

MEDIUM RE-USE DURING PILOT SCALE ALGAE CULTIVATION FACILITATED BY SUBMERGED MEMBRANES (MAF-TECHNOLOGY)

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Introduction

- Medium recycling is needed to enable upscaling & to improve the economics of algae cultivation.
- Membrane technology can be used for:
 - Pre-harvesting activities & desalting
 - Medium recycling

Aim of the study = Long-term performance of the MAF-technology connected to pilot photobioreactors for continuous preconcentration of algae biomass and medium recycling.

Conclusions

- Continuous harvest with the MAF-technology was realized for *Nannochloropsis* sp., *Scenedesmus* sp. and *Chloromonas typhlos*:
 - > 95 % medium reuse & > 95 % recycling of salts demonstrated
 - > 95 % reduction on discharge of brackish water
- No negative impact on growth was seen due to recycled medium
- Stressed culture → reduce MAF performance was observed
- Redosing of nutrients in recycled medium is important.

MAF-technology

- MAF = Membrane based Algae Filtration
 - Submerged membranes (UF & MF)
 - Pre-concentration factors of > 20 times are realistic
 - Algae densities reached: > 40 g/L OM
 - Computer controlled
- Working principle proven at lab and semi-pilot scale:

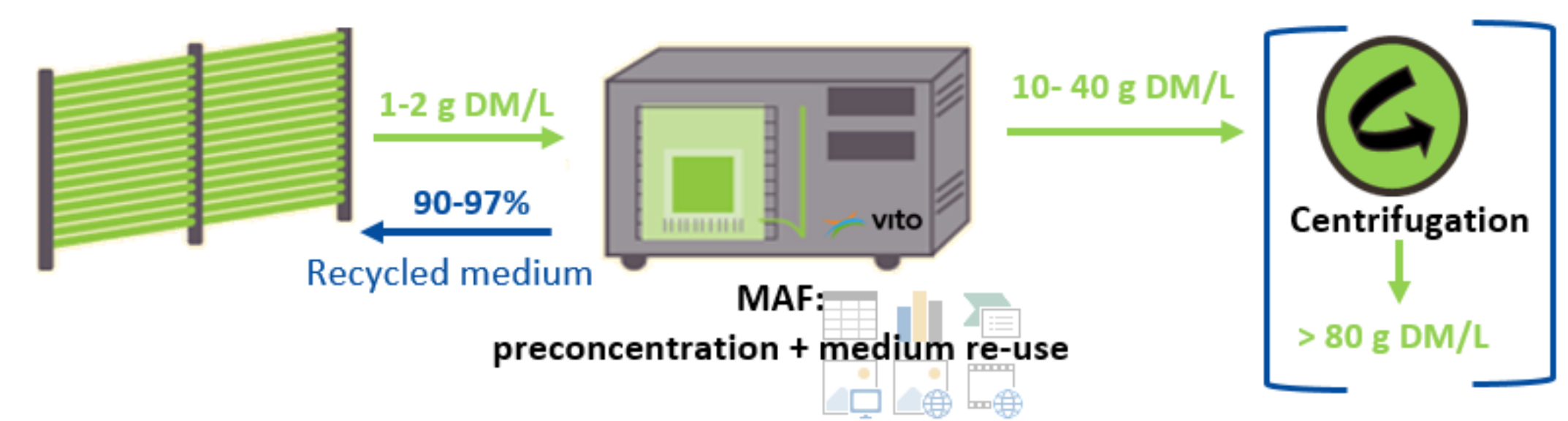


Figure 1: Continuous harvest with preconcentration of algae biomass via MAF-technology.

- Mild harvesting (low shear stress)
- Required centrifugation capacity reduced > 10-20 times
- Continuous harvesting → higher algae growth rates

Results Chloromonas

Set-up:

- MAF-2 (UF; 1,3 m² membrane surface)
- Linked to 1,5 m³ photobioreactor
- Fixed daily harvesting= 150 L/d (10%)



Figure 2: MAF connected to photobioreactor in Sunbuilt (Belgium)

Performance:

- Period: 2/2-4/3/2021
- 4,1 m³ harvested
- Average medium re-use: 95 %
- Average VCF = 20

