>
<td></td>
</tr>
<tr>
<td>MV 1074 SA 01 MED</td>
<td></td>
<td>MF 5030</td>
<td></td>
</tr>
<tr>
<td>MV 2080</td>
<td></td>
<td>MF 5040</td>
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</tr>
</tbody>
</table>

- Food contact approval
- USP Class VI approval
- UV stabilization
Range mapping

Volume Resistivity (Ohm.cm) versus Processing (extrusion + injection) temperatures (°C)

- MV 1074 / 30 R 51
- MH 1657
- MF 5070 / MF 5080
- MF 5030
- MF 5040
- MV 2080
- MF 5010 / MF 5020
- MH 2030

Inherent volume resistivity (Ohm.cm)
# Overview of the Pebax® antistatic range

<table>
<thead>
<tr>
<th>Matrices Grades</th>
<th>PE</th>
<th>PP</th>
<th>ABS, PS, HIPS</th>
<th>PC blends, PBT</th>
<th>PMMA</th>
<th>PA</th>
<th>POM</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV 1074</td>
<td>Injection molding (+) 10 – 20%</td>
<td>Injection molding (+) 10 – 20%</td>
<td></td>
<td></td>
<td>Injection molding (++) 10 – 20%</td>
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<tr>
<td>MV 2080</td>
<td>Injection molding (+) 10 – 20%</td>
<td>Injection molding (+) 10 – 20%</td>
<td></td>
<td></td>
<td>Injection molding (++) 10 – 20%</td>
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</tr>
<tr>
<td>MH 1657</td>
<td>Injection molding (+) 10 – 20%</td>
<td>Injection molding (+) 10 – 20%</td>
<td>Injection molding (++) Sheet extrusion (++) 10 – 25%</td>
<td></td>
<td>Injection molding (++) 10 – 20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MH 2030</td>
<td>Injection molding (+) 10 – 20%</td>
<td>Injection molding (+) 10 – 20%</td>
<td>Injection molding (++) Sheet extrusion (++) 10 – 25%</td>
<td></td>
<td>Injection molding (++) 10 – 20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 R 51</td>
<td>Injection molding (++) Sheet extrusion (++) 10 – 20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Injection molding (++) 7 – 20%</td>
<td></td>
</tr>
<tr>
<td>MF 5010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Injection molding (++) 7 – 20%</td>
<td></td>
<td>Injection molding (++) 8 – 20% Sheet extrusion (++) 15 – 30%</td>
</tr>
<tr>
<td>MF 5020</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Injection molding (++) 8 – 20% Sheet extrusion (++) 15 – 30%</td>
</tr>
<tr>
<td>MF 5030</td>
<td>Injection molding (+++) 7 – 20%</td>
<td>Injection molding (+++) 15 – 30%</td>
<td>Injection molding (+) 10 – 20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MF 5040</td>
<td>Blow molding (+++) 25 – 35%</td>
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</tbody>
</table>
**Processing recommendations**

- **Pebax® antistatic grades** are **hygroscopic polymers** i.e. they easily absorb moisture
  - Many times processing issues are due to high moisture level

- **To ensure trouble free processing we recommend drying**
  - MV series and 30R51 SA 01: dry air dryers 65-75°C, 4-6 hours
  - MH series: dry air dryers 70-90°C, 5-7 hours
  - MF series (MF 5010, MF 5030, MF 5070 and MF 5080): dry air dryers 70-90°C, 4-6 hours
  - MF series (MF 5020 and MF 5040): dry air dryers 80°C, 2-4 hours

- **Standard loading for Pebax® antistatic grades:**
  - Injection molding: loading **5-15%**
    - lower because Pebax® antistatic grades tend to concentrate at the surface during injection
  - Extrusion: loading **20-35%**
    - Because of stable and uniform flow characteristics
  - For optimal ratio cost / performance we recommend to use Pebax® antistatic grades in the surface layer(s) of multilayer film
    - Monolayer extrusion when volume resistivity needed

- **All Pebax® antistatic grades** can be either used in **dry-blend or in compounds**
  - No effect on electrical properties, e.g. 20% of MF 5030 in PE (injection)
    - Dry blend: Surface resistance: $2.10^8$ Ohm
    - Compound: Surface resistance: $1.10^8$ Ohm
Host polymer selection

Generally, host polymer is chosen by customer
- We suggest the most adapted Pebax® antistatic grades

