

**Biodiesel from wastewater?**



# The pilot set-up, first results and next steps

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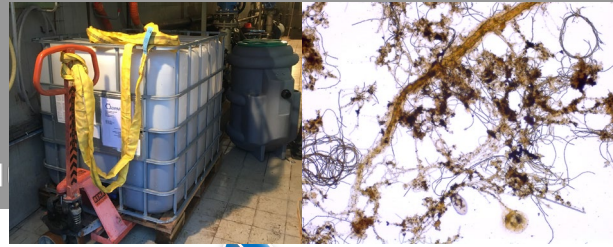
Remondis Aqua Industrie GmbH & Co. KG

**#EUGreenWeek**  
**2021 PARTNER EVENT**



# Lipid pilot

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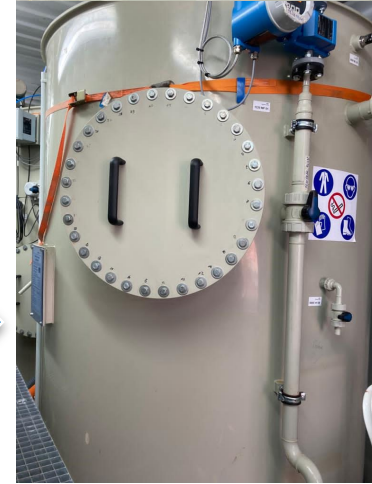
4 m<sup>3</sup> Mixing tank (homogenization)



4 m<sup>3</sup> Reactor 1 (anoxic, lipid accumulation)



4 m<sup>3</sup> Reactor 2 (micro-aerobic, biomass growth)



3.7 m<sup>3</sup> Separation unit



Storage tank (effluent)

Inoculation with surplus sludge (SIVOM)

Inlet water (after screen)

