Hydrodynamic Separation: Innovative solutions for wastewater treatment

PARC’s Hydrodynamic Separation (HDS) provides a compact, low-energy, cost-efficient method of concentrating biomass in wastewater processes.

**OVERVIEW:**

**PARC solution**

PARC’s HDS technology can separate particles and flocs, including neutrally buoyant ones, without physical barriers or moving parts. It uses low energy and scales easily to handle higher throughput. It can be deployed in various stages of wastewater treatment processes with little impact on the available footprint.

**Harvesting organics to reduce energy use**

Wastewater treatment is a very energy-intensive process, and the aeration process consumes nearly 60% of the total energy used at a treatment plant. By applying HDS to recover suspended organics in primary clarifiers, energy needed for the subsequent aeration process for carbon oxidation can be reduced by as much as 15% and the size of bioreactors can be 20% smaller. In addition, if the recovered organics are transferred directly to anaerobic digesters connected to cogeneration facilities for methane production, 20% or more energy can be recovered for the treatment plant.

**Concentrating MLSS to reduce the number of secondary clarifiers**

In activated sludge treatment systems, mixed liquor suspended solids (MLSS) is removed in secondary clarifiers through settling and either returned to bioreactors or processed as waste activated sludge. Since MLSS is neutrally buoyant, the settling process is very slow and requires large surface areas of clarifiers. HDS can efficiently remove neutrally buoyant particles and flocs without significantly impacting the available footprint. By applying HDS before secondary clarifiers to concentrate MLSS to return it back to the bioreactors, the solid loading rate to the clarifiers can be greatly reduced. As a result, the total number of clarifiers needed at a treatment plant can be reduced by as much as 50%.
Other applications
PARC’s HDS can be used for other applications including:

<table>
<thead>
<tr>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction of solid loading rate to membrane bioreactors (MBRs)</td>
</tr>
<tr>
<td>Removal of fine sands</td>
</tr>
<tr>
<td>Removal of oil, fats, and grease</td>
</tr>
</tbody>
</table>

How it works
Relying on no physical barriers, HDS 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 manifests themselves in a pair of Dean Vortices. As particles flow down the channel, they spiral around the Dean Vortex core while a combination of drag and shear-induced forces move them toward the channel center. Under the correct conditions (specified by the channel geometry and flow rate), these dynamic forces cause 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 the effluent.

Although HDS leverages centrifugal force, it is fundamentally different than centrifuges and hydrocyclones. Instead of relying on density differences between particles and fluid, HDS is solely based on hydrodynamic forces, resulting in 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 creating modules. These are assembled with multiple channels in parallel, a common source water inlet distributor, and common effluent and concentrate collectors. Depending on the application, modules can then be combined into compact stacks to achieve the required throughput. By cascading several HDS channels in series, higher concentration can be achieved. We currently have two HDS designs: one for particles and another for flocs. Each design has different channel dimensions, performance specifications, and operating requirements.

Pilot system deployed in the field
In 2012, PARC received a Public Interest Energy Research (PIER) grant from the California Energy Commission to deploy a pilot system at a local wastewater treatment plant to demonstrate the HDS technology. The 40 LPM pilot unit has four sequential stacks of HDS channels connected in a way that the concentrate from each stack feeds into a smaller stack of HDS channels, increasing the concentration at each stage by fivefold. The system is designed to recover 70% of solids in 0.2% of the volume. The pilot system is currently deployed at a wastewater treatment plant in California.

Apply HDS in your wastewater treatment systems
PARC can help commercial partners who are interested in applying the HDS technology in their wastewater treatment facilities. Contact Business Development at engage@parc.com