

## Nattviken's new cultivation system for microalgae

*Nattviken Invest AB has resumed growing microalgae in its laboratory at Mid Sweden University facility in Härnösand since October 2018. The cultivation system has undergone some modification from the former set-up and a powerful centrifuge (originally thought for engine waste oil cleaning) was implementing for biomass harvesting.*

### A NEW CULTIVATION SET-UP

Originally Nattviken's microalgae cultivation system consisted of a tubular transparent plastic bag laying on a table slightly sloped to allow natural water flow placed under a series of led lights.

The cultivation media from an open storage tank placed under the bag at the lower end of the table was then pumped up to the upper end, from there the media flowed into the bag under the led lights for then coming back to the storage tank by gravity through a hole at the end of the bag.

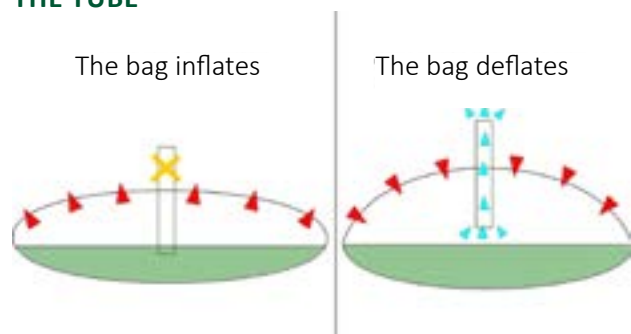
Nutrients were added in form of N-P-K solution (commercially available as gardening fertilizer). Air was also injected into the stream with a small compressor to ensure carbon dioxide availability in the water. See pictures below:



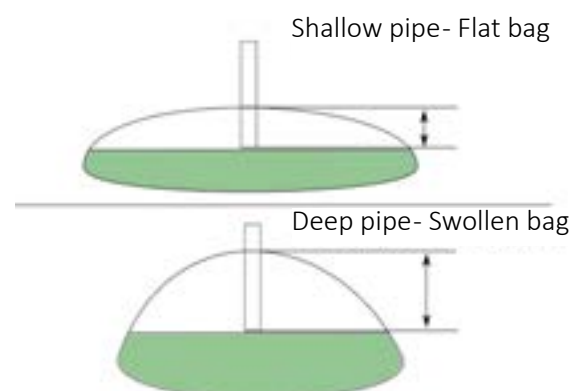
Nevertheless dosing the airflow in the bag was not an easy task as the bag was not equipped with any relief valve and therefore blew up.

One of the key aspects of Nattviken's cultivation system is its simplicity and therefore a very simple as much as effective solution was found to the air dosage problem: a small hole was opened at the end of the bag and a little plastic tube was inserted vertically.

### THE TUBE



The tube acts as a self regulating valve: when the end of the tube is submerged in the cultivation media no air can escape the bag so it will start inflating, the bag lifts the tube when inflating allowing the air to escape. See the picture above.



The bag "stabilizes" with the tube's tip oscillating in and out the media surface. Thus, the depth of the little tube inside the bag also allowed to determine the shape of the bag itself (See picture above).

## THE BIOMASS HARVESTING

At least 3 multi-species microalgae batches has been cultivated at Nattviken's laboratory since October 2018 yielding more than 2kg of microalgae pasta.

A centrifuge able to generate up to 10.000 times the gravitational force was used to harvest the biomass. (See pictures below)



The extracted biomass (microalgae pasta) had a dry matter ranging between 30% and 40%.

## RESULTS

### Self sufficient

The system proved to be almost completely self sufficient: under 7 month the only work required to maintain its operativity consisted of adding nutrients and water to obviate evaporation.

Especially in the longer cultivation runs (over 30 days), a layer of biomass used to deposit and attach to the bottom of the bag, this layer starts thickening up accumulating more and more biomass.

### Alien organisms

Given the open nature of the system towards air and tap water, some alien organisms were found in the harvest. Some of these alien organisms morphology happened to be really thin and long (like spaghetti) See picture below.



## Skeins bundling up

In extremely long cultivation runs (over 60 days), skeins of these spaghetti-like organisms began to bundle up together with other microalgae and small air bubbles, resulting initially in algae-clumps formations and later in a coagulated foam floating on the media surface in the bag and incapable of being recirculated down in the storage tank. The so formed foam started shading the stream underneath and the microalgae struggled to grow ever since.

## Growing peak

Nonetheless the growing peak of the algae batch normally occurs after 3 weeks (when using residual media from a previous batch) while the first algae clumps do not start to form before approximately 5 weeks.

## The centrifuge

Despite being designed for engine waste oil, the centrifuge have successfully served its purpose of biomass harvesting from water media. The residual water media discharged from the centrifuge was still rich in microalgae not damaged from the process, therefore a new batch was always able to start growing from the centrifuged media.

The centrifugation process preserved the microalgae cell structure intact. The specimens obtained by diluting the algae pasta was good enough to recognize the algae morphology under an optical microscope without any struggle.

## FUTURE WORK

Moreover in the short future Nattviken Invest AB will investigate on the potential of turning the natural algae coagulation/foam occurred in its bag system into an advantageous passive filtration method.

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