New Water Culture
Friday 11 December

Life cycle assessment of wastewater source separation scenario: Case study on a new district in Bordeaux
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1. Introduction

Source separation: A good solution for resource recovery!

Highly concentrated stream and dedicated to specific components

**Urine separation**
- Urine collection by urine diverting toilet or urinals,
- Transport by truck,
- Treatment
- Reuse in agriculture

**Blackwater separation**
- Vacuum toilet to collect concentrated blackwater
- Vacuum sewer to transport it
- Treatment for energy recovery (and nutrients)
- Digestate can be reused in agriculture

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PRE-CONFERENCE “WATER, MEGACITIES AND GLOBAL CHANGE”
1. Introduction

A tool has been developed for:

- Evaluation of several types of source separation, several treatments
- Extended boundaries of study in order to take into account the impact of source separation on the whole sanitation system
- Taking into account the type of urbanism
  - Evaluation at district scale with the impact on the centralised treatment
  - Balance between what happened without the district and with the district
2. Methodology

Functionnal Unit: 1PE = 60 gDBO$_5$/day

Block 1
- Modelling of wastewater management in the district
  - Modelling of the district
  - Influent production
  - Transports design
  - Decentralised treatments

Block 2
- Modelling of the centralised WWTP
- Modelling of wastewater management in the centralised WWTP

Block 3
- Life Cycle Assessment
  - Inventory generation
  - LCA methods
  - Analysis and interpretation of the results

Scenario characteristics
- Size
- Urbanism
- Type de separation
- Flush volume
- Type of transport
- Outlet of wastewater
- Processes

Wastewater collection:
- Transport by lorry
- Material and diesel for trenches construction
- Energy consumption for operation

Wastewater treatment:
- Incineration grits
- Chemicals production
- WWTP infrastructure
- Gas Boiler
- French electricity mix
- Direct emissions into air and water

N and P application (by-product):
- Transport
- Spreading emissions

Benefits:
- Avoided electricity production
- Avoided fertiliser production
- Avoided potable water production

Functionnal Unit : 1PE = 60 gDBO$_5$/day
2. « Le Belvédère » district

9.3 ha with 140,000 m² of floor for:
• 84,000 m² of housing and hotels
• 5,000 m² of offices
• 93,000 m² of business /shop

2,128 inhabitants
4,126 employees

Wastewater:
• 362 m³/day
• 2,280 PE
2. Source separation scenarios

Goal: Resource recovery

Urine separation and Blackwater (BW) separation

From totally centralised treatment to totally decentralised treatment
2. Wastewater treatment plant (WWTP)

Clos de Hilde in Bordeaux

2 WWTP simulated:
- The current WWTP
- The advanced WWTP to recover nitrogen

Effluent:
- 10 mgTSS/L,
- 25 mgN-NH$_4$/L,
- 15 mgN-NO$_3$/L,
- 0.5 mgP-PO$_4$/L
3. Results - GWP 100

- **Three main contributors to climate change impacts:**
  - Direct emissions ($N_2O$)
  - Biofilter emits more than activate sludge
  - Infrastructure
  - Chemical

- **N-recovery WWTP**
  - Decrease in direct emissions
  - Increase in avoided fertiliser production
  - $\rightarrow$ 15% decrease in total $CO_2$eq emissions
3. Results – GWP 100

- For all scenarios, the N-recovery WWTP allows to reduce by at least 16% the balance compared to the current WWTP.
- Source separation allows to reduce the emissions by at least 65% compared to the current REF.
- BW-GW: the reuse of greywater is beneficial even with a high-technology = MBR.
3. Results – Cumulative energy demand

- Urine scenario ➔ decrease in energy consumption
- Nuclear energy: French electricity mix for electricity production
- Increase in energy for
  - BW: vacuum sewer
  - BW-GW: + greywater treatment = MBR
Conclusions

• **Source separation** allow to **reduce** significantly the impact of sanitation system of **climate change** thanks to
  • Decrease in $\text{N}_2\text{O}$ emissions and
  • Increase in the substitution of **nitrogen fertilisers** ➔ avoided production of fertiliser

• However blackwater collection by **vacuum sewer is a high consumer of energy** in this district.
• Greywater treatment by **MBR** induces also an **high energy consumption**
• French electricity mix hides the drawbacks of these scenarios on climate change
Online Pre-Conference
WATER, MEGACITIES AND GLOBAL CHANGE
7 – 11 December 2020

Thank you for your attention!

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www.design.cnrs.fr/
DESIGN project
ANR-17-CE22-0017