Innovative solutions for sustainable water treatment
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Human Health Depends on Advanced Water Treatment

1 billion people have no access to safe drinking water *

2.5 billion people lack adequate sanitation *

Constant need to intensify water treatment to protect human health

* Source: WHO and UNICEF, 2009
BASF Objective is to Contribute in Providing Water Treatment Solutions

- BASF deals **responsibly with water** resources in production processes
- BASF supports the new water management concept of **water “cultivation”**
- BASF moves from chemicals supplier to **provider of innovative solutions** based on chemistry
- BASF **enables our customers** to jointly develop and effectively operate water treatment facilities worldwide

Chemistry solutions as enabler to provide advanced water treatment

* Cultivation concept: optimize as much as possible the use of water, reuse to maximum extent and discharge less with better quality
Growth Field Water Solutions: 3 Innovation Cases

New chemical solutions:
Advanced Flocculant Technology for Sludge Dewatering

New process solutions:
Chemical flux enhancer for improved membrane bioreactor performance

New membrane materials:
Ultrafiltration membranes with reduced fouling properties

Innovation focus moves from molecules to materials and solutions
Innovation Case 1

**Advanced Flocculant Technology for Sludge Dewatering**

**Targets**

- Reduce transportation costs by increasing cake solids
- Increase throughput of sludge
- User friendly treatment (stable liquid flocculant form)
- Performing on various types of sludge

Flocculants reduce water content in sludge and operative costs
Innovation Case 1

Advanced Flocculant Technology for Sludge Dewatering

Product Performance
Filtrability of treated sludge with linear product

- Water from sludge after 5s (ml)

- Filterability higher than benchmark
- Cake solids performance confirmed by lab work and field tests

Product Stability
Oscillation method to estimate viscosity / stability

- 0.01/0.05 Hz
- Ratio G’ at 0.27 Hz

- Cause Pump Blockage
- Predictive method to estimate the risk of gel formation
- Confirmation by test on pilot rig

Intensive research to develop an advanced flocculant range
Innovation Case 1

Advanced Flocculant Technology for Sludge Dewatering

ZETAG® 9000 Series

- Improve **dewatering performance** (higher cake solids) that reduces cost of incineration, thermal drying and higher throughput
- **Cost performance** solution due to high solid content and effective polymer formulation
- **User friendly technology** due to its stabilized polymeric liquid formulation, no gel formation

Optimal results across a broad array of sludge and process conditions
Innovation Case 2
Enhancement of Waste Water Treatment. Membrane BioReactors (MBR) Concept

Pros
- Higher water quality
- Less space needed
- Lower capital costs

Cons
- Higher operating costs
- Fouling

MBR required solutions to reduce operation issues
Innovation Case 2

Flux Enhancers as Antifouling Strategy for Membrane BioReactors (MBR)

- **Irreversible** and **reversible** fouling are the key limited factors for operation
- Microbial Products are considered as **key foulants**
- **Antifouling strategies:**
  - Injection of air
  - Regular physical or chemical cleaning
  - Chemical flux enhancement

Chemical solutions improve MBR Economics
Innovation Case 2

Comparison of New BASF Additives With Benchmark

- Similar effect of BASF products versus benchmark but with **lower** dosage
- Strong reduction of reversible and irreversible fouling with BASF additives
- Reduction of capillary suction time and time-to-filter: better filterability and better dewatering properties

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**BASF flux enhancers limit fouling risk**
Innovation Case 2
How Does BASF Solution Work?

- Charge neutralization effect (cationic polymers-negatively charged sludge)
- Enhanced flocculation (sludge particle size increases with product)
- Overall reduction of foulants

BASF flux enhancers capture foulant and protect membrane blocking

<table>
<thead>
<tr>
<th>Industrial Sludge Volume (%)</th>
<th>Foulant concentration (mg l⁻¹)</th>
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<tr>
<td></td>
<td>Carbohydrates</td>
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without BASF product | with BASF product
Innovation Case 3
New Membrane Development to Reduce Fouling Propensity

- Surface properties influence fouling
  - Hydrophilicity
  - Surface tension
  - Surface smoothness

- Screening for polymer additives to identify leads
  - Compatible with membrane formation
  - Evenly distributed in membrane
  - Reduced fouling propensity

BASF chemical expertise allows to identify technical lead
Innovation Case 3
Pilot Capabilities Setup Using Rhine Water in Ludwigshafen

Benchmarking of existing technology to new membrane fiber
Innovation Case 3

Improved Membranes Demonstrate Operating Benefit

Lower pressure build up with new membrane requires 50% less cleanings

Conditions

Constant flux 86 kg/m²/h

Permeate backwash

Chemical enhanced backwash
Innovation Case 3
Improved Membranes Demonstrate Operating Benefit

- Operating with constant cleaning intervals
- Flux increased from 86 l/m²/h to 114 l/m²/h with the new membrane
- 33% more clean water per module

Improved membrane increases the production of clean water by 33%
Access to pure water is essential for human life as well as for economic and social development in all regions of the world.

BASF is contributing by using water responsibly in all our operations globally.

BASF is offering a variety of products helping our customers to manage their water needs more effectively.

BASF is preparing for future challenges by driving innovations in fields that we illustrated with our three innovation cases today:

- New chemical solutions: Zetag® 9000
- New process solutions: Chemical flux enhancer for Membrane Bioreactors
- New membrane solutions: Reduced fouling UF membranes

BASF vision is to become leading provider of innovative chemical solutions to the water industry worldwide.