Sustainable Polyurethanes and Polycarbonates from biobased aromatics

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Covestro at a Glance
One of the World's Leading Polymer Producers
Climate change
Population growth
Demographic change
Urbanization

WE NEED TO MASTER THESE CHALLENGES WITH INNOVATIVE AND SUSTAINABLE SOLUTIONS.
Sustainability

Covestro 2025 sustainability goals along the value-chain

GLOBAL TRENDS

RESEARCH AND DEVELOPMENT
Our R&D project portfolio aligned with UN Sustainable Development Goals

PROCUREMENT
100 % of suppliers compliant with our sustainability requirements

PRODUCTION
Reduce specific CO₂ emissions by 50%

PRODUCTS ON THE MARKET
10 000 000 people in underserved markets reached through our business solutions

ACROSS THE VALUE CHAIN
We aim to get the most value out of the carbon employed – Carbon Productivity
Business Units

Polyurethanes
Raw materials for rigid and flexible foams

Polycarbonates
Granules and sheets for a wide variety of applications

Coatings, Adhesives & Specialties
Raw materials for coatings, adhesives and specialties
In 1953, Hermann Schnell invented Polycarbonate.
Polycarbonates (PCS)
Products and solutions

Key markets: automotive, electrics/electronics, construction, medical

Polycarbonates are transparent, break-resistant and readily formable high-tech plastics.

Polycarbonates are marketed as granules, sheets and films.
Polycarbonates (PCS)
Products and solutions

- Computers
- Smartphones
- Flat-panel displays
- DVD/CD

Granules
- Roof structures
- Windows
- Conservatories
- Partition walls

Sheets
- Automotive glazing
- Bodywork parts

Films
- Medical devices

- Break-resistant
- Lightweight
- Transparent
- Dimensionally tough
- Heat-resistant
Polycarbonates (PCS)

Chemistry

\[ 2 \text{Phenol} + \text{Acetone} \rightarrow \text{Polycarbonate} \]

Makrolon®
Bio-based phenol
Our expertise in this field

bacteria cell as a chemical reactor

GLUCOSE

new reactions

CHO* → 4HB → PHENOL

removed reactions

* precursor in the aromatic amino acid pathway

Source:
WO 2014/076113
Dr. Jorgen Magnussen
Bio-based phenol
Relevance of phenol for polycarbonate

* bio-content calculated as bio-based carbon content typically used for certificates according to ASTM D6866

* calculation based on eco-profile values of PlasticsEurope (http://www.plasticseurope.org/plastics-sustainability-14017/eco-profiles.aspx)
In 1937, Otto Bayer invented polyurethane chemistry.
Polyurethanes (PUR)
Products and solutions

Key markets: automotive, construction, domestic appliances, furniture and mattresses

The material can be rigid, soft, elastic or thermo-formable (thermoplastics).

Covestro develops and manufactures the key polyurethane components: polyols and isocyanates such as MDI and TDI.
Polyurethanes (PUR)
Products and solutions

**Flexible foam**
- Upholstered furniture
- Mattresses
- Car seats

**Rigid foam**
- Insulating materials for buildings and cooling devices

**Thermoplastics**
- Sports and leisure
- Automobile components

- Flexible
- Hard-wearing
- Lightweight
- Readily moldable

- Insulating
- Rigid
- Lightweight

- Tough
- Flexible
- Resistant to cold and heat
A breakthrough: bio-based aniline
Producing a crucial chemical more sustainably

DISRUPTIVE NEW PROCESS DEVELOPED:

• Producing the key chemical aniline based on renewable resources

• Carbon content: 100% biobased – sparing fossil resources like crude oil

• Reduction of carbon footprint

• Proof in laboratory – now scale-up
Aniline – an indispensible chemical
Usually based on crude oil

Strategic raw material for the chemical industry
Aniline usually based on fossil resources like crude oil
COVESTRO uses ca. 1 million tons per year = 20% of global aniline consumption
Usage: for polyurethane foam to insulate buildings and cooling devices

Crude oil → Benzene + HNO₃ → Nitrobenzene → H₂ → Aniline → Polyurethane
Aniline – an indispensable chemical

Producing aniline from wood, straw or field corn

COVESTRO can produce aniline without using fossil raw materials

Based on biomass: unrefined raw sugar e.g. from field corn, wood or straw

Step 1: Biocatalysis: sugar becomes pre-aniline through microorganism

Step 2: Chemocatalysis pre-aniline becomes aniline

Plant

Raw sugar

Intermediate

Aniline

Polyurethane

CO2
Functionalized aromatics from biomass

Biorizon program

Biomass → aromatic monomers → drop-in

near drop-ins → functionalized monomers

**Biorizon**

*The way to aromatics*

**Furanic Intermediates & Aromatic Derivatives (FIAD)**

Dienes

Diels-Alder & Ring-opening

Dienophiles

Aromatics

**functionalized aromatic monomers for polymer industry**

- novel functionalities
- improved performance behavior
- reduction of greenhouse gas emissions
Partnership Along the Value Chain
Covestro links chemicals to key consumer markets

CO₂

Chemicals

Polymers & Intermediates

Applications
Progress in renewable polymers

Innovative solutions
To make the world a brighter place
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The company assumes no liability whatsoever to update these forward-looking statements or to adjust them to future events or developments.
THANK YOU FOR YOUR ATTENTION

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