SPORTS MARKET SOLUTIONS

STRETCH THE LIMITS™

ARKEMA INNOVATIVE CHEMISTRY
THE UNITED STATES IMPORTS 2 BILLION SHOES EACH YEAR

New materials for connected fitness (wearable devices), substantial improvements in light-weighting, and enhanced design capabilities are driving innovation in sports. Pebax® — an ingredient brand synonymous with extreme performance.

The world is becoming more extreme™.
SPORTS OVERVIEW
RECOGNIZED BY ATHLETES AROUND THE WORLD

- HAS BEEN TO THE TOP OF MT EVEREST
- HOLDS SPRINT WORLD RECORD
- SCORED 80% OF WORLD CUP GOALS

INNOVATING LIGHTWEIGHT SOLUTIONS WITH FOAM TECHNOLOGY AND CARBON FIBER FILLED GRADES

POWER BRANDS

PEBAX®

WORLD FAMOUS DURABILITY AND RESISTANCE

- #1 PVDF SINCE 1963
- WEATHER RESISTANCE
- CHEMICAL RESISTANCE

TARGETING WEARABLE TECHNOLOGY & HIGH DURABILITY

KYNAR®
TRADEMARK LICENSING PROGRAM

RECOGNIZED BY ATHLETES AROUND THE WORLD

- EXTREME ENERGY RETURN
- EXTREME LIGHTWEIGHT
-OPTIONALLY BIO-BASED

INNOVATING LIGHTWEIGHT SOLUTIONS WITH FOAM TECHNOLOGY AND CARBON FIBER FILLED GRADES
A VARIETY OF SPORTS APPLICATIONS
A VARIETY OF SPORTS APPLICATIONS

- Lightweight
- Shock resistant
- Energy return
- Tough and flexible
- Enduring elasticity

*OPTIONALLY BIO-BASED
Lightweight Sports Market Presentation

Density (g/cm³)

- Pebax® TPE
- TPU
- COPE

- Soft grades
- Rigid grades

Up to 20% savings

Thinner mold designs

Cut more cost and weight
1000g of TPU equipment ~22,500 steps ~22,500kg moved!

800g of Pebax® TPE equipment ~22,500 steps ~18,000kg moved!

~4,500kg spared!

20% lighter
HIGHER ENERGY RETURN FOR ATHLETES

Energy Loss Factor (ELF)

- ELF = 0
- ELF = 0.1 - 0.2
- ELF = 0.4 - 0.5

Theoretical

Load

Elongation

TPU (80 shore A)

Pebax® TPE (80 shore A)

Marketable benefit to consumers

Tell emotional stories

Tell emotional stories
HIGHER ENERGY RETURN FOR ATHLETES

Energy Loss Factor vs. Temperature

Sustained performance at low T

No energy compromise
ENDURING ELASTICITY

Ross Flex

Pebax® TPE

90° angle
100 cycles/min

Very strong fatigue resistance

Pebax® 5533

Ross Flex at -40°C

> 50,000 cycles

DOES NOT BREAK
TOUGHNESS AND FLEXIBILITY

Modulus of rigidity (MPa) vs. Temperature (ASTM D 1043)

- TPU
- COPE
- Pebax® TPE

-40 -20 0 20 40 60 80

Temperature °C

Sustained flexibility at low T
Avoid cold stiffening
Impact resistance
ISO 179 (V-notched Charpy impact test)

Sustained strength at low T

Avoid brittleness in the cold

Impact Strength (kJ/m²)

Temperature (°C)

TPU 64 Shore D
Pebax® 63R53

No Break
PEBAX® THERMOPLASTIC ELASTOMERS

PEBAX® resin

<table>
<thead>
<tr>
<th>PE</th>
<th>polyether</th>
<th>flexible, lower Tg</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA</td>
<td>block amide</td>
<td>rigid, higher Tg</td>
</tr>
<tr>
<td>X</td>
<td>eXtreme</td>
<td>Stretch the Limits™</td>
</tr>
</tbody>
</table>

Polyether group

Wide Range

Stretch the Limits™
A WIDE RANGE OF SOLUTIONS

<table>
<thead>
<tr>
<th>Flexibility modulus (MPa)</th>
<th>More flexible</th>
<th>More rigid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pebax® Classic</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Pebax® Rnew</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Pebax® C</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Pebax® Clear</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Rilsan® PA11</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

- **Pebax® Classic** is the least rigid option.
- **Rilsan® PA11** is the most rigid option.

Product codes:
- Pebax® Classic: 55R53, 63R53, 70R53, 80R53
- Pebax® Rnew: 40R53, 55R53, 72R53
- Pebax® C: 35R53, 63C73
- Pebax® Clear: X2102
- Rilsan® PA11: 63R53, 72R53, X2099, BZM 7, BZM 8
GLASS & CARBON FIBER FILLED GRADES

RIGIDITY OF GF & CF GRADES

- Glass Filled (GF)
- Carbon Fiber Filled (CF)

- Improved strength
- Increased rigidity
- Improved lightness
- Added strength & rigidity

Flexibility modulus (MPa)

<table>
<thead>
<tr>
<th>Material</th>
<th>Flexibility Modulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>6333</td>
<td>285</td>
</tr>
<tr>
<td>PSR5 (CF)</td>
<td>1000</td>
</tr>
<tr>
<td>BZM7 (GF)</td>
<td>1500</td>
</tr>
<tr>
<td>BZM8 (GF)</td>
<td>2200</td>
</tr>
<tr>
<td>X2083 (CF)</td>
<td>2600</td>
</tr>
<tr>
<td>BZM 30 (GF)</td>
<td>5600</td>
</tr>
<tr>
<td>BSR 30 (CF)</td>
<td>11,100</td>
</tr>
</tbody>
</table>

