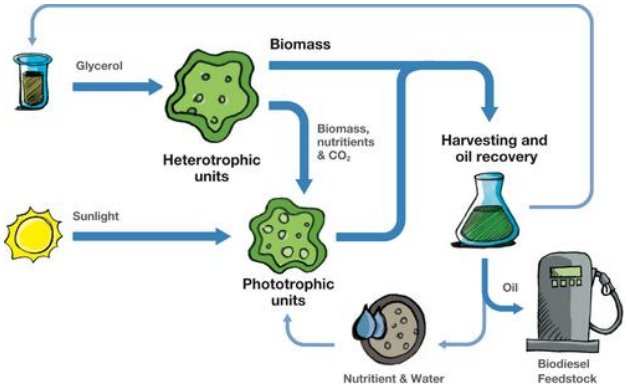
Microalgae flocculation as harvesting process in the EU project InteSusAl

Dorinde Kleinegris, Ben van den Broek, Maria Barbosa

Wageningen UR – Food & Biobased Research, The Netherlands



InteSusAl – the project

- Collaborative project across 6 partners, 4 countries in Europe
- To produce 90-120 dry tonnes per hectare per annum
- Demonstration project to integrate heterotrophic and phototrophic production technologies
- Bio-diesel glycerol used as carbon source to heterotrophic unit
- Demonstration at 1 hectare pilot unit, then 10 hectare operations
- Biomass validation for conversion to biodiesel
- Sustainability, economic and environmental, of demonstration units via life cycle analysis

Harvesting

Flocculation for pre-concentration of the microalgae suspension will be tested for the selected microalgal species:

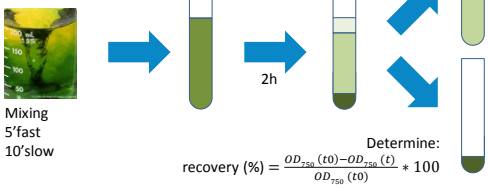
- Chemical flocculation through the addition of inorganic or organic flocculants
- Bioflocculation (increased pH levels)
- Co-bioflocculation, in which microalgae species with a propensity to flocculate will be used to flocculate the species of interest.

Approach

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

Phaeodactylum tricornutum
- Saltwater like medium
- T: 25C
- 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



Determine:

recovery (%) $= \frac{OD_{750}(t0) - OD_{750}(t)}{OD_{750}(t0)} * 100$

Results

Tested flocculants	*C. protothecoides* Conc. / pH / ratio F:NF algae tested	*C. protothecoides* Max. recovery (%)	*P. tricornutum* Conc. / pH / ratio F:NF algae tested	*P. tricornutum* Max. recovery (%)
Non-ionic and anionic polymers	10 ppm	-	10 ppm	-
Cationic polymers	5 – 10 ppm	99.7	1 – 16 ppm	97.7
Cationic starch	4 – 16 ppm	93.5	10 ppm	-
Chitosan	6 – 14 ppm	99.4	10-40 ppm	98.0*
pH	pH 7 - 12	74.8	pH 9 - 12	99.0
pH and extra Mg (0.15 mM)	pH 7 - 12	81.0	pH 9 - 12	99.0
Co-bioflocculation (*Ettlia texensis* or *Tetraselmis suecica*)	1:1 – 2:3 – 1:2 – 1:3 – 1:9	49.5	n.d.	n.d.

*good inflocculation but didn't sink to bottom

Conclusions and next steps

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 lager variety of strains as possible. For the best flocculants from the above experiments these aspects will be tested at lab scale. In the end, the most optimum flocculation method will be tested at large scale and implied in the demonstration project.