Introduction LANXESS
Niels van der Aar, Head of Technical Service & Application Development

Meeting: Ingenieursvereniging Zuid Limburg @ Chemelot
Location: Geleen, The Netherlands
Date: 15-04-2014
Content

1. Introduction LANXESS
2. Introduction LANXESS Keltan® Elastomers
3. Introduction Keltan® EPDM
LANXESS – a leading Specialty Chemicals Company

Background

- Spin-off from Bayer in 2004, listed in the DAX since 2012
- Core business: Plastics, synthetic rubber, intermediates and specialty chemicals
- Name: combination of the French word "lancer" (to set in motion) and "success"

Global success story*

- 52 production sites worldwide
- Around 17,500 employees in 31 countries
- Global sales of €8.3 billion in 2013

Strategy of targeted innovation

- Vital role in LANXESS’ growth
- Focus on process and product innovation

* As of January 2013
### Business portfolio based on 3 strong segments – 14 Business Units

<table>
<thead>
<tr>
<th>Performance Polymers</th>
<th>Advanced Intermediates</th>
<th>Performance Chemicals</th>
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<tbody>
<tr>
<td>Butyl Rubber</td>
<td>Advanced Industrial Intermediates</td>
<td>Material Protection Products</td>
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<tr>
<td>Performance Butadiene Rubbers</td>
<td>Saltigo</td>
<td>Inorganic Pigments</td>
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<td>Keltan Elastomers</td>
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<td>Functional Chemicals</td>
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<td>High Performance Elastomers</td>
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<td>Leather</td>
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<td>High Performance Materials</td>
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<td>Rhein Chemie</td>
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</tbody>
</table>

- **Sales:** €500 m
- **Sales:** €200-500 m
- **Sales:** <€200 m
LANXESS offers by far the broadest portfolio of synthetic rubbers in the industry

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Tire; BTR and PBR</th>
<th>Technical Rubber Products; KEL and HPE</th>
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<tbody>
<tr>
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<td>SBR</td>
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<td><strong>LANXESS</strong></td>
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Lanxess is the Global Rubber Company
# Keltan® EP(D)M, Brief Historical Overview

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950s</td>
<td>Ziegler and Natta discover a new class of polymerization catalysts for the preparation of polyolefinic and elastomeric copolymers of ethylene and propylene</td>
</tr>
</tbody>
</table>
| 1967 | B.F. Goodrich plant on stream in Orange, TX  
Start of Keltan production in Geleen, NL |
| 1972 | EPDM plant of Bunawerke Hüls on stream in Marl, D  
EPDM plant of Bunawerke Hüls on stream in Marl, D |
| 1982 | Polysar takes over B.F. Goodrich's plant in Orange  
Polysar takes over B.F. Goodrich's plant in Orange |
| 1990 | Bayer acquires Polysar's rubber business  
Bayer acquires Polysar's rubber business |
| 1994 | Bayer takes over Hüls' EPDM plant  
Bayer takes over Hüls' EPDM plant |
| 1996 | Acquisition of Nitriflex plant by DSM  
Acquisition of Nitriflex plant by DSM |
| 1997 | Name change: Polysar EPDM and Buna AP become Buna EP  
Name change: Polysar EPDM and Buna AP become Buna EP |
| 2002 | Start of EPT-3 plant in Geleen  
Start of EPT-3 plant in Geleen |
| 2005 | Carve out of LANXESS from Bayer  
Carve out of LANXESS from Bayer |
| 2007 | Start of reactive extrusion line in Triunfo  
Start of reactive extrusion line in Triunfo |
| 2011 | Acquisition of DSM Elastomers by LANXESS, 1st Keltan ECO  
Acquisition of DSM Elastomers by LANXESS, 1st Keltan ECO |
| 2012 | Name change: Buna EP becomes Keltan / start streamlining portfolio  
Name change: Buna EP becomes Keltan / start streamlining portfolio |
| 2012 | Groundbreaking of new 160 kt EPDM plant in China  
Groundbreaking of new 160 kt EPDM plant in China |
| 2013 | Former BU TRP split into Keltan Elastomers (KEL) & High Performance Elastomers (HPE)  
Former BU TRP split into Keltan Elastomers (KEL) & High Performance Elastomers (HPE) |
| 2013 | Official opening new Headquarters in Geleen  
Official opening new Headquarters in Geleen |
| 2013 | Conversion EPT3 to Keltan ACE technology  
Conversion EPT3 to Keltan ACE technology |
Keltan® Elastomers - The only true global EPDM supplier

