Lotus: the company

Lotus Filter Systems S.L. is a recently formed company with a fully consolidated Floating Treatment Wetland (FTW) wastewater treatment technology known as “Lotus Laguna”. This technology is protected by US patent 8889006 and is being extended to more than a dozen countries through the Patent Cooperation Treaty WO 2014 113768 A1.

Although the company has been recently formed its Engineering and Design staff has participated in design, construction and maintenance of more than 150 FTW wastewater treatment facilities for urban and industrial wastewater.

At present the company has satellite offices throughout in Spain and Peru with expansion plans for other countries.
The basics of Lotus Laguna technology

Lotus platforms, with specially selected aquatic plants, are set afloat upon the surface of new, or existing, treatment lagoons with aerobic, anoxic and anaerobic treatment areas.

The platforms hold the plants in vertical position till they develop a thick mat of roots and rhizomes which may grow to a depth of 70 cm. and provide waste degrading bacteria a massive support to form biofilms essential for the treatment of wastewater.

Once installed Lotus installation requires little, or no, energy to operate, has minimal maintenance and provides decades of reliable and sustainable wastewater treatment.
Biological Curtains

The effectiveness of Lotus technology is due to the exposure of wastewater the greatest possible quantity of waste degrading bacteria in aerobic, anoxic and anaerobic treatment zones. To obtain this efficiency, besides providing a support for aquatic plants, each Lotus platform provides a number of proprietary Polypropylene bioreactor reactor curtains, commonly referred to as “Biological Curtains”. These act as a physical support upon which bacteria form biofilms at varying depths
Hydraulic Curtains

Each Lotus installation is sloped to form aerobic, facultative and anaerobic zones.

“Hydraulic Curtains”, made of the same meshed material as the Biological Curtains, channel the wastewater through the facility exposing it to the maximum amount of roots and rhizomes as well as bioreactor curtains.

To minimize the use of energy the wastewater is gravity fed through the entire facility. Solar power may be used for the primary treatment systems, and the effluent recycling equipment to eliminate the maximum amount of nutrients, such as Nitrogen and Phosphorous.
Lotus curtains and the creation of biofilm

Lotus technology relies upon bacteria to process wastewater into clean water. Besides relying upon the aquatic plants to maintain massive amounts of physical support for biofilms to thrive upon, it’s proprietary polypropylene curtains create an environment most suitable to the formation and maintenance of biofilm.

To obtain the maximum digestion of organic waste, and the transformation of nutrients into clean water, Lotus curtains provide the labyrinth mesh-like structures (seen on the right) at aerobic, anoxic and anaerobic treatment depths. At these depths bacteria establish and maintain biofilms at their peak biological efficiency.

As may be seen in the next page, Lotus curtains start creating “Initial Biological Substrate” within 24 hours of being immersed in the waste water and it can grow to a width of about 1 cm. within six months.
Initial Biological Substrate (IBS)

24 hours  10 days  3 months  4 months  6 months
Lotus technology is a synthesis of well established treatment methods

- Lagoon Treatment Systems
- Constructed Wetlands
- Percolating Filters
- Bioreactors
- Physical Filtration Systems
- Active Sludge Treatments
- Anaerobic Reactors
The Lotus synthesis

Lotus Laguna combines the Anaerobic and Aerobic treatment characteristics and synthesizes them into one comprehensive technology.

<table>
<thead>
<tr>
<th>Characteristic Feature</th>
<th>Aerobic Treatment</th>
<th>Anaerobic Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD Processing Capacity</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>COD Processing Capacity</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Kinetic Reaction</td>
<td>Fast</td>
<td>Slow</td>
</tr>
<tr>
<td>Hydraulic Retention Time</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Sludge Yield</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Odor Problems</td>
<td>Potentially Low</td>
<td>Potentially High</td>
</tr>
<tr>
<td>Startup time</td>
<td>2-4 weeks</td>
<td>2-4 months</td>
</tr>
<tr>
<td>Post Treatment</td>
<td>Discharge or filtration</td>
<td>Aerobic</td>
</tr>
<tr>
<td>Physical Foot-Print</td>
<td>Large and dispersed</td>
<td>Small and compact</td>
</tr>
<tr>
<td>Carbon Foot-Print</td>
<td>High to Very high</td>
<td>Low</td>
</tr>
</tbody>
</table>