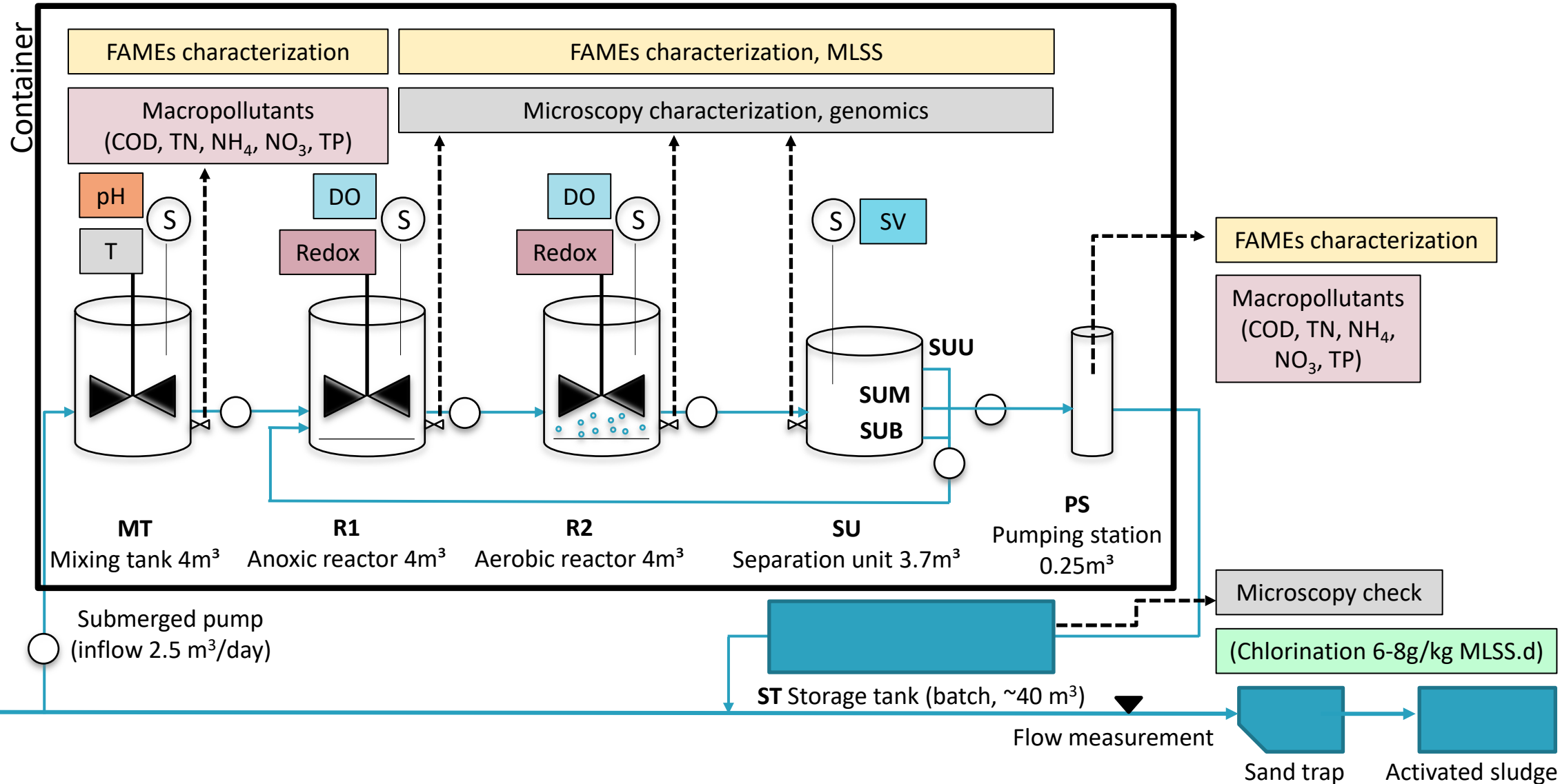


Sludge recirculation

Surplus sludge (lipid enriched biomass)

# Lipid-pilot sampling design

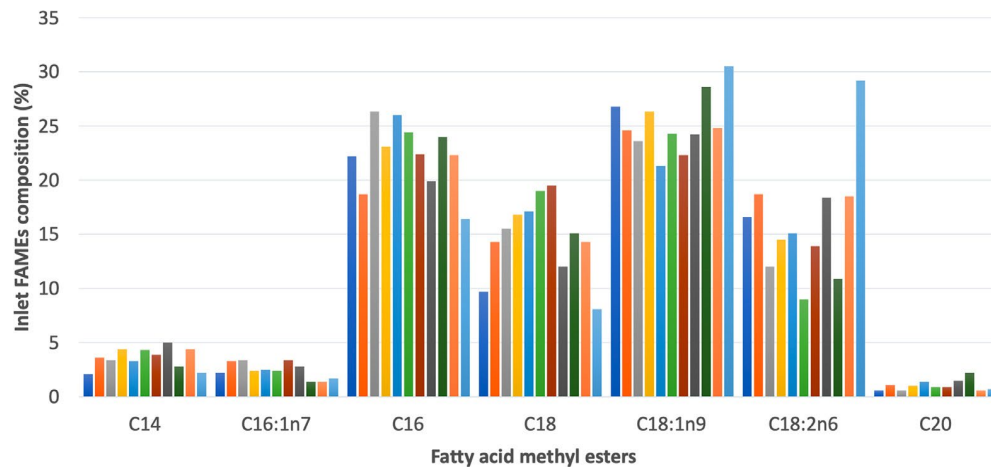
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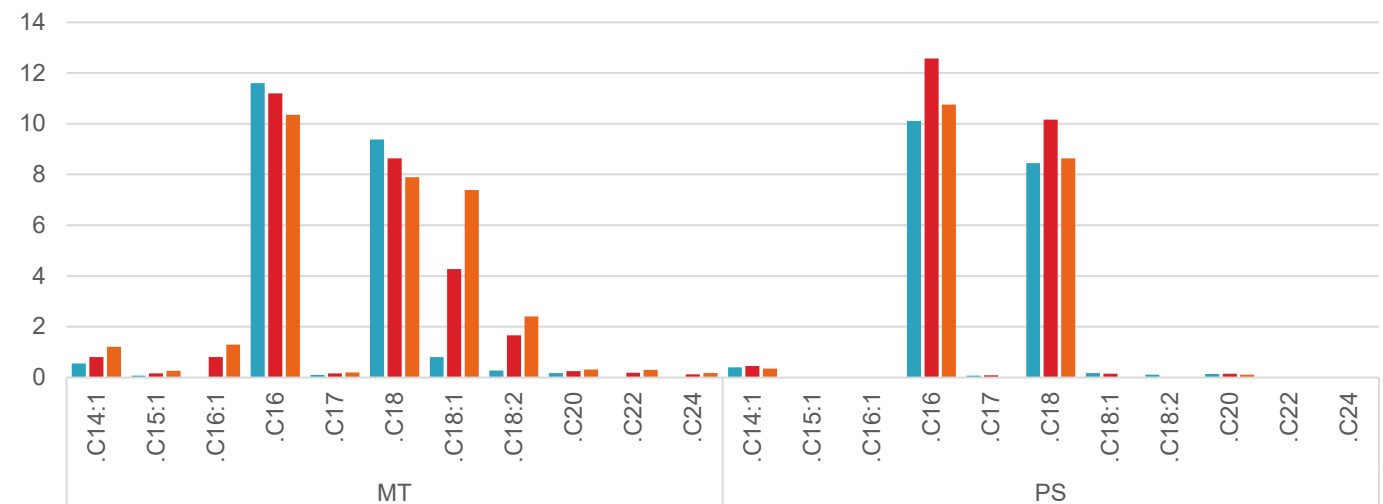
# SIVOM inlet water: composition of lipids

- Lipid content in sewage inlet:
  - Reported ranges between 19-539 mg/L (98-131 mg/l medium range)
- Most common lipids C16 (palmitic), C18:1 (oleic) and C18 (stearic) and C18:2 (linoleic acid)
- Lipid content in SIVOM inlet: 32.5-37.5 mg/L
  - Lipid content in lipid-pilot outlet: 20-37.5 mg/L
  - Most common lipids C16 (palmitic) and C18 (stearic acid)

