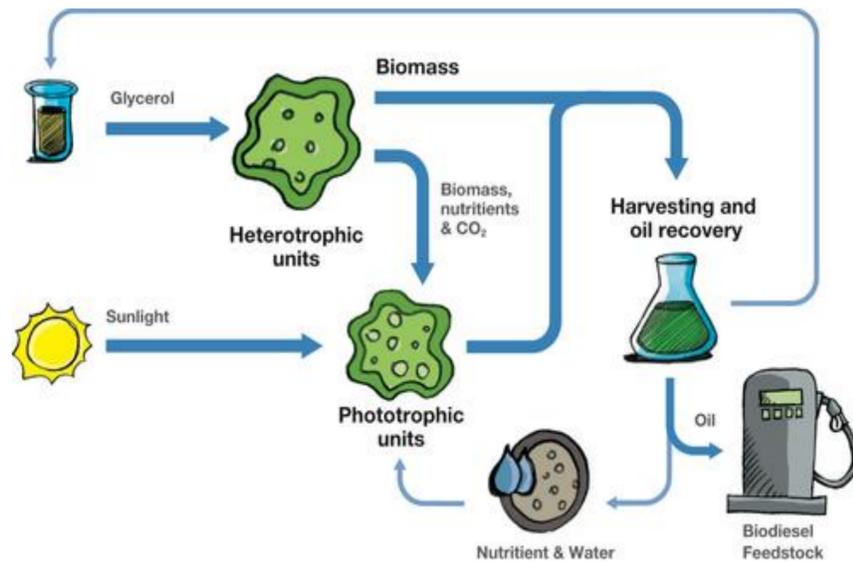


Microalgae flocculation as harvesting process in the EU project InteSusAl

InteSusAl the project



The Partners



Harvesting

Flocculation for pre-concentration of the microalgae suspension has been tested for the selected microalgal species:

- Chemical flocculation through the addition of inorganic or organic flocculants
- Bioflocculation (increased pH levels)
- Co-bioflocculation, in which microalgae species with a propensity to flocculate will be used to flocculate the species of interest.

Approach

The Algae

Chlorella protothecoides

- Peptone medium
- T: 25C
- pH: 6.8

Phaeodactylum tricornutum

- Saltwater like medium
- T: 25C
- pH: 7.5

Nannochloropsis sp.

- saltwater like medium
- T: 25°C
- pH: 7.5

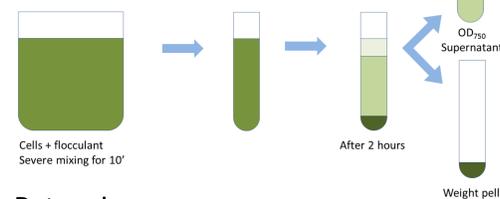
- 1) Batch growth
 - Light increase stepwise (50, 100, 200, 400 μmol m⁻² s⁻¹)
- 2) Turbidostat
 - Cells are in continuous steady state (growth phase)
 - Every day fresh supply of biomass



Cultivation

Flocculation

Test all flocculants in tubes:



Determine:

$$1) \text{ Recovery (\%)} = \frac{OD_{750}(t_0) - OD_{750}(t)}{OD_{750}(t_0)} * 100$$

$$2) \text{ Concentration factor (CF)} = \frac{M_{\text{initial suspension (gram)}}}{M_{\text{pellet (gram)}}$$

pH flocculation tests in photobioreactor

- Increase pH by shutting off CO₂ supply
- Addition of NaOH to increase pH further to 10.5
- Shut down mixing (aeration)

Medium re-use

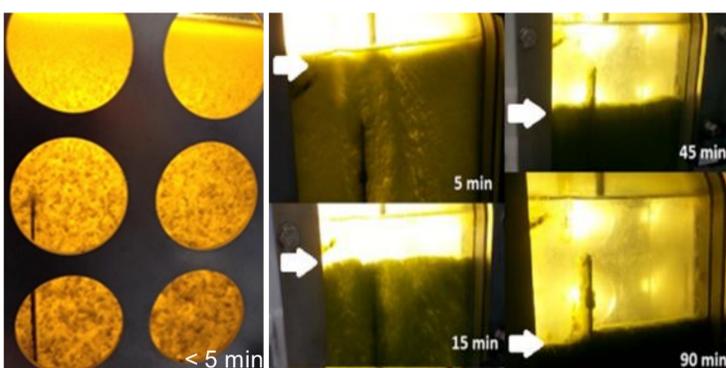
After growth + flocculation:

- 1) Treat supernatant:
 - a. No treatment
 - b. Replenish nutrients
 - c. Filter + replenish nutrients
 - d. Centrifuge + replenish nutrients
- 2) Grow microalgae on supernatant in Erlenmeyer flasks

Results

Flocculation – tube tests	<i>C. protothecoides</i>			<i>P. tricornutum</i>			<i>Nannochloropsis sp.</i>
	RE [%]	CF [-]		RE [%]	CF [-]		RE [%] and CF [-]
SNF H538	52	9.4	SNF H538	95	4.3	SNF H538	✗
BASF ZETAG 7557	97	5.1	BASF ZETAG 7557	98	5.6	BASF ZETAG 7557	✗
Synthofloc 5080H	77	13.5	Synthofloc 5080H	94	3.9	Synthofloc 5080H	✗
Chitosan	99	6.6	pH 10.5	77 - 97	1.1	pH	✓
pH 12.0	75	7.1	pH 10.0	99	1.2 – 2.0	Al ₂ (SO ₄) ₃	✗
pH 11.5	34	24.4	pH 9.5	43 - 97	2.3 – 15.4	Fe(III)Cl ₃ ·6H ₂ O	✗
pH 11.0	26	28.6	pH 9.0	65 - 79	4.5 – 11.0		

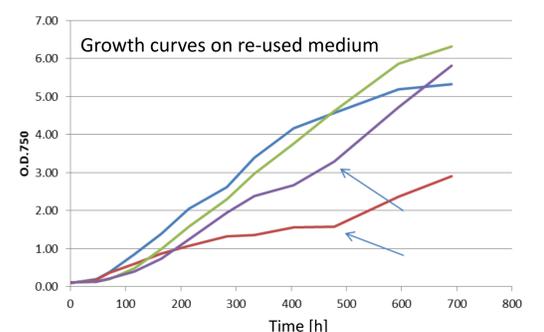
Flocculation – reactor tests



Medium re-use



- (1) untreated;
- (2) centrifuged medium;
- (3) filtered medium;
- (4) filtered + nutrients;
- (5) fresh medium



Conclusion

An excellent flocculant must be cheap, available at industrial scale, safe, do not modify the quality of biomass separated, do not compromise the quality of remaining water and useful for a larger variety of strains as possible. Flocculation by increasing pH proved to be best when taking these aspects into account.