SPORTS MARKET PRESENTATION
DRY BLENDS PEBAX® RNEW 80R53 + PEBAX® X2083

The graph shows the relationship between the percentage of Pebax X2083 in Pebax 80R53 SP02 and various properties:

- **Flex modulus (MPa)**
- **Notched charpy impact 23°C (kJ/m²)**
- **Notched charpy impact -30°C (kJ/m²)**

The x-axis represents the percentage of Pebax X2083, ranging from 0% to 100%. The y-axis on the left shows the flex modulus (MPa) ranging from 0 to 3500, and the y-axis on the right shows the puncture energy (kJ/m²) ranging from 0 to 60.

Key data points include:
- 3% CF content: Flex modulus is approximately 1000 MPa, notched charpy impact 23°C is about 6 kJ/m², and notched charpy impact -30°C is around 15 kJ/m².
- 6% CF content: Flex modulus is around 1500 MPa, notched charpy impact 23°C is approximately 9 kJ/m², and notched charpy impact -30°C is about 12 kJ/m².
- 9% CF content: Flex modulus is approximately 2000 MPa, notched charpy impact 23°C is about 12 kJ/m², and notched charpy impact -30°C is around 15 kJ/m².
- 12% CF content: Flex modulus is around 2500 MPa, notched charpy impact 23°C is approximately 15 kJ/m², and notched charpy impact -30°C is about 20 kJ/m².
- 15% CF content: Flex modulus is around 3000 MPa, notched charpy impact 23°C is approximately 18 kJ/m², and notched charpy impact -30°C is about 25 kJ/m².
- 30% CF content: Flex modulus is around 3500 MPa, notched charpy impact 23°C is approximately 30 kJ/m², and notched charpy impact -30°C is about 30 kJ/m².

The graph suggests that as the percentage of Pebax X2083 increases, the flex modulus and puncture energy also increase, while the notched charpy impact at both temperatures decreases.
## PEBAX® X2083 - CF MASTERBATCH GRADE

**MASTERBATCH**

- **PEBAX® elastomer** + **30% CF**

Blend with other PEBAX® grades to create a tailored CF% compound

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon fiber - average content</td>
<td>30%</td>
</tr>
<tr>
<td>Density</td>
<td>1.17</td>
</tr>
<tr>
<td>Flexural Modulus*</td>
<td>2.6 GPa</td>
</tr>
<tr>
<td>Charpy V-notched impact (23°C)*</td>
<td>48 kJ/m²</td>
</tr>
<tr>
<td>Charpy V-notched impact (-30°C)*</td>
<td>45 kJ/m²</td>
</tr>
</tbody>
</table>
**HIGHER RIGIDITY, IMPROVED IMPACT STRENGTH**

<table>
<thead>
<tr>
<th>Cond = 15j, 50% RH, 23°C</th>
<th>CF / GF</th>
<th>Density (g/cm³)</th>
<th>ShoreD ISO868</th>
<th>Flex modulus ISO178</th>
<th>Tensile</th>
<th>Charpy impact</th>
<th>Fatigue bending (-10degC, 60deg bend angle)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Content (%)</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80:20 blend vs BZM8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same rigidity, lower density, improved impact strength.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>80R53+X2083 (80:20)</th>
<th>80R53+X2083 (60:40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BZM7</td>
<td>BZM8</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Density (g/cm³)</strong></td>
<td>1.07</td>
</tr>
<tr>
<td><strong>ShoreD ISO868</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Flex modulus ISO178 (MPa)</strong></td>
<td>1500</td>
</tr>
<tr>
<td><strong>Tensile</strong></td>
<td></td>
</tr>
<tr>
<td>Modulus (MPa)</td>
<td></td>
</tr>
<tr>
<td>Stress @yield (MPa)</td>
<td>48</td>
</tr>
<tr>
<td>Strain @yield (%)</td>
<td>7</td>
</tr>
<tr>
<td>Stress @break (MPa)</td>
<td>31</td>
</tr>
<tr>
<td>Strain @break (%)</td>
<td>&gt;100</td>
</tr>
<tr>
<td><strong>Charpy impact</strong></td>
<td></td>
</tr>
<tr>
<td>Notch, 23degC (kJ/m2)</td>
<td>22</td>
</tr>
<tr>
<td>Unnotched, 23degC (kJ/m2)</td>
<td></td>
</tr>
<tr>
<td>Notch, -30degC (kJ/m2)</td>
<td>12</td>
</tr>
<tr>
<td>Unnotched -30 degC (kJ/m2)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Fatigue bending</strong></td>
<td></td>
</tr>
<tr>
<td>(-10degC, 60deg bend angle)</td>
<td>150k cycles</td>
</tr>
</tbody>
</table>
HIGH PERFORMANCE TEXTILES

**Elastomeric Fibers**
for uppers & apparel

**Kynar® PVDF fiber**
for anti-friction/stain socks

**Breathable Film**
for apparel

**Hot Melt Adhesives**
for no-sew garments (web, filament, film)
KYNAR® PVDF FOR SPORTS

Flexible offshore flow lines
Extreme durability in corrosive environment
Chemical processing equipment
Ultra-high purity Extreme chemical resistance

Rigid and FLEX grades for wearable technology

The most weather resistant coating resin in the world
Over 50 years of proven durability
Global trademark licensing program

A leading fluoropolymer in Li-ion batteries