FAMES relative concentrations in urban sewage inlet



FAMES relative concentrations in SIVOM inlet and outlet of lipid-pilot





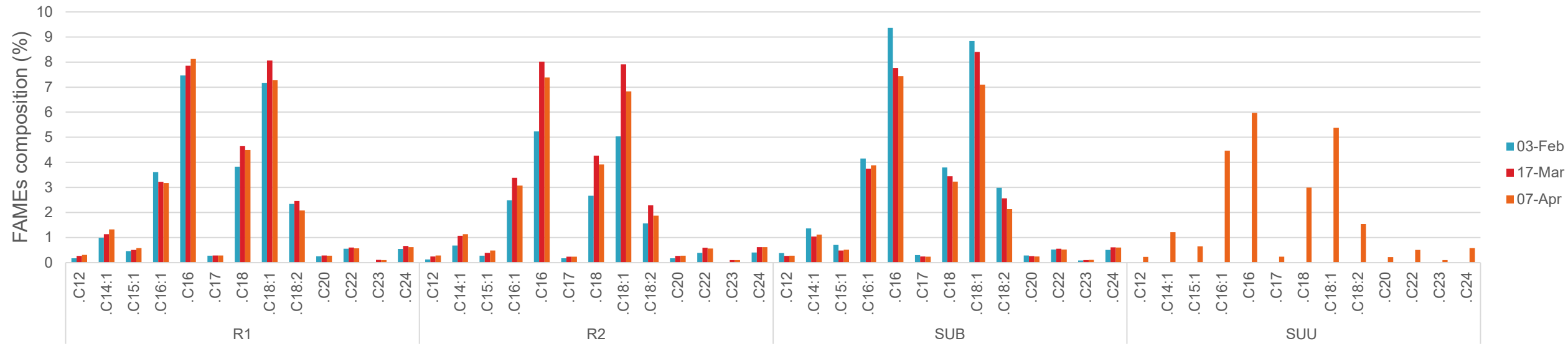


# FAMES composition and yield in different reactors

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- Lipid content does not differ much in between the reactors: 48-72 mg/g dry weight
- Biodiesel yield within the first three months up to 5.3% (in average 4.5%)
- Transesterification efficiency ~80%
- Most common lipids C16 (palmitic) and C18:1 (oleic acid)

# Biodiesel production – general info

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- Industrially today, biodiesel (FAMES) is produced by processing vegetable oil and animal fat.
- Solvent extraction of the lipids followed by transesterification are the preferred approaches to produce biodiesel.

## Our Original Plan:

- Hydrothermal lipid extraction experiments with the Lipid-rich sludge sample (Remondis + Animox):
  - Requirements: Intermediate sludge samples to perform the optimization experiments to figure out the optimum parameter set; required dry solid content: 20 %
- Transformation into Biodiesel (Remondis + BDI): High-FFA-esterification and transesterification experiments and analysis of the produced biodiesel
  - Requirements: at least 4 Liters of extracted Lipid/Oil sample

## Challenges:

- Delays and lack of time to perform enough optimization experiments
- Dewatering of the sludge sample (low dry solid content of ca. 0.5%)
- High quantity of the required sample (more than the pilot capacity)





# Short summary and next steps

## ■ Current status:

- Dewatering experiments: trying several methods including filtration, centrifugation and vacuum evaporation to gain basic concentrated samples ready for qualitative analysis for further planning; eventually combining these methods to reduce the required amount of the sample.

## ■ Change of plans the next steps:

- Lipid Extraction optimizing experiments (Remondis + Animox):
  - Batch hydrothermal treatment (2 Liter Autoclaves) with the dewatered samples to evaluate the optimum conditions (If required followed by solvent extraction)
- Up-scaled extraction (20 Liter Autoclaves) and recovery of lipids from the lipid-rich sludge
- Production of the demo-biodiesel and assessment of its quality in lab-scale (Remondis + IRSA-CNR):
  - Conversion of the lipids into biodiesel under acidic conditions and purification through distillation; including optimization studies of the reactive conditions and final characterisation of the demo-biodiesel product
- Quality check with standard biodiesel (Remondis + BDI): Analysis of some selected parameters to make a statement about suitability to produce standard biodiesel.

## ■ Timeline

- The pilot run is estimated to 8 months (January-August 2021)
- Collection and transportation of sludge to Remondis (from June/July for the method development and then in August 2021)



A microscopic view of a biological sample, likely a tissue section or a culture. The image shows a complex network of thin, light-colored fibers or cells, possibly collagen or a similar extracellular matrix component. There are numerous small, dark, circular or oval structures scattered throughout, which could be nuclei, cells, or other biological markers. The overall appearance is dense and intricate. The text "Questions?" is overlaid in the center in a bold, black, sans-serif font.

**Questions?**