ALGAE BIOMASS HARVESTING FROM OPEN POND USING THE MEMBRANE-BASED MAF TECHNOLOGY: LONGER-TERM FIELD OPERATIONS

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Introduction

- At Yara Sluiskil, two 100 m³ algae open pond systems are operational for reducing the nitrogen content in the regeneration water from a demineralization unit.
- Challenge = efficient harvesting of large volumes of low-density algae from open pond systems.
- Good dewatering results were obtained in off-site MAF trials per; Volume concentration factors (VCF) of > 200 were realized with a low density influent.

Aim of the study = Evaluate long-term performance of the MAF-technology for continuous preconcentration of the mixed algae biomass from the open pond

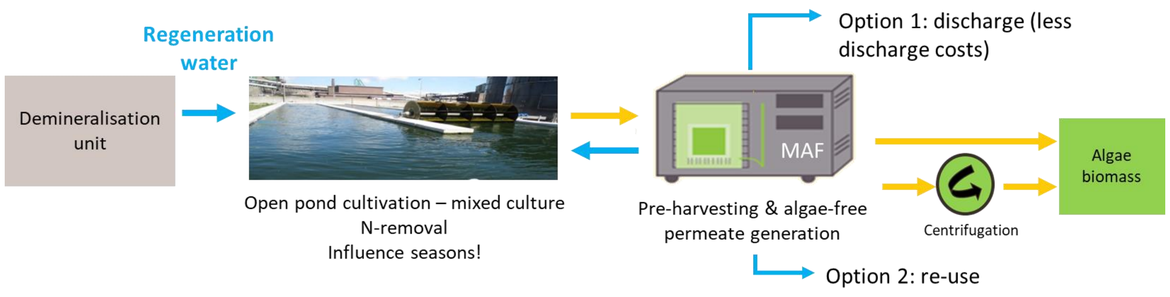

Figure 1: Continuous harvest with preconcentration of algae biomass via the VITO MAF-technology.

MAF-technology

- MAF = Membrane-based Algae Filtration
  - Submerged membranes (UF)
  - PLC controlled; remote controlled
  - Mild harvesting (low shear stress)
  - Continuous harvesting → higher algae growth rates

Conclusions

- Two longer-term continuous MAF harvesting trials were realized, treating > 240 m³ of algae suspension.
- A stable and robust operation of the MAF algae harvesting technology was observed.
- Volume Concentration Factors up to 100 were reached, of which 98 % was converted into clear permeate.
- Backwashable membranes enabled to reduce maintenance from a weekly to an intervention every 2-3 weeks.
- To be investigated: impact of the harvesting approach on the algae production yield in the pond – an improved yield is expected.

Results

- End of September 2022, a pilot MAF unit was installed next to the open pond under a shelter and was connected to the open pond (Figure 2 & Figure 3).
- During two test periods, lasting 70 days (till mid-Dec,) and 50 days (Jan,-March), the PLC controlled system was operated continuously (24/24 and 7/7) – table 1.
- At regular timepoints, samples were collected from influent, permeate and the MAF-concentrate (Figure 4).

Table 1: Pilot MAF-harvesting information related to harvested amounts, volume concentration factors (VCF), medium re-use and fluxes.

Phase	#days	Amount feed (L)	VCF	Cleaning	Medium reuse (%)	Flux (L/hm²)
Day 1-6	5	11879	84	x	98,9	98 --> 40
Day 6-8	2	5916	36		97,8	
Day 8-12 (2)	5	9090	64	x	97,2	30 --> 18
Day 12-15	3	5673	31		97,8	40 --> 18
Day 15-19	4	10242	71	x	98,7	44 -->20
Day 19-22	3	7943	53		98,4	
Day 22-26	4	9098	64		98,6	21 --> 21
Day 26-29	3	4569	47	x	97,2	21 --> 21
Day 29-35	6*	16036	80		99,2	21 --> 21
Day 35-40	5	6306	44		98,0	21 --> 18
Day 40-42	2	4428	30	x	97,1	21--> 21
Day 42-48	6	14287	98		99,1	21 --> 21
Day 48-51	3	7498	51		98,3	21 --> 21
Day 51-54	3*	3783	26		96,6	21 --> 21
Day 54-58	4	9859	68		98,7	35 --> 21
Day 58-61	3	6677	46		98,1	21 --> 21
Day 61-64	3	7553	52		98,3	21 --> 21
Day 64-68	4	6944	48		98,1	21 -->12
Day 68-70	2	3391	23	x	96,2	12 --> 15
Total	70	151172			98,3	
Phase	#days	Amount feed (L)	VCF	Cleaning	Medium reuse (%)	Flux (L/hm²)
Day 0				x		
Day 1-7	6	12962	94		99,0	21 --> 21
day 7-13	6	7465	65	x	98,3	18 --> 12
Day 13-20	7	14213	103		99,1	21 --> 18
Day 20-27	7	12979	94	x	99,0	21 --> 18
Day 27-34	7	10847	90		98,8	21 --> 21
Day 34-41	7	15524	112		99,2	32 --> 21
Day 41-49	8	15678	113		99,2	21 -->18
Day 49-50	2	3961	30	x	96,7	21--> 18
Total	50	93629			98,9	

Biomass collection

Biomass collection

Robustness & reliability evaluation

* Electricity issues

Figure 2: Pilot MAF-harvesting equipment in shelter near algae pond, comprising MAF-device (right) & cooled storage vessel for AMF-concentrated algae (left).

Figure 3: Extraction point of algae suspension from the open pond (left), clear MAF-permeate (middle), algae biomass sampling from MAF (right).

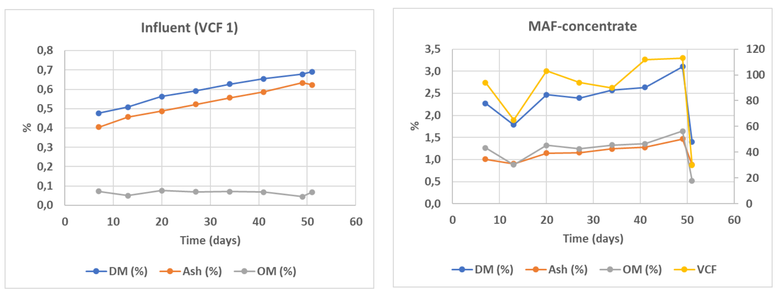

Figure 4: Composition of influent (left) & MAF concentrate (right). During the first 70 days, the DM content varied between 0,6 and 0,7 %. During the very cold break the biomass density was reduced but increased gradually after restart of the experiment. Most of the dry matter in the influent consists of ash.

IDEA - Implementation and development of economic viable algae-based value chains (NWE639)

Duration: 9/2017 – 10/2021, capitalisation till 12/2023

Website: www.nweurope.eu/IDEA

Lead partner: VITO, Belgium

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