Intermediates

Glyoxal from BASF

The Sustainable Solution
Reliable supply around the world

Boosting customer success through application service

Customer specific logistics services

Sustainable development of customers’ products with glyoxal from BASF
Glyoxal (40%)
What do we deliver?

Reliable supply around the world

- BASF is the No 1 producer of glyoxal with a world-scale production of 60,000 t in Ludwigshafen, Germany
- Global organization – “We’re there – wherever our customers are”
  - Local sales forces and customer service teams in all regions
- Verbund – BASF’s glyoxal is part of the petrochemical value chain
  - Implication: Cost-efficiency, preservation of valuable resources, efficient production
BASF Intermediates

Glyoxal (40%)

What do we deliver?

Reliable supply around the world

- BASF Verbund: A benefit for our customers
  - Backward-integrated to obtain production efficiency and reliability
  - Strategic and long-term commitment to glyoxal value chain in Europe
  - Value chain with applications in many different industries
  - Know-how Verbund to deliver broad application expertise

Backward-integrated production process

<table>
<thead>
<tr>
<th>Backward-integrated production process</th>
<th>Textile resins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td></td>
</tr>
<tr>
<td>Naphtha</td>
<td></td>
</tr>
<tr>
<td>Ethylene</td>
<td></td>
</tr>
<tr>
<td>Ethylene glycol</td>
<td></td>
</tr>
<tr>
<td>Glyoxal (40%)</td>
<td></td>
</tr>
<tr>
<td>Imidazoles</td>
<td></td>
</tr>
<tr>
<td>Paper resins</td>
<td></td>
</tr>
</tbody>
</table>


BASF Intermediates

Glyoxal (40%)
What do we deliver?

Boosting customer success through application service

- 55 years of glyoxal R&D experience
- “Know-how Verbund” that comprises more than 8,300 employees working in R&D with broad expertise in many application areas of glyoxal
- A pipeline full of new products and applications from the glyoxal value chain: for example imidazoles and ionic liquids
- Global technical marketing and active joint R&D with customers to find tailor-made solutions and ensure success
- Proven track record of innovative partnerships that make our customers more successful
BASF Intermediates

Glyoxal (40%)

What do we deliver?

<table>
<thead>
<tr>
<th>Application</th>
<th>Characteristic</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textiles</td>
<td>Crosslinking agent or building block for crosslinker</td>
<td>Softer and less wrinkled textiles</td>
</tr>
<tr>
<td>Paper</td>
<td>Crosslinking agent or building block for crosslinker</td>
<td>Paper wet strength (e.g. toilet paper)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paper dry strength (e.g. recycled paper)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Efficient paper coating additive for high-quality papers</td>
</tr>
<tr>
<td>Leather</td>
<td>Crosslinking in tanning process</td>
<td>Preservation of leather quality</td>
</tr>
<tr>
<td>Cosmetics</td>
<td>Use of glyoxal-crosslinking polymers (hydrocolloids)</td>
<td>Better viscosity</td>
</tr>
<tr>
<td>Epoxy</td>
<td>Building block for specific epoxy applications</td>
<td>Higher epoxy stability performance</td>
</tr>
</tbody>
</table>
BASF Intermediates

Glyoxal (40%)
What do we deliver?

<table>
<thead>
<tr>
<th>Application</th>
<th>Characteristic</th>
<th>Benefit</th>
</tr>
</thead>
</table>
| Oil & Gas       | ■ Sulfur scavenger  
                 ■ Use of glyoxal-crosslinking polymers (hydrocolloids) | ▶ Anti-corrosive  
                                                                  ▶ Safety at work  
                                                                  ▶ Improves viscosity in oil-drilling fluids |
| Biocide         | ■ Efficient biocide activity                        | ▶ Health industry disinfectant, veterinary hygiene biocide  
                                                                  ▶ Efficient co-biocide with glutaraldehyde since it has no R42 risk labeling |
| Glyoxylic Acid  | ■ Building block                                    | ▶ Serves as an intermediate for vanillin, agricultural chemicals, antibiotics, allantoin, complexing agents |
| Wood Hardening  | ■ Crosslinking agent  
                 or building block for crosslinker                 | ▶ Cures wood  
                                                                  ▶ Protection from moisture |
Glyoxal (40%)
What do we deliver?

- Customer specific logistics services
  - Bulk and packaged material in all regions of the world:
    - Drums, 260 kg
    - IBC, 1300 kg
    - Bulk
  - Advice on packaging and tailor-made solutions on demand
  - Global logistics team to ensure efficiency in our supply chain
  - Dedicated storage facilities to guarantee supply
Glyoxal (40%)
What do we deliver?

Sustainable development of customers’ products

- Registration under BPD (Biocidal Products Directive) and REACH
- Advice on REACH-related issues
- FDA-registered as a component for food packaging applications
- In its application as a crosslinker, glyoxal has approvals in cosmetics and food packaging in accordance with:
  - BgVV recommendation XXXVI for paper in contact with food (Germany)
  - FDA (CFR 21 part 176) indirect food additives: paper and paperboard components (USA)
  - Cosmetic directive 76/768/EEC (directive 2008/14/EC of 15 February 2008 adapting Annex III and SCCP opinion SCCP/0881/05)
- Biodegradable according to OECD guideline 301 C-E, 303 A
- Shows more than 90% decrease of dissolved organic carbon (DOC)
# Product Specification

<table>
<thead>
<tr>
<th>Inspection characteristic</th>
<th>Specification</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assay</td>
<td>39.5% – 40.5%</td>
<td>STI 8804</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BASF method</td>
</tr>
<tr>
<td>Acid number</td>
<td>Max. 1.5 mg KOH/g</td>
<td>STI 8804</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DIN EN ISO 3682</td>
</tr>
<tr>
<td>Color value</td>
<td>Max. 20 APHA</td>
<td>STI 8802</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DIN EN 1557</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>Max. 100 ppm</td>
<td>STI 8803</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HPLC</td>
</tr>
<tr>
<td>pH</td>
<td>2.0 – 3.5</td>
<td>STI 8808</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DIN 19268</td>
</tr>
</tbody>
</table>

- Molecular weight: 58.0
- PRD number: 30037091
- CAS registry number: 107-22-2
- Melting temperature: -14 °C
- Boiling temperature: 104 °C
- Density at 20 °C: 1.27 g/cm³
- Ignition temperature: 285 °C