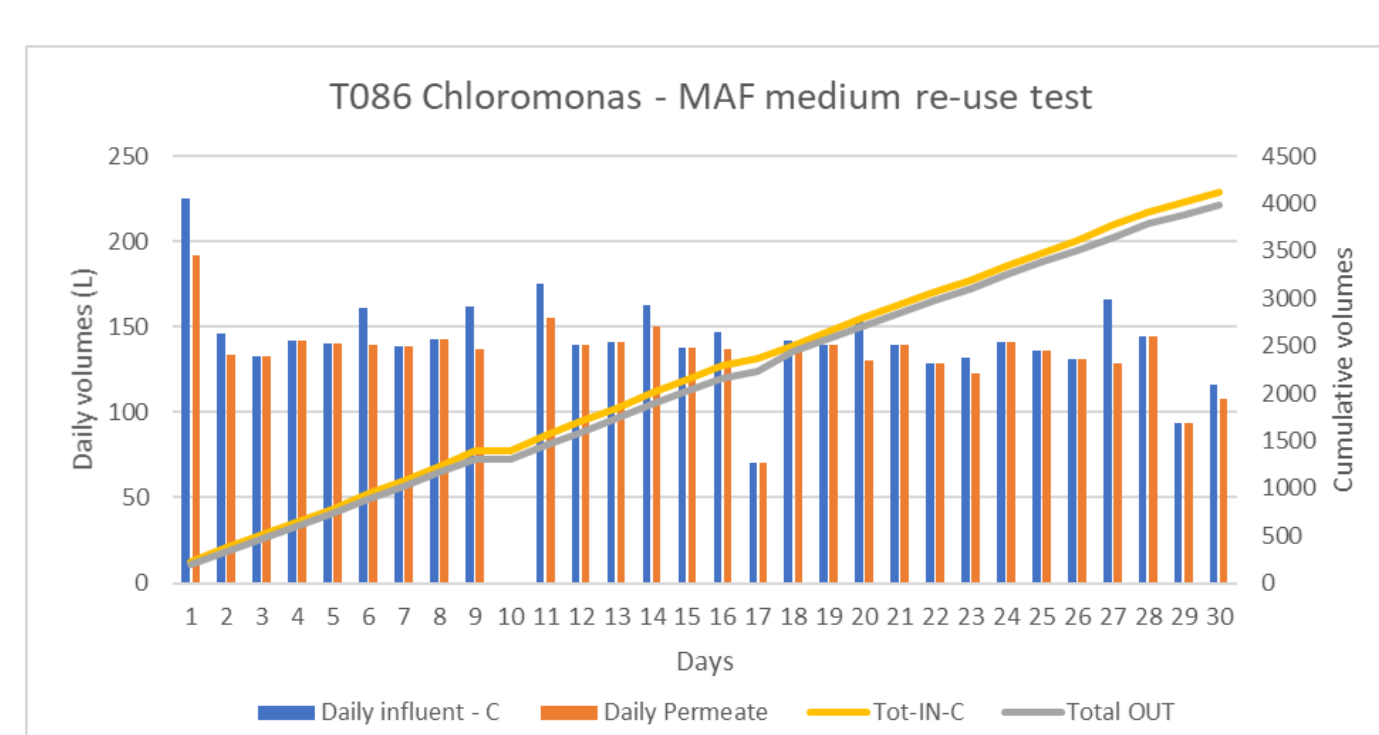


Figure 3: Daily & cumulative MAF results with *Chloromonas typhlos*.



Results Nannochloropsis

Set-up:

- MAF-2 (UF; 1,3 m² membrane surface)
- Linked to 1,5 m³ photobioreactor
- Turbidity guided harvest with
- Maximal daily harvest 300 L/d (20%)



Figure 4: MAF connected to photobioreactor in Sunbuilt (Belgium)

Performance:

- Period: 26/4-10/5/2021; 31/5-1/6/2021
- Average daily harvest: 123-108 L/d (< 10%) – turbidity limit
- Stressed culture from start by CO₂ supply issue & challenging nutrient dosing → inorganic precipitated on membranes
- Average medium recycling: 91-95 %

