Brighter Use of Resources

How alternative building blocks can be used in the plastics industry

Dr. Christoph Gürtler
Dr. Annika Stute
BMBF Statuskonferenz, Berlin 17.-18.4.2018
CHALLENGE: SAVING OUR FOSSIL RESOURCES
Challenge: Saving our fossil resources
Use of carbon in the most productive way

- Chemical industry is dependent on the element carbon
- Current carbon source: fossil raw materials, such as oil
- 4% – 6% of global output is used for plastics production
- But oil reserves are finite and will be depleted in the long run
- Markets are subject to fluctuations
Exploring alternative feedstocks...

New products and research and development projects

**Biomass**
- Bio-based hardeners for car and furniture coatings
- Bio-based aniline for insulation material
- Bio-based resin for stable timber construction materials

**CO₂**
- CO₂-based polyols for mattresses and upholstery (cardyon™)
- CO₂-based polyols for hoses, car seats and insulation material

**pFA**
- Paraformaldehyde (pFA) based polyols for sporting goods and cables
Impact on sustainability
Conservation of resources

• Contributes to resource efficiency by saving petroleum-based raw materials
• New process fundamentally more environmentally compatible than conventional production
• Carbon footprint reduced compared with conventional product
EXTENDING THE SCOPE FOR CO$_2$

DREAM RESOURCE PROJECT
Covestro successfully developed a process to produce polyols on the basis of propylene oxide (PO) and CO$_2$.

Now a publically funded project is focussing on the reaction of ethylene oxide (EO) and CO$_2$.

By bringing EO and CO$_2$ together, polyols for a broader range of applications can be made.

The aim is to substitute up to 20% of fossil based feedstocks in polyols.

Lab scale process is in development.
CONVENTIONAL POLYURETHANE (EO)

EO + R-OH → R'[-O-]n[-O-]O OH + O=C=NR → R'-[-O-]n[-O-]O[-N=CR]'

Polyol + Isocyanate → Polyurethane

CO2 BASED POLYURETHANE (EO)

EO + CO2 → R-OH → R'[-O-]n[-O-]O OH + O=C=NR → R'-[-O-]n[-O-]O[-N=CR]'

Polyol + Isocyanate → Polyurethane
Bringing competencies together
Academia and industry join forces – project Dream Resource

Kick-off September 1st, 2016
### Work in progress

#### Mid-term achievements

<table>
<thead>
<tr>
<th>Application tests</th>
<th>Surface active behavior</th>
<th>Analytics</th>
<th>Material samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Techno-economic assessment</td>
<td>Ecotoxicology</td>
<td>Life cycle assessment</td>
<td></td>
</tr>
</tbody>
</table>

- **Material samples**
  - Progress in lab scale process
  - EO/CO₂ copolymers and PO/EO/CO₂ terpolymers successfully synthesized onto diverse starters
  - Incorporation of up to 13 wt.-% of CO₂ in polyols achieved
  - Over 30 kg of material samples for tests in diverse applications were handed over
  - Preparation to take the next step in upscaling is ongoing
Driving, cooling, cleaning with CO₂
Different applications are conceivable

- Combination of the novel EO/CO₂ polyols with isocyanates yield polyurethanes for rigid or molded foams
  - Application in car seats and insulation boards possible
- Furthermore the EO/CO₂ materials are promising candidates for non-ionic surfactants
  - These can be found e.g. in laundry detergents
  - EO/CO₂ material show enhanced sustainability
Pushing boundaries further
Striving for a broader raw material base

Our vision
• Use alternative building blocks in as many different types of plastics as possible
• Replace as much fossil raw material as possible with alternative building blocks

The right way
• to broaden the plastic industry’s raw material base
• to promote circular economy
THANK YOU

DR. CHRISTOPH GÜRTLER
Covestro Deutschland AG
+49 241 6009 2177
christoph.guertler@covestro.com

DR. ANNIKA STUTE
Covestro Deutschland AG
+49 241 6009 2653
annika.stute@covestro.com