solutions treatments opportunities

4th International Conference

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PHARMACEUTICAL WASTEWATER TREATMENT WITH ELECTROPEROXICOAGULATION (EPC)

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Overview

Pharmaceutical Wastewater – Towards a Safe Discharge

Pharmaceuticals products play a vital role in modern medicine.

Active Pharmaceutical Ingredients (APIs) are developed to be:

- highly active and toxic for infectious organisms, and
- biologically stable, to activate under specific conditions.

These characteristics poses severe issues to human and environmental health when they occur in the environment.

Pharmaceutical industry wastewater is one of the many routes for API to reach the environment.

Turning Challenges into Opportunities
Pharmaceutical wastewaters

High complexity

Increase of volume

High variability

Concerted Strategy that simultaneously acts at

- **the point of generation and**
- **treatment capabilities increase**

Waste segregation at source

API safe discharge

Best Available Techniques

Application of Electroperoxicoagulation (EPC) to Pharmaceutical Wastewaters

Electroperoxicoagulation

Pollutants are removed by oxidation with hydroxil radical and by coagulation with iron hydroxide

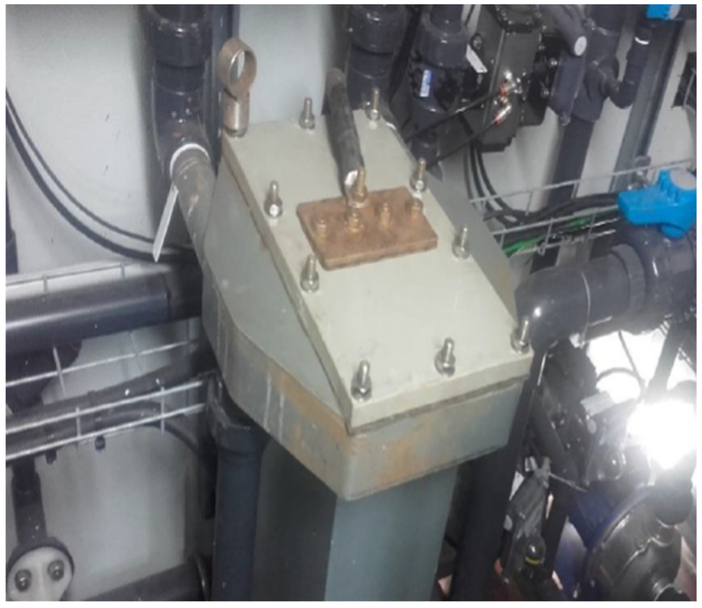
Iron coagulant is generated in situ by oxidation of the iron anode

Generated iron radicals react with pollutants and hydrogen peroxide

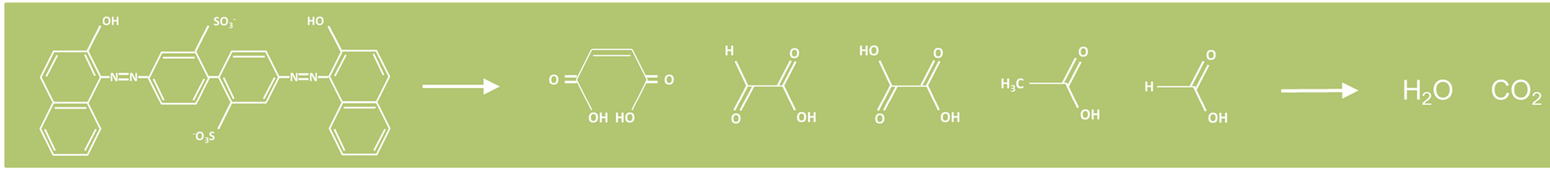
Sacrificial anode. Not necessary to add other salts for coagulation

Electro-fenton reaction occurs. Highly oxidizing environment

Application of Electroperoxicoagulation (EPC) to Pharmaceutical Wastewaters



Converts complex molecule (polycyclic aromatic hydrocarbons, long chain double bond C=C compounds) into simple molecules



Application of Electroperoxicoagulation (EPC) to Pharmaceutical Wastewaters

Results of in situ continuous feed pilot test studies at Hovione, Loures.