But in some cases, we can advise to change the host polymer if:
- It has a too high MFI compared to Pebax® antistatic grades
- Issue of compatibility or bad SR performance is expected
- Sealability is a key requirement (film application)

Examples
- Film extrusion with LDPE, that has to be sealed
  - Issue: Lack of adhesion between LDPE and Pebax® MF 5080, thus bad sealing
  - Solution: Do a multi-layer structure with LLDPE (MFI 1) for inner layer to get good seal. LLDPE has a better compatibility with Pebax® than LDPE
- Molded parts in PP-H (MFI 50), with Pebax® MF 5030
  - Issue: MFI is too high compared to MF 5030, prefer lower MFI for host polymer to increase SR performance
  - Besides Homo-PP is not giving the best compatibility with MF 5030.
  - Solution: Change to CO-PP (MFI 15)
Choice of Pebax® antistatic grades

What are the most adapted Pebax® antistatic grades for the following matrices?

● 1. Polyolefins
  – PE, PP,
  – Injection molding, Film and sheet extrusion, Blow molding extrusion

● 2. Styrenics
  – ABS, PS
  – Injection molding, Sheet extrusion

● 3. Polyamides
  – Polyamides 6, 11, 12
  – Injection molding

● 4. Specific matrices
  – PC blends, PBT, PMMA, POM, etc.
  – Injection molding, Sheet extrusion
Pebax for Active Molecule Carrier

Active Molecules Carrier
The Pebax® MP1717 structure consists of regular linear chains of rigid polyamide and soft polyether segments. This unique chemical structure allows for, through the polyether phase, the absorption and controlled release of volatile molecules (fragrances, oils, insecticides...)

Advantages of using Pebax® MX 1717

<table>
<thead>
<tr>
<th>KEY PROPERTY</th>
<th>Pebax® SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>High level of initial absorption of volatile substances</td>
<td>Pebax® MX 1717</td>
</tr>
<tr>
<td>Uniform release over time</td>
<td>Pebax® MX 1717</td>
</tr>
<tr>
<td>Long lasting affect</td>
<td>Pebax® MX 1717</td>
</tr>
<tr>
<td>Consistency of the substances released</td>
<td>Pebax® MX 1717</td>
</tr>
<tr>
<td>Ease of the processability and recycling</td>
<td>Pebax® MX 1717</td>
</tr>
</tbody>
</table>
**Pebax for Active Molecule Carrier**

**PEBAX® MX 1717: EXCELLENT ABSORPTION, OPTIMUM DIFFUSION**

As depicted in the graph below for the case of lavender perfumes, Pebax® MX1717 exhibits a high level of initial absorption (up to 50%) and a uniform and long lasting release of the fragrance compared to other supports.
Kynar for Polymer Processing Aids

Kynar Flex® PVDF

PPA – Polymer Processing Aid
**EASE OF PROCESSABILITY AND RECYCLING**

Pebax® MX1717 pellets can be impregnated before transformation through dry-blending with the volatile substances.

- The low melting point (135°C) of Pebax® MX1717 allows for injection molding or extrusion of the polymer without the degradation of these volatile substances.
- Standard conditions of processing and coloration can be applied. To avoid modification of the volatile substances, lower processing temperatures are recommended.

**APPLICATIONS**

Pebax® MX1717 can be used as a support for oils, perfumes, insecticides, and pheromones (air fresheners, insect repellent devices, etc.).
Elimination of melt fracture as a function of time

LLDPE + 300ppm of KynarFlex PPA 5300° (blown film)
DIE BUILD-UP (DIE DROOL)

Accumulation of material with time due to:
- thermal degradation of re-circulating material in the tool
- thermal degradation or stagnation of low Mw components or fillers...
- sporadic elimination of stacked part

Die build-Up

generation of surface or volume defect on the final part (black spots, "gels")
KYNAR FLEX PPA ELIMINATES
DIE BUILD-UP (DIE DROOL)

- Makes a coating on barrel & die inner surface
- Generates slipping on the tool surface which:
  - limits long residence time
  - limits thermal degradation
  - avoids accumulation of materials
  - provides an easier, continuous and smooth elimination of potential defects
Results:

+ 500ppm KynarFlex PPA

Kynar Flex PPA significantly reduces/delays die buildup
OUR RANGE OF PPA

Kynar® PPA offerings

All grades have Food Contact Approval

**Contain synergist**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>8600 / 8601</td>
<td>For melt fracture elimination</td>
</tr>
<tr>
<td>5300 / 5301</td>
<td>- based on fluoropolymer + PEG</td>
</tr>
<tr>
<td>2200 / 2201</td>
<td>- excellent efficiency in &quot;filled&quot; resins</td>
</tr>
<tr>
<td></td>
<td>- Low melt index resin (PE up to 2), high shear rate</td>
</tr>
<tr>
<td></td>
<td>- Higher melt index resin, low shear rate, DBU reduction</td>
</tr>
</tbody>
</table>

**Pure Fluoropolymers**

- no synergist, no minerals
- superior thermal stability

<table>
<thead>
<tr>
<th>Grade</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>3120-50 / 3121-50</td>
<td>- Low melt index resin, surface appearance, pressure reduction</td>
</tr>
<tr>
<td>2800-20 / 2821</td>
<td>- DBU reduction and surface appearance</td>
</tr>
<tr>
<td>2500-20 / 2501-20</td>
<td>- Low temperature processing</td>
</tr>
<tr>
<td>705*</td>
<td>- DBU reduction</td>
</tr>
</tbody>
</table>

(*) Food contact approval in progress

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<table>
<thead>
<tr>
<th>Grade</th>
<th>Melt viscosity 230°C / 100 s⁻¹</th>
<th>Melt point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K3121-50</td>
<td>23 kP</td>
<td>186 °C</td>
</tr>
<tr>
<td>K2821*</td>
<td>15 kP</td>
<td>142 °C</td>
</tr>
<tr>
<td>K2500-20</td>
<td>15 kP</td>
<td>121 °C</td>
</tr>
<tr>
<td>K705</td>
<td>3 kP</td>
<td>172 °C</td>
</tr>
</tbody>
</table>
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Summary

- **Kynar Flex® PPA** allows a wider operating window of process parameters by delaying occurrence of melt fracture.

- **Designed to eliminate surface defects, delay onset of die build-up & increase output**
  - especially for LLDPE, mPE and PP film extrusion
  - useful with metallocene based resins
  - also for blow molding and tube extrusion of polyolefins
  - can work in other thermoplastic polymers
Arkema Functional Polyolefins
For Polymer Compounds And Masterbatches
**Universal carrier masterbatch**

- High filler acceptance (Lotryl polarity)
- Outstanding additive dispersion
  - Example nanoclays dispersion
    - Poor dispersion in PE Clays not dispersed
    - Good dispersion in Lotryl/Lotryl T
  - 50% NC

- Typical recommended grades:
  - Lotryl® 24MA02 and Lotryl® T24MA02...
  - Evatane®: High fluidity grade 20-20, 42-60...

- Outstanding processibility
  - High output

- Excellent thermal stability:
  - Lotryl masterbatch: can be used in high temperatures resins (PA, PET, PBT, PPS)
  - Compatible with high temperature processes (extrusion coating&lamination)

- Lotryl T: Ideal for applications where pigment dispersion must be improved
**Orevac® CA100: PP coupling agent**

**Improved the mechanical properties and processibility of filled compounds.**

- Fiber glass reinforced PP compounds
- Mineral-filled PP compounds
- PP compounds with natural fibers

**Typical loading: 1 – 4% of modifier**

**Benefits**

- Excellent adhesion between PP and polar substrates
- Reactive towards Glass, Metals, Minerals, Natural fillers or fibers
- Better matrix / filler interactions
- Improved mechanical properties (tensile properties, impact resistance)
PA impact modifications

Lotader® 4700
- Supertough PA6 and PA66 above -10° C
- Lotader® 4700 = universal modifier for PA
- Typical loading = 2-20% of modifier

Orevac® IM300
- High resilience at 23° C in PA6 and PA6,6 (> 90 kJ/m²)
- High fluidity
- Typical loading = 15 – 20%

Orevac® IM800
- Recommended for performance at very low T
- Very low ductile/brittle transition (at around -25° C)
- High level of impact resistance at room temperature
  - > 80 kJ/m² in PA6
  - > 100 kJ/m² in PA6,6
- High level of impact resistance at -40° C
  - > 18 kJ/m² in PA6
  - > 25 kJ/m² in PA6,6
- Typical loading = 15 -25% of modifier
PBT and PET impact modifications

