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
- NYCOMED
- SANDOZ
- HUNTSMAN
- CYTEC INDUSTRIES
- ROHRER|CHEM
- syngenta
- BASF
- CIBA VISION
- Novartis
- Roche
- EBERHARD
- RIEMSER
- ecoSign
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 2’000 ~ 4’000</td>
<td>250</td>
<td>Requires high COD removal</td>
</tr>
<tr>
<td>NH₄-N</td>
<td>mg/l 0 ~ 500</td>
<td>50</td>
<td>Nitrogen removal is very difficult</td>
</tr>
<tr>
<td>TDS</td>
<td>mg/l up to 10’000</td>
<td>2’100 ~ 5’000</td>
<td>Salt removal is very costly</td>
</tr>
</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

Neutralization & Flocculation

Primary Clarifier

Equalization 1 - 2 days

Secondary Clarifier

Treated effluent

Aeration Basin

≈ 5 g/l MLSS

Excess Sludge

Multipurpose Plants

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)

\textbullet \textit{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
- Aerobic biological treatment
- GAC adsorption
- Evaporation
- Sedimentation
- Flocculation

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

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 -> Flocculation
Homogenization
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

Ozon Generator

Cooler

H₂O₂ 35%

Liquid Oxygen

Oxidation tank

Offgas

Ozon destroyer

Bio 1

Bio 2 (MBR)
Case study – Granular Activated Carbon Adsorption

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