- **EPC reaction, sludge separation with ultrafiltration, final step of activated carbon.**

Critical compounds removal %				
AOX	DCM	Zinc	Iron	COD
99 %	> 99 %	99 %	84 %	83 %

AOX – halogenated; DCM – dicloromethane; COD – chemical oxygen demand

API removal %			
Minocycline	Lisacline	Fluticasone	Iohexol
99 %	99 %	≥ 89% (*)	≥ 96 % (*)

(*) Limit of detection.of analytical method reached for treated efluent sample.

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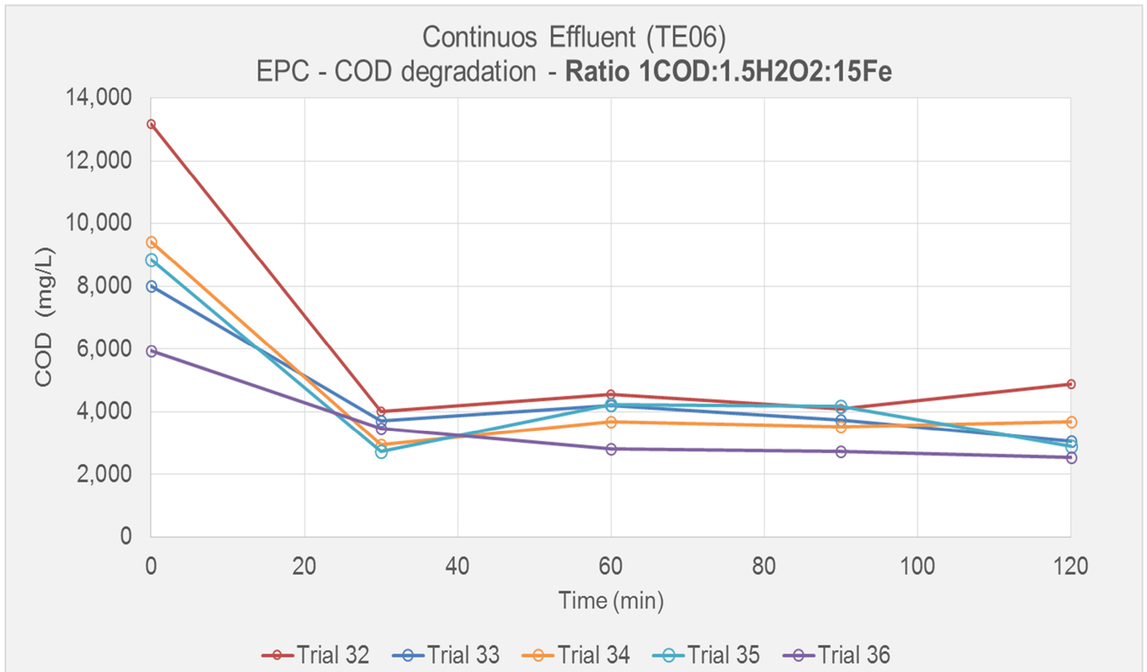

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Key Results:

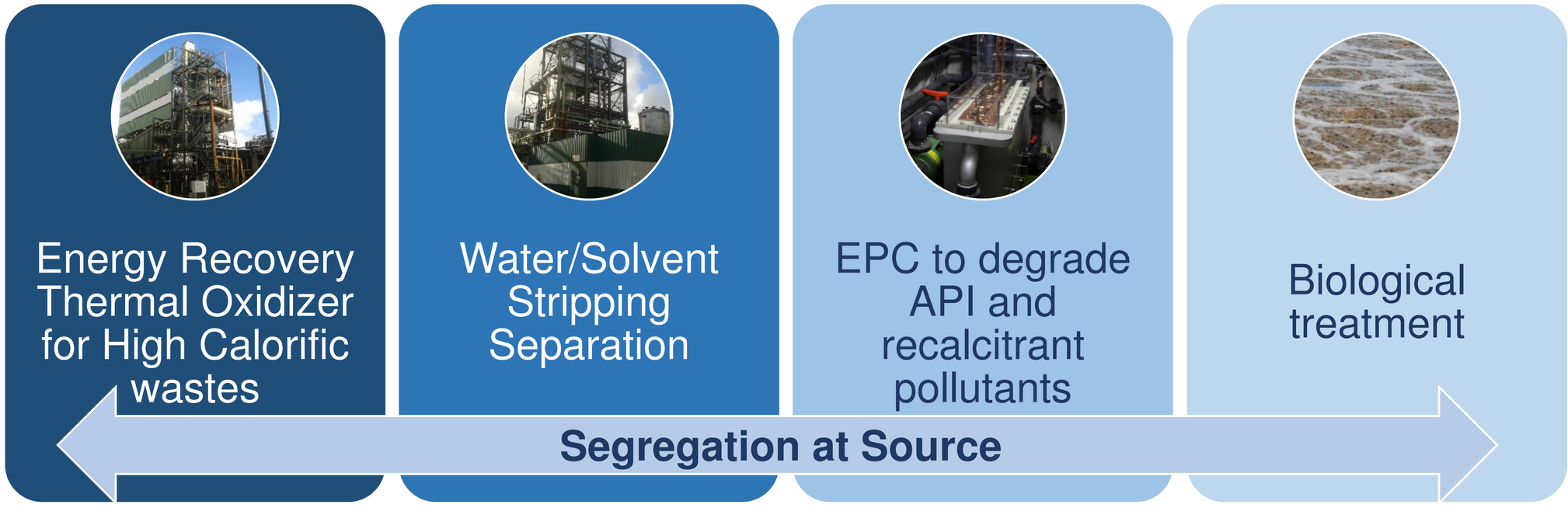
80% **pollution removal (COD) in the first 30min of reaction**