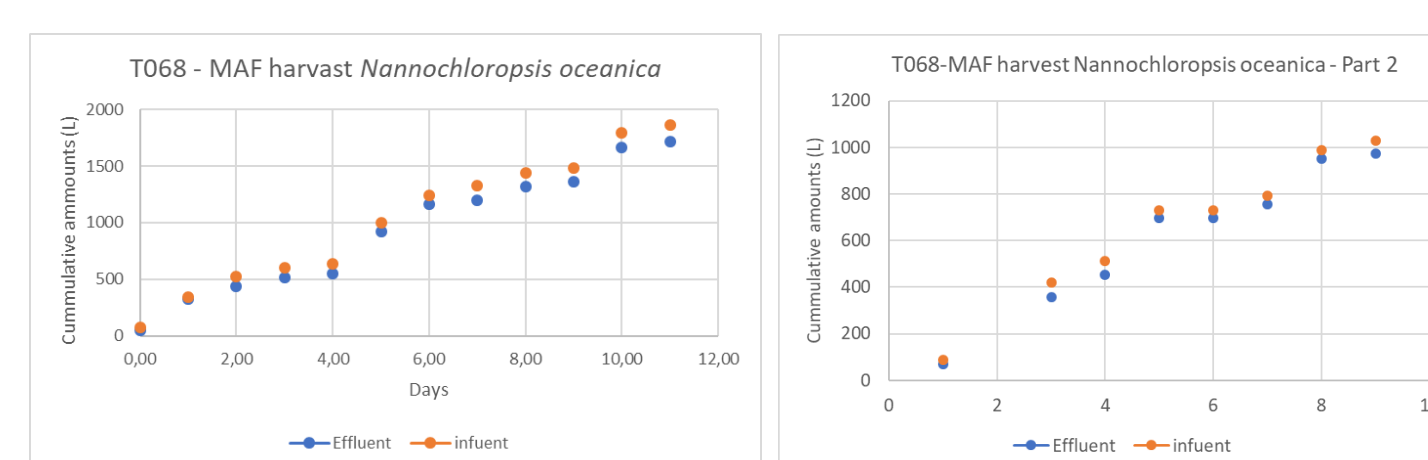


Figure 5: Cumulative MAF results with stressed *Nannochloropsis*.



Results Scenedesmus

Set-up:

- MAF-3 (UF; 2,7 m² membrane surface)
- Linked to 1.8 - 2.4 m³ photobioreactor
- Turbidity guided harvest
- Maximal daily harvest: 400-800 L/d (20-40%)



Figure 6: MAF connected to photobioreactor in Jülich (Germany).

Performance:

- Period: 8/6/2021 - ongoing
- Harvested sofar: > 9500 L
- Average medium re-use: 95%
- Very good algae growth

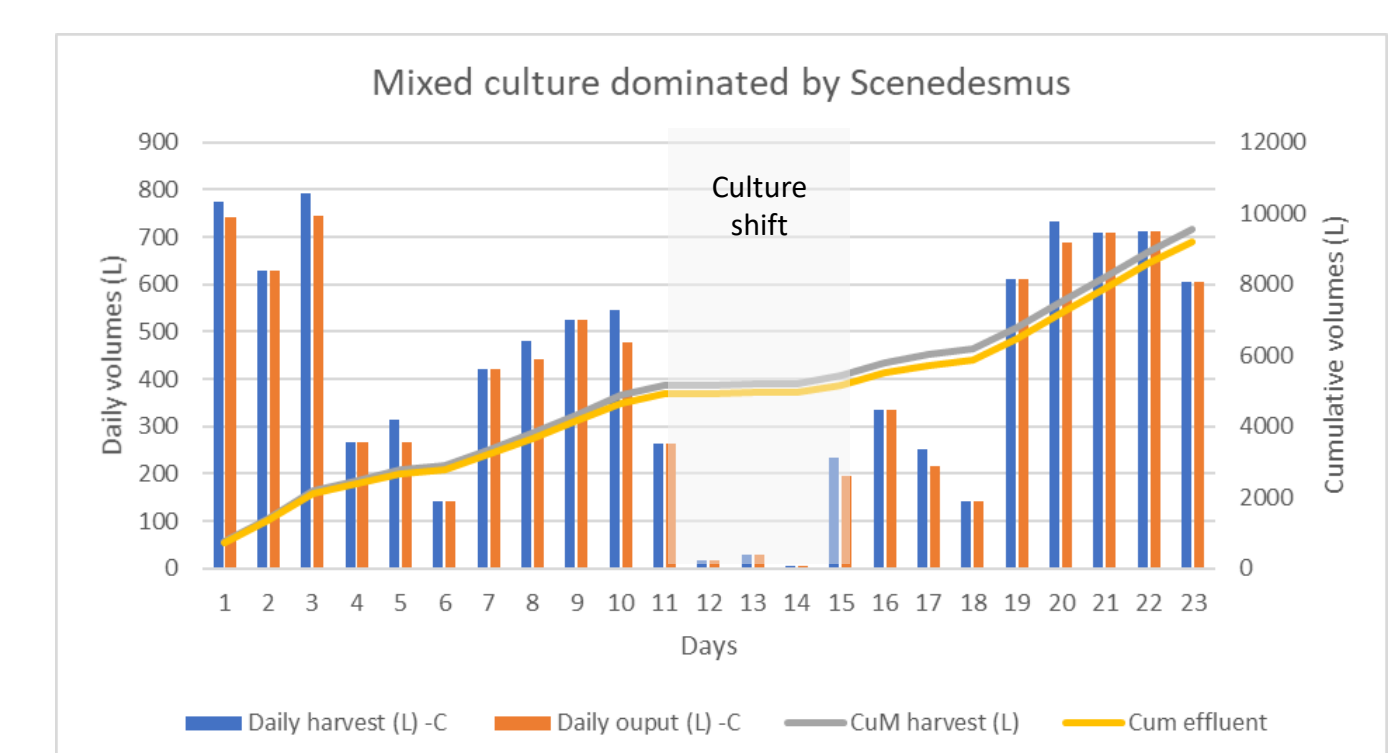


Figure 7: Cumulative MAF results - *Scenedesmus* sp. dominated mixed culture.