- Used to improve impact resistance of PBT and PET

- Formulation recommendations
  - PBT or PBT + glass fiber:
    - Lotader AX8900 + Lotryl 35BA40: cost competitive + high fluidity
    - Lotader AX8930: less reactive, less viscous compounds
    - Lotader AX8700/AX8750 + Lotryl 35BA40
  - High fluidity needed for good injection molding
  - Combination of Lotader® and Lotryl® allows adjustments in terms of:
    - Fluidity
    - Cost (Lotryl cheaper than Lotader)

- PET modification
  - Lotader AX8900/8700 + Lotryl 24MA02/29MA03/35BA40
  - Lotader® AX/Lotryl® ratio (1:6)
  - Lotryl 35BA40: higher fluidity and better performance at low T
Impact modification of PPS

- **Used to improve impact resistance of PPS**

- **PPS is a material with very good properties**
  - Very stiff
  - High heat resistance
  - Good chemical resistance (fuels, etc.)

- **Lotader® AX8820/ AX8840 / AX8900 / AX8700 for modification of PPS**
  - Add flexibility to PPS when needed
  - Processing temperatures (up to 300°C) without degradation
  - Lotader® AX8900 or AX8700 softer than Lotader® AX8840 or AX8820
  - Thanks to its lower reactivity, Lotader® AX8820/AX8930 can be used for PPS modification in injection molding applications
  - **Typical loading: 10 to 15% of modifier**
PC modification

Lotryl® T for PC modification

- Add flexibility to PC when needed
- Improve pigment dispersion
- Reduce the brightness, decrease the gloss appearance
- Processing temperatures (up to 300°C) without degradation
- Lotryl® 24MA02T or 29MA03T
- Typical loading: 2 to 5% of modifier
Lotader® AX8840 / AX8700 / AX8900

- Compatibilization for polymer blends
- Improvement of mechanical properties  

<table>
<thead>
<tr>
<th>Starting formulation</th>
<th>Multipurpose toughness Starting formulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET/PE</td>
<td>1/5 of minor component Lotader AX8840 / AX8900 / AX8700</td>
</tr>
<tr>
<td>PBT/PA</td>
<td>1/5 of minor component Lotader AX8900 / AX8700</td>
</tr>
<tr>
<td>PBT/PP</td>
<td>1/5 of minor component Lotader AX8900 / AX8700</td>
</tr>
<tr>
<td>PA/PE</td>
<td>1/5 of minor component* Lotader 3210 / 3410 / 4210</td>
</tr>
<tr>
<td>PA/PP</td>
<td>1/5 of minor component* Orevac CA100</td>
</tr>
<tr>
<td>PLA/PE</td>
<td>5 - 10 % Lotader AX8900 / AX8700</td>
</tr>
<tr>
<td>PC/ABS alloys</td>
<td>5% Lotryl T 29MA03T or Lotader AX8900/AX8700</td>
</tr>
<tr>
<td>PC/PBT alloys</td>
<td>Lotader AX8900 +Lotryl T 35BA40T / 29MA03T or Lotader AX8900 / AX8700</td>
</tr>
</tbody>
</table>

Synergic effect
Wire & Cable – Coupling agent for HFFR Sheathing

- **Cable regulation requires Halogen Free Flame Retardant (HFFR) sheathing.**
  - Formulations: based on polyolefin (PE, EVA, Lotryl) components compounded with high rate of flame retardant filler.
  - No halogen / Zero-halogen

- **Evatane® or Lotryl® (20-40%) matrix**
  - Mechanical properties;
  - Flexibility

- **Orevac® /Lotader® coupling agents (4-5%)**
  - Improve mechanical properties.
  - At interface, Matrix (PE/EVA/EMA) and Fillers

- **Recommended grades:**
  - Lotryl® 24MA005 or 30BA02
  - Evatane® 28-03
  - Orevac® 18341 / Lotader® 3210

- **Flame retardant fillers (up to 60%):**
  - Aluminum trioxide (ATH)
  - Magnesium dioxide (MDH), used for high processing temperatures (to be checked).
Rubber flow aid

Rubber compounds for the production of hardness rubber parts with high levels of fillers are really hard to process.

Lotader® 8200:
- High flow grade. MFI = 200 g/10min
- Good compatibility with elastomers (EPDM, CR, NBR, ...)
- Process aid
- Additive to disperse filler
- Hardening agent
- Typical loading: 10 – 20% of Lotader® 8200
Thank you
For More details get in touch with

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