67% **increase of biodegradability**

88% **toxicity decrease**

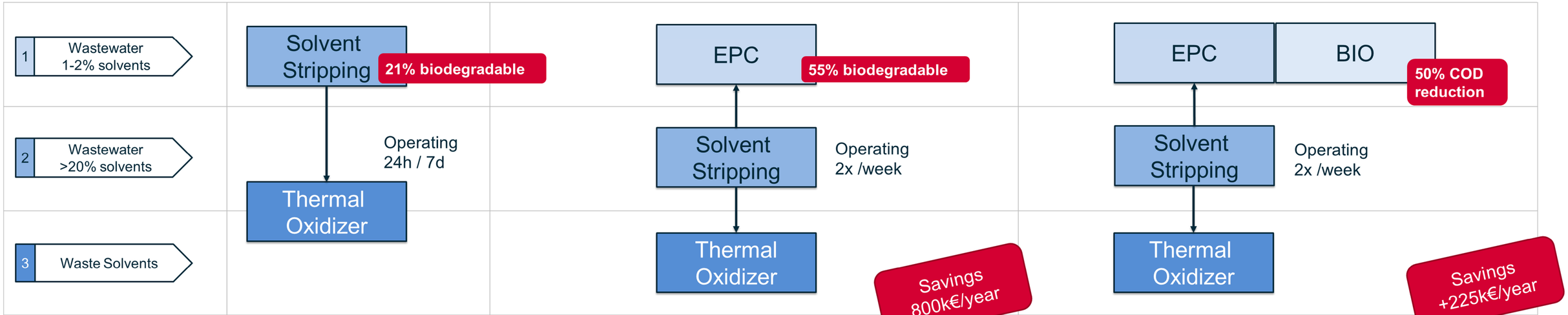
Breaking Paradigms:
Segregation at Source and Selective Treatment

Hybrid Solution: EPC + Biological treatment integrated with installed technologies (thermal oxidiser & stripping) allied with good management practices at point of generation



Eco-toxicity evaluation of individual streams
Selective treatment according to adequation removal rate

Breaking Paradigms:
Segregation at Source and Selective Treatment



Disadvantages
- High running costs
- Consumption steam for solvent stripping
- Consumption of natural gas to produce steam

Advantages
- 55% Reduction of steam consumption
- 23% Reduction on boiler make-up water
- 39% Increase of Thermal Oxidizer availability
- Improve biodegradability of treated wastewater
- Removal of complex pollutants (solvents, API, metals)

Disadvantages
- Consumption of hidrogen peroxide

Advantages
- Reduction of consumption of hidrogen peroxide
- Reduction of running costs
- Increase of treatment robustness

Disadvantages
- Investment of additional ~1M€ for Bio
- Higher footprint requirements

Environmental Benefits

- **API safe discharge, combating antibiotic resistence**

- **Significant reduction on plant Carbon Footprint:**
  - Reduction of Natural Gas consumption for steam production
  - Reduction of Consumption of Hydrogen Peroxide with the installation of the biological treatment in the Phase 2

- **Positive benefit for downstream Municipal wastewater treatment plant:**
  - Increase of biodegradability and
  - Lower toxicity of Hovione treated wastewater

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Thank you for your attention.

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