Wastewater treatment in the chemical industry

- Short introduction of ecoSign
- Challenges in the treatment of chemical wastewater
- How to approach the increasingly stringent requirements in a cost effective and sustainable manner?
- Example for the treatment of a highly demanding wastewater from dye manufacture
- Conclusions
ecoSign – short overview

- Consulting and engineering services in industrial wastewater treatment & air pollution control

- We have a wide experience in the treatment of highly demanding wastewater in particular from chemical and pharmaceutical industries.

- Our integrated approach considers both, end-of-pipe treatment and source control in order to provide cost effective solutions.

- We elaborate cost effective and customized solutions and are independent from suppliers.

- Worldwide activities and knowledge of local requirements in particular for Asia.
Worldwide activities for global leading companies

- Austria
- France
- Germany
- Ireland
- Italy
- Slovenia
- Spain
- Switzerland
- Mexico
- USA
- China
- Taiwan
- Thailand
- India
- Singapore
- Ciba
- nycomed
- SANDOZ
- HUNTSMAN
- Huntsman
- Lonza
- Novartis
- Roche
- Syngenta
- BASF
- DSM
- CIBA VISION

Project sites
Challenges in the treatment of chemical wastewater

- India has very stringent discharge limits in particular for following parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Typical raw effluent</th>
<th>Discharge limit</th>
<th>Treatment challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>COD</td>
<td>mg/l</td>
<td>2’000 ~ 4’000</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Requires high COD removal</td>
</tr>
<tr>
<td>NH₄-N</td>
<td>mg/l</td>
<td>0 ~ 500</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nitrogen removal is very difficult</td>
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<tr>
<td>TDS</td>
<td>mg/l</td>
<td>up to 10’000</td>
<td>2’100 ~ 5’000</td>
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<td></td>
<td></td>
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<td>Salt removal is very costly</td>
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</tbody>
</table>

The shown limits for some selected parameters may vary within India.

In spite of the high wastewater complexity bio-treatment is the most established technology in chemical industry due to cost effectiveness.
Principle of a biological treatment plant

Only biodegradable organics can be removed in bio-treatment, therefore source control is of high importance.
Overall approach is required for effective treatment

Wastewater management and source control
- Identification of critical effluent streams
- Segregation and pre-treatment or incineration of critical streams

Avoid and minimize waste at source
- Optimize process (yield, non-persistent waste, recycling, etc.)
- Source control in production to minimize waste discharge

Appropriate technology
- Well designed and operated end-of-pipe treatment facilities
- Monitoring of key operating data and wastewater analyzes
- More and more tertiary treatment is required to meet the limits
Examples of source control in production

- Repair leaks (pumps, pipes, ….)
- Complete emptying of vessels
- Avoid false discharge into sewer
- Clean only if required and re-use rinse
- Dry cleaning is better than flush down
- Incinerate heavily polluted residues or 1\textsuperscript{st} rinse (e.g. residues from spray drier or filter press)

- Each kilogram of refractory not discharged into WWTP saves money
Examples of most common treatment technologies

- Wet air oxidation
- Fenton oxidation
- Ozone oxidation
- Incineration
- Membrane filtration
- Solvent extraction
- Evaporation
- Ulitma ratio
- Flocculation
- Sedimentation
- Aerobic biological treatment
- GAC adsorption
- Cracks refractory COD into biodegradable molecules
- Only reduction of volume

Very often a combination of different technologies is required for the treatment of complex industrial wastewater
Case study – treatment of poorly biodegradable effluent

Evaluation of a treatment concept with >94% elimination!

900 m³/d wastewater
~2’000 mg/l COD
poorly biodegradable

Feasibility and treatability studies with different technologies

- Evaporation and incineration of concentrate
- Low pressure wet air oxidation
- UV/H₂O₂ Oxidation
- Fenton oxidation
- O₃/H₂O₂ Oxidation

Huge effort in production to minimize COD discharge to <1’500 mg/l
Case study - treatment approach

900 m³/d wastewater
~2’000 mg/l COD
poorly biodegradable

EQ tank
Homogenization

Flocculation
De-colorization & solid removal

Bio 1
Elimination of BOD

Oxidation with Ozone & H₂O₂
Cracking of refractory COD

Bio 2 (MBR)
BOD removal and nitrification

GAC filters 3 x 20 m³
Further COD reduction

Treated effluent <120 mg/l COD
Case study – effective color removal in flocculation unit

- Flocculation unit removes solids, color, phosphate and heavy metals
Case study – simplified PFD of the ozone oxidation

- 60% ~ 70% COD removal and colourless wastewater
Case study – Granular Activated Carbon Adsorption

- Polishing treatment with GAC filters to further reduce COD well below the very stringent discharge limit.

COD limit <120 mg/l
Case study – Scope of ecoSign for the new WWTP

ecoSign has been in charge for:

- Situation analysis involving source control
- Technical and economical evaluation of treatment alternatives
- Coordination and evaluation of treatability studies
- Conceptual design and engineering from design through dimension to automation concept
- Drawing up of tender documents and support on supplier evaluation
- Detail engineering together with client’s local engineering team
- Support during commissioning
Conclusions

- India has very stringent discharge limits for treated effluent in particular for COD, nitrogen and TDS.
- Wastewater treatment in chemical industry is very demanding and requires very high removal efficiency to meet the very low limits.
- **Source control is of high importance to make end-of-pipe treatment more efficient and cost effective.**
- There is no cheap all-rounder and very often a combination of different technologies is required for the treatment of complex industrial wastewater.
- Good treatment solutions need creativity, courage and a wide practical experiences.

**Thank you for your attention**