Hydrodynamic Separation:
Cost-effective dewatering of microalgae for biofuels

PARC’s hydrodynamic separation (HDS) innovation provides a compact, low-energy, cost-effective method to dewater microalgae for biofuels and other applications.

OVERVIEW: Opportunity
The search for commercially viable alternative energy sources to fossil fuels has been underway around the world. Among them is to make biofuels using microalgae that are easily accessible in most geographical areas and has the highest oil productivity per acre of any biofuel crop. One of the challenges, however, is the cost of extracting microalgae from the surrounding fluid given that the concentration of microalgae grown in ponds is normally much less than 1% and that microalgae is nearly neutrally buoyant.

Many separation methods such as filtration and centrifuging are available, but most of them require a fair amount of energy. To make microalgae biofuel commercially viable, it is critical to develop a more cost-effective way to harvest them. PARC’s HDS technology provides a cost-effective and energy-efficient way to separate microalgae from the surrounding fluid and concentrate them without destroying the algae cell structure.

PARC solution
Regardless of the shape of microalgae, PARC’s HDS technology can effectively separate them from the surrounding fluid with low energy input. So far, the experiments have been conducted using filamentous microalgae like Spirulina and single cell microalgae such as Chlorella vulgaris, resulting in over 97% and 86% harvesting efficiency, respectively. By cascading multiple channels, concentration higher than 10g/mL can be achieved.

PARC’s HDS technology:
- Efficiently removes particles or flocs using no physical barriers or moving parts
- Separates neutrally buoyant, suspended particles and flocs
- Uses low energy
- Yields high throughput
- Reduces overall system footprint to fit in space-constrained areas
- Scales up easily based on modular architecture
**How it works**

Relying on no physical barriers, PARC's HDS technology carefully balances a combination of fluidic forces to separate particles (solids, flocs, and emulsions). Centrifugal force creates transverse flow patterns in a curved channel, which under certain circumstances manifest themselves as a pair of Dean vortices, as shown in *Figure A*. As particles flow down the channel, they spiral around the Dean vortex cores while a combination of drag and shear-induced forces move them toward the channel center. Under the correct conditions (specified by channel geometry and flow rate), this dynamic causes the particles to focus into a band near the outside wall. At the end of the length of the channel, the single flow is separated into two flows: the concentrate and effluent outputs, as shown in *Figure B*.

Although HDS technology leverages centrifugal force, it is different than centrifuges and hydrocyclones. Instead of relying on density differences between particles and fluid, HDS technology is solely based on hydrodynamic forces, resulting in a particle size dependent separation that allows for direct concentration of particles of any density, including neutrally buoyant ones.

Scaling the volume throughput can be achieved by assembling channels, in parallel, into modules, with a common source water inlet distributor and common effluent and concentrate collectors, as shown in *Figure C*. Depending on application, modules can then be combined into compact stacks to achieve the required throughput.

**Take action**

PARC is interested in working with commercial partners who want to use the technology for microalgae dewatering or similar applications.

Please contact Business Development:
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