As a result Lotus Laguna treats wastewater using little, or no energy, producing minimal sludge, preventing the proliferation of mosquitos and avoiding foul odors.
Cost comparisons

Installation Costs

In comparison to the installation cost of the most commonly used decentralized treatment technologies, Lotus proves to be the lowest cost alternative for small communities.
Maintenance and Operating Costs

In comparison to the operating and maintenance costs of the most commonly used decentralized treatment technologies, Lotus again proves to be the lowest cost alternative for small communities. Its simple protocols and procedures are able to be carried out by personnel without much training, while installation parameters may be monitored from the Lotus Central Office.
10 year Installation, Maintenance and Operating Costs

In comparison to the 10 year installation, operating and maintenance costs of the most commonly used decentralized treatment technologies, Lotus proves to be the lowest cost alternative for small communities.
Lotus Applications

- Decentralized wastewater treatment from small and medium municipalities, residential developments, hotels, malls and restaurants.
- Re-utilization of outdated lagoon systems.
- Agricultural and Stormwater runoff.
- Industrial wastewater from:
  a) Concentrated Animal Feeding Operations (CAFO’s) such as pork, beef and poultry.
  b) Aquaculture.
  c) Food Processing.
  d) Meat Processing.
  e) Dairies.
  f) Wineries
  g) Petrochemical and gas industries.
  h) Mining Operations.
Case study of an installation for a small community

Data applicable to installation in a municipality in Badajoz, Spain

Current population: 1,320 inhabitants
Projected future population: 1,516 inhabitants
Flow rate 334 m$^3$/day: 220 liters per person

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Influent Parameters</th>
<th>Required Effluent Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD (mg O/l)</td>
<td>300</td>
<td>25</td>
</tr>
<tr>
<td>COD (mg O/l)</td>
<td>600</td>
<td>125</td>
</tr>
<tr>
<td>SS (mg/l)</td>
<td>350</td>
<td>35</td>
</tr>
<tr>
<td>TN (mg/l)</td>
<td>50</td>
<td>15</td>
</tr>
<tr>
<td>TP (mg/l)</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>
Design parameters

Installation for a community with a population of 1,516.

- **Organic load**: 40-50 gr BOD/m².
- **Land required**: 1.8 m² per person.
- **Distribution**: A 2,376 m² Lotus treatment area with a 400 m² of sand, or constructed wetland, polishing filter.

Installation Sections:

- **Pre-treatment**: sand-grease trap.
- **Biological treatment**: two 1,188 m² ponds with depths ranging from 3.5m at the influent zone to 1m at the effluent zone.
- **Tertiary (polishing) treatment**: one area of 400 m² with a sand filter, or constructed wetland.
Lotus installation for a community of 1,516 persons
The Lotus advantages

Lotus:
1. Requires simple low-cost civil engineering.
2. Requires virtually no energy to operate.
3. Has very low maintenance costs.
4. Eliminates odors and noises.
5. Eliminates sludge and its management.
6. Provides effluent for re-use.
7. Provides a virtually unlimited operational life.
8. May be fitted inside already constructed facilities, obsolete ones, or natural environments.
9. May operate as a primary, secondary and tertiary system.
10. Provides treatment facilities that are pleasant looking, ecologically functional areas with a minimum environmental impact.
11. Prevents the proliferation of mosquitoes.
12. Adapts to surrounding natural ecosystems.
Real-time support for projects throughout the world

From its offices in Seville, Spain, Lotus Filter Systems S.L. provides real-time expert support to its clients located anywhere in the world.

Lotus provides assistance is during:

- The design phase of a project
  - Gathering of pertinent design data
  - Cost analysis and logistics
- The construction phase of a project
  - Provide the knowhow of having constructed over 150 FTW projects
  - Provide the civil engineering support required for project proposal and execution
- The Maintenance and Operation of installations
  - Analysis of effluents
  - Prevention, detection and treatment of the onset of plant diseases.
And,
Lotus is 100% approved by Nature
Let’s talk

Lotus Filter Systems

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