**Details**
- EPDM plants in all strategic regions
- Regional service
  - 25 sales offices
  - technical services
  - application development
- Expansion in China
  - largest world scale plant
  - wholly owned by LANXESS

**Global set-up**
- Geleen, NL
- HQ
- Pittsburgh, US
- Orange, US
- Marl, DE
- Changzhou, CN
- São Paulo, BR
- Shanghai, CN
- Singapore, SG
- Triunfo, BR

- BU Keltan: Production site
- Production site planned
- Regional sales offices and technical services
Committed to EPDM growth: Building the largest EPDM plant in the world, Changzhou, China

- Investment in China to support strong growth
- Investment of €235 million, largest LANXESS investment in China to date
- Highly competitive site with best-in-class ACE technology
- Start-up in end 2014 with targeted capacity of 160 kt per year
  - Ability to serve local customers quicker with premium products
  - Shorter delivery times to customers in Asia
  - Enhanced R&D capabilities in China
Natural Rubber versus EPDM

Natural rubber production

EPDM rubber production
Keltan® EPDM: a speciality Elastomer

Keltan® EPDM: a speciality Elastomer

General Purpose Elastomers, such as: NR, BR, SBR

Specialty Elastomers, such as CR, NBR, EP(D)M, IIR

High Performance Elastomers, such as FKM, HNBR, EVM

Keltan® EPDM: a speciality Elastomer

a registered trademark of Lanxess AG
What is EP(D)M?

$E = \text{Ethylene}$  
$P = \text{Propylene}$  
$D = \text{Diene}$  
$M = \text{Saturated polymer backbone (ASTM designation)}$

**Typical range for commercial grades:**
- Ethylene content: 40 to 75 wt.-%
- Propylene content: 20 to 60 wt.-%
- Diene content: 0 to 12 wt.-%
- Total: 100 wt.-%

$\text{wt\% ethylene + wt\% propylene + wt\% diene = 100\%}$
Temperature resistance versus oil swell

Rubber Classification according to ASTM D2000

Temperature resistance (°C)

Oil swelling IRM 903 (vol.%)

FKM  MVF Q  MVQ  ACM  AEM  EVM  90% VA
HNBR  CO/ECO  CM  CSM  CR  SBR  40% VA
NBR  BR  NR  IIR  EPDM  FKM  MVF Q  MVQ  ACM  AEM  EVM  90% VA  HNBR  CO/ECO  CM  CSM  CR  SBR  40% VA
60  80  100  120  140  160  180  200  220  240  260
0  20  40  60  80  100  120  140  160  180  200  220  240  260

TMC meeting Chemelot  March 14th 2014
Elastomer map of properties
EPDM = the outdoor rubber

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<thead>
<tr>
<th></th>
<th>non polar</th>
<th>polar</th>
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<tbody>
<tr>
<td>oil resistance</td>
<td></td>
<td></td>
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<tr>
<td>ozone and ageing</td>
<td></td>
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</tr>
<tr>
<td>resistance</td>
<td></td>
<td></td>
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<tr>
<td>thermal stability (°C)</td>
<td>80</td>
<td>150</td>
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<tr>
<td>mechanical properties</td>
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<tr>
<td>low temperature</td>
<td>-72</td>
<td>-60</td>
</tr>
<tr>
<td>properties (Tg / °C)</td>
<td>-120</td>
<td>-130</td>
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<table>
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<th>elastomer</th>
<th>NR</th>
<th>EPDM</th>
<th>BR</th>
<th>IIR</th>
<th>SBR</th>
<th>CM/CSM</th>
<th>EVM</th>
<th>CR</th>
<th>MVQ</th>
<th>ECO/CO</th>
<th>NBR</th>
<th>HNBR</th>
<th>AU</th>
<th>FKM</th>
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</tbody>
</table>

