Selecting the optimal WWTP configuration including resource recovery units

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SMART-Plant

Scale-up of low-carbon footprint Material Recovery Techniques for upgrading existing WWTP

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SMART-Plant

**MAIN GOAL**

**REDUCE** energy and environmental footprint
**RECOVER** valuable materials (water, cellulose, biopolymers, nutrients)
**PRODUCE** products exploitable in construction, chemical and agriculture

DSS for selecting the optimal WWTP configuration including resource recovery units
Scale-up of low-carbon footprint Material Recovery Techniques for upgrading existing WWTP

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SMART-Plant

Total EC funding

7,5M€
SMART-Plant

Scale-up of low-carbon footprint Material Recovery Techniques for upgrading existing WWTP

DSS for selecting the optimal WWTP configuration including resource recovery units

Partners

26
SMART-Plant

DSS objective
Advise the potential stakeholders on how to implement the SMART-Plant Technologies for their specific wastewater treatment problem

SMARTech pilot-plants
SMARTech process models
• Complex dynamics (ASM2d, ADM1)
• Discrete events (SBR)
• Complex control systems
• Large system of differential-algebraic equations (DAE)
Dynamic fine-screen and post-processing of cellulosic sludge (ST1)

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Polyurethane-based anaerobic digestion bio-filter (ST2a)

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Short-Cut Enhanced Phosphorus and PHA Recovery (SCEPPHAR) main-stream process (ST2b)

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Energy

Biopolymers

Cellulose

Nutrients
Tertiary hybrid ion exchange for N and P nutrients recovery (ST3)

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Short-Cut Enhanced Nutrient Abatement (SCENA) and ordinary digestion side-stream process (ST4a)

DSS for selecting the optimal WWTP configuration including resource recovery units
SCENA and CAMBI-enhanced digestion side-stream process (ST4b)

DSS for selecting the optimal WWTP configuration including resource recovery units
SCEPPHAR side-stream process (ST5)

DSS for selecting the optimal WWTP configuration including resource recovery units
Which plant configuration is best for me?

Try our hyper-tech solution Decision Support System!
**STEP1: Design problem set-up**
- New design or retrofit
- Geo-location (weather)
- PE, legal limits, etc.
STEP2: Wastewater inflow generation

- Dry weather model
- Wet weather model
- Sewer model

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STEP3: Superstructure generation and simulation
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Conventional A2O process

Redeclare Stage3 with ST2b

Automatic built-up of WWTP configurations

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STEP4: Objective values estimation
- Effluent Quality Index (EQI)
- Frequency Effluent Violations (FEV)
- Net Present Value (NPV)
- GreenHouse Gas (GHG) emissions

Compute for all possible WWTP design configs!
STEP5: Design configuration sorting

Multi Criteria Decision Making (MCDM) based on user preferences technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)

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STEP6: Design parameter optimization
Minimize NPV optimizing Volume, S/L separation capacity, etc.
Constraints on FEV, HRT, SOR, etc.
Decrease configurations to optimize with MCDM
STEP7: Uncertainty analysis
Input and parameter uncertainty
Sensitivity analysis given the optimal design
Conclusions

• Design is based on dynamic and static process models
• Effluent limits fully accounted
• Design of discrete event processes (e.g. SBR)
• Design integrates the WWTP control system
• Influent model for Europe

For future work
• Test global optimization strategies for design optimization
• Build user friendly web-interface
• Perform simulations in a distributed computing environment
• Integrate other resource recovery technologies
• Increase the range of application of the inflow model to North America
• Integrate Life Cycle Analysis frameworks
Questions?
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