Intermediates

Glyoxal from BASF

The Sustainable Solution
BASF Intermediates

Glyoxal (40%)

What do we deliver?

- Reliable supply around the world
- Boosting customer success through application service
- Customer specific logistics services
- Sustainable development of customers’ products with glyoxal from BASF
BASF Intermediates

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

<table>
<thead>
<tr>
<th>Backward-integrated production process</th>
<th>Textile resins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>► Naphtha</td>
</tr>
<tr>
<td></td>
<td>► Ethylene</td>
</tr>
<tr>
<td></td>
<td>► Ethylene glycol</td>
</tr>
<tr>
<td></td>
<td>► Glyoxal (40%)</td>
</tr>
<tr>
<td></td>
<td>► Imidazoles</td>
</tr>
<tr>
<td></td>
<td>► Paper resins</td>
</tr>
</tbody>
</table>
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>
<tbody>
<tr>
<td>Oil &amp; Gas</td>
<td>- Sulfur scavenger</td>
<td>▶ Anti-corrosive</td>
</tr>
<tr>
<td></td>
<td>- Use of glyoxal-crosslinking polymers (hydrocolloids)</td>
<td>▶ Safety at work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▶ Improves viscosity in oil-drilling fluids</td>
</tr>
<tr>
<td>Biocide</td>
<td>- Efficient biocide activity</td>
<td>▶ Health industry disinfectant, veterinary hygiene biocide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▶ Efficient co-biocide with glutaraldehyde since it has no R42 risk labeling</td>
</tr>
<tr>
<td>Glyoxylic Acid</td>
<td>- Building block</td>
<td>▶ Serves as an intermediate for vanillin, agricultural chemicals, antibiotics, allantoin, complexing agents</td>
</tr>
<tr>
<td>Wood Hardening</td>
<td>- Crosslinking agent or building block for crosslinker</td>
<td>▶ Cures wood</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▶ Protection from moisture</td>
</tr>
</tbody>
</table>
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
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 BASF method</td>
</tr>
<tr>
<td>Acid number</td>
<td>Max. 1.5 mg KOH/g</td>
<td>STI 8804 DIN EN ISO 3682</td>
</tr>
<tr>
<td>Color value</td>
<td>Max. 20 APHA</td>
<td>STI 8802 DIN EN 1557</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>Max. 100 ppm</td>
<td>STI 8803 HPLC</td>
</tr>
<tr>
<td>pH</td>
<td>2.0 – 3.5</td>
<td>STI 8808 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

- **Inspection characteristic**
  - Assay
  - Acid number
  - Color value
  - Formaldehyde
  - pH

- **Specification**
  - 39.5% – 40.5%
  - Max. 1.5 mg KOH/g
  - Max. 20 APHA
  - Max. 100 ppm
  - 2.0 – 3.5

- **Test method**
  - STI 8804
  - STI 8804
  - STI 8802
  - STI 8803
  - STI 8808
  - BASF method
  - DIN EN ISO 3682
  - DIN EN 1557
  - HPLC
  - DIN 19268