- EPDM: Ethylen-Propylen-Dien-Monomer (EPM) rubber
- NR: Natural Rubber
- BR: Butadiene Rubber
- IIR: Isoprene Rubber
- SBR: Styrene-Butadiene Rubber
- CM/CSM: Chloroprene/Conjugated Sulfur Rubber
- EVM: Ethylene-Propylene Rubber
- CR: Chloroprene Rubber
- MVQ: Chlorosulfonated Polyethylene Rubber
- ECO/CO: Ethylene-Cyclohexylene Rubber
- NBR: Nitrile Butadiene Rubber
- HNBR: Hydrogenated Nitrile Butadiene Rubber
- AU: Acrylonitrile Butadiene Rubber
- FKM: Fluorocarbon Rubber
The Future: Global Keltan® Portfolio
Broad range of global grades

<table>
<thead>
<tr>
<th>POLYMER / SLOW CURING</th>
<th>MEDIUM / FAST CURING</th>
<th>ULTRA FAST CURING</th>
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<tbody>
<tr>
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<td>Amorphous</td>
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<td>Oil extended</td>
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<tr>
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Broadest technology basis & portfolio in the industry

**Advanced Technology**

**ACE**
- improved energy utilization
- cleaner zero-chlorine products
- no catalyst waste

**Green**
- first bio based EPDM
- moving away from petroleum dependence
- reduced carbon footprint

**Keltan’s wide variety in applications**

- Industrial
- Wire & cables
- Oil additives
- Consumer
# Keltan® Eco – First commercially available bio-based EPDM

## Characteristics
- Keltan® Eco contains ethylene from sugar cane
- No compromise on quality
- True technical drop-in
- Unique opportunity to develop sustainable “Green” products

## Benefits
- Reduced dependence on fossil resources
- Reduced carbon footprint due to sugar cane
- Truly sustainable & validated by Life Cycle Assessment
- Bio-based content can be measured by ASTM D6866 Carbon-14 test
- Broader portfolio available
Route to bio based EPDM

Keltan® Eco compared to conventional EPDM

Sugar cane → Ethanol → Ethylene → EPDM → End products

- 100% bio-based
- 50-70% bio-based
- 0% bio-based
- 15-20% bio-based

Raw materials: Sugar cane, Crude oil

End products: Keltan® Eco compared to conventional EPDM

EPDM
Opportunities for more sustainable compounding

Green compound opportunities

Keltan® Eco is an excellent starting polymer for “green” compound developments in combination with:

- Bio-based oils
- Carbon Black – Pyrolised tires
- Bio-sourced fillers – Wood flour
- Recycled material – Rubber dust (inert filler)
- Factice – Process aid
- De vulcanized rubber
Content

✓ Introduction LANXESS
✓ Introduction LANXESS Keltan® Elastomers
✓ Introduction Keltan® EPDM
# Keltan brand: committed to deliver on our values

## Global Partnership
- Production plants in all major sales regions, close to customers with even shorter lead times
- Global plant flexibility to ensure security of supply
- Supporting customers, enabling them to grow globally

## Premium quality
- Consistent high product quality
- Broadest product portfolio in the market
- High quality level of packaging, documents and people

## Best Service
- Availability of strong commercial and technical service teams
- Technical events with customers, supporting their business individually
- Online database to support customers technically

## Sustainable innovation
- Keltan Eco enables customers “greener” products
- ACE technology leads to improved energy efficiency, cleaner products and new innovations
- Developing new unique grades to meet the needs of customers

## The Power of Keltan®
- Consistent high product quality
- Broadest product portfolio in the market
- High quality level of packaging, documents and people
- Keltan Eco enables customers “greener” products
- ACE technology leads to improved energy efficiency, cleaner products and new innovations
- Developing new unique grades to meet the needs of customers
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