UHDENORA, your reliable technology and services partner in South America

Dr Albert Zimmermann
UHDENORA S.p.A.
Summary

• Company updating

• Technology Expertise

• Product Portfolio

• After Sales Partnership
UHDENORA: Flexibility to Satisfy Customer Needs Since 2001

Scope of Services
Design and construction of electrolysis plants, advanced membrane electrolysis based on Single Element technology.
Uhde Single Element – BM 2.7 Electrolyzer

- Cell Rack
- Single Elements
- Catholyte Header
- Pressure Bolts
- Copper Bus Bars
- Anolyte Header
Power Saving Evolution - BM 2.7 Single Element

Power Consumption in kWh/ t NaOH

<table>
<thead>
<tr>
<th>Year</th>
<th>Power Consumption in kWh/ t NaOH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>BM 2.7 v4 2130</td>
</tr>
<tr>
<td>2008</td>
<td>BM 2.7 v5 2070</td>
</tr>
<tr>
<td>2011</td>
<td>BM 2.7 v5 plus 2055</td>
</tr>
<tr>
<td>2012</td>
<td>BM 2.7 v6 2035</td>
</tr>
</tbody>
</table>

1) 6 kA/m², 90°C, 32 % NaOH

Services for element upgrading or replacement with Gen v6 available
Characteristics of new Generation 6

- Cathode as woven mesh
- Elastic Element
- Current Distributor
- Collecting Channel
- Anode as expanded metal
- Downcomer
- Discharge pipe
- Outlet Nozzle
- Flange
Application of forces for tightening and elastic element compression are separated in the Uhde Single Element

1. Step
Application of force for element tightness

2. Step
Application of force for optimal compression of elastic element
Generation 6 - Reference Installations

Customer: BEFAR
Location: P.R. China
Capacity: 159,700 t/year of Cl₂
Process: BM Technology
Licence: Uhdenora
Commissioning: 2014
References Membrane electrolysis

Customer: Quimpac
Location: Peru
Capacity: 64,000 ECU
Process: UHDENORA
Commissioning: 2014
Scope: E,P + Supervision

Basic and Detailed Engineering
Process equipment
Electrical Distribution
Instrumentation
Supervision to Erection, Start Up and Commissioning
NaCl-ODC was released in 2013

Power Consumption in kWh/ t NaOH$^1$)

1) At 6 kA/m$^2$, 90°C, 32% NaOH
2) Expected at 6 kA/m$^2$ for NaCl-ODC operation
   Currently operated at 4 kA/m$^2$
NaCl-ODC Is Commercial since June 2013

**NaCl-ODC Highlights**

- ODC (Bayer Material Science) combined with Uhde BM2.7 design
- 1st demo electrolyzer with 20,000 mtpy Cl\(_2\) for BMS, Uerdingen
  - time online: > 42 months
- Current density: 4-5 kA/m²
- Total elect. power consumption reduction by 25%
- **Commercial order** for 40,000 ktpy Cl\(_2\) + 40,000 tpy Cl\(_2\) awarded in China (under installation)
Growing HCl-ODC market due to growing isocyanate business

<table>
<thead>
<tr>
<th>Customer:</th>
<th>Yantai Juli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location:</td>
<td>Laiyang, China</td>
</tr>
<tr>
<td>Capacity:</td>
<td>100,000 t/year of Cl₂</td>
</tr>
<tr>
<td>Process:</td>
<td>ODC Technology</td>
</tr>
<tr>
<td>Licence:</td>
<td>UHDENORA/Bayer</td>
</tr>
<tr>
<td>Commissioning:</td>
<td>1st quarter 2012</td>
</tr>
</tbody>
</table>

TK EL/UHDN accumulated contract awards HCl Capacity [Mio. tpy Cl₂ 100 %]

![Graph showing TK EL/UHDN accumulated contract awards HCl Capacity from 1988 to 2014]
Skid Mounted Chlorine Plants: a Joint Development Cooperation

- Feedback from Over 220 chlorine plants
- Process Expertise for all Sections
- Technology Licensor
- EP and EPC Experience
- Operational Excellence

**Results**

Standardized – Pre Assembled – Automated 45 TPD Cl₂ Plant

New standard 15 TPD Cl₂ skid mounted plants

**On demand**

Customized skid units for higher capacities

---

135 TDP Skid mounted Cl₂ Drying Tower
Skid units from workshop to site

- Connected together in the final field configuration
- Pre-assembled in workshop
- Checked under UHDN supervision
- Transported to site

Combined with other elements to complete process unit
Shipment of Skid Units
From construction to installation: - Waste Gas Dechlorination

- waste gas dechlorination tower
- hypo cooling and circulation

from workshop to site

at site
Leuna Harze Plant (Germany)

Contractor: ThyssenKrupp Uhde GmbH
Location: Leuna, Germany
Capacity: 15,000 t/year of Cl₂
Process: Chlor-Alkali
License: UHDENORA S.p.A.
Skid supplier: UHDENORA S.p.A.
Commissioning: 2012
Produquimica Industria & Comercio S.A. (Brazil)

Contractor: Produquimica S.A.
Location: Brazil
Capacity: 15,000 t/year of Cl₂
Process: Chlor-Alkali
License: UHDENORA S.p.A.
Skid supplier: UHDENORA S.p.A.
Commissioning: 2014
After Sales Partnership
UHDEnora Expertise Is More Than Electrolyzers

- Cell room
- Salt
- Evaporation

- Performance Improvement
  - Technical Exchange
  - Benchmarking
  - Performance Investigation
  - Plant Upgrade
  - Process Improvements
  - Element Upgrade
  - Element Replacement

- Maintenance and Repair
  - Training
  - Plant Safety Review
  - Element Assembly
  - Remembraning/Recoating

- Delivery of Spare Parts
  - Elements
  - Accessories
After Sales Partnership
There are good reasons to deploy a Full Service for cell house maintenance

**Situation in the plant**
- Cost reduction requirements
- Lean organisation
- Less personnel for special tasks
- Rotation of personnel
- Delivery commitment

**Buy in of**
- Extended and overall warranties
- Execution experience for cost & time effectiveness
- Single point of responsibility for maintenance
- Technology expertise
After Sales Partnership
UHDENORA offers various *Full Service* packages for maintenance work

*Full Service* packages for

- Element Upgrade
- Remembraning
- Recoating
- PipeTech™ – Upgrade / Replacement of existing plastic piping
Why UHDENORA?

- **Experience and References**: Over 220 chlorine plants in operation (TK Electrolysis and UHDENORA)
- The only *single source* supplier
- Two *strong shareholders* with over 60 years of electrolysis experience each (part of ThyssenKrupp Uhde global network)
- **Extensive knowledge** and experience in all sections of a Chlor-Alkali plant (not only cell room)
- Dedicated and *experienced after sales services*
- **International reputation** for full service support through all plant lifetime
- **Quality**-certified systems and standards
- **Safety and environmental** considerations
UHДENORA, your reliable technology and services partner in South America

Thank You For Your Attention