

## **Technology Brief**

### **Membrane Filtration-based Algae Dewatering System**

Several algae derived products are being developed for a variety of applications, in nutraceutical, vitamins, food supplements, and animal/fish feed industries. Algae is also being considered as a promising renewable bioenergy source because of high oil content of certain algae strains. Algae grown in open ponds or in closed PBRs are very dilute with < 1 gm/liter solids concentration. The whole cell algae concentration must be increased substantially for optimal downstream processing and conversion to produce algal products. Because of very dilute algae concentrations and consequently very large volumes of water that must be processed, harvesting and concentrating algae contributes a significant cost to algal products. Reduction of capital and operating costs of algae harvesting and concentration step is essential to make algal products economical.

Techverse, Inc. has developed a membrane filtration-based, continuous, algae dewatering process to produce algae paste in a U.S. DOE SBIR project. The membrane process utilizes SmartFlow Technologies' "open channel" membrane module technology that allows free flow of high solids concentration fluid streams enabling production of algae paste and superior membrane performance compared to other membrane filtration systems. The Phase II pilot scale continuous-flow system (Figure 1) consisted of three membrane stages with a total membrane area of 3.8 m<sup>2</sup> and was designed for dewatering ~1% w/w algae feed, at a rate of ~100 L/hr producing a continuous, steady state, ~20% w/w algae paste discharge. Algae is fed continuously from a storage tank (not in the picture) through a feed tube seen on the right side of the photo. After reaching steady state, concentrated algae paste is continuously collected in the blue bucket hanging below the bleed tube. Smaller, single stage, lab scale, 0.1 m<sup>2</sup> membrane area (Figure 2) and field scale, 0.8 m<sup>2</sup> membrane area (figure 3) systems, suitable for initial feasibility studies, were demonstrated during Phase I project in a batch mode.

During the first year of Phase II, the pilot system testing was conducted using several algae strains of industrial interest, with feed of pre-concentrated 0.3 % w/w to 2 % w/w algae, demonstrating continuous, steady state, algae paste production in short 4 to 7-hour tests at Arizona Center of Algae Technology and Innovation (AzCATI) facilities. Generation of algae paste of >20% w/w concentration was demonstrated for all algae strains tested with appropriate test parameters. During the second-year of Phase II, several long term (24-hr) dewatering tests were conducted to demonstrate, run-on-run, reproducible algae dewatering performance with a membrane cleaning in between runs. In these tests, the algae were grown as a part of a wastewater treatment process. Gravitational settling enhanced either by chemical coagulant or bio-flocculation were used for pre-concentrating algae for feeding in to the pilot scale system.

Our membrane filtration-based algae dewatering systems are modular and can be designed for any scale - from a small lab demonstration scale to an intermediate pilot scale to a full production scale - system to process harvested algae of any strain at any specified feed rate and feed concentration to produce desired product algae concentration with no loss of algae in the permeate.

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**Figure 1.** Photo of the Phase II continuous flow pilot scale algae dewatering skid



**Figure 2.** Photo of Phase I lab scale batch system



**Figure 3.** Phase I field scale batch system