EWS:AOx™ as Next Generation Landfill Leachate Treatment Solution
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Who We Are

- A technology company in water.
- Founded ten years ago.
- Publicly trading on OTC as “OCLN”.
- Our technology has wide application range, so business model is licensing and joint ventures.
- Focusing on early adopters, to shorten the adoption process.
- Electro Water Separation™: an award-winning, patented system, developed entirely in-house.
Electro Water Separation™

- EWS is a two-stage process.
- Uses electrical reactions in real time (no settling or chemicals).
- Effectively clears up very dirty, very oily water.
- Thoroughly proven in the field.

<table>
<thead>
<tr>
<th>Parameter (ppm)</th>
<th>OriginClear Influent</th>
<th>OriginClear Effluent</th>
<th>Removal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Oxygen Demand</td>
<td>20</td>
<td>5.9</td>
<td>71%</td>
</tr>
<tr>
<td>Chemical Oxygen Demand</td>
<td>530</td>
<td>41</td>
<td>92%</td>
</tr>
<tr>
<td>Total Recoverable Petroleum Hydrocarbons (HEM)</td>
<td>142</td>
<td>Non-detect</td>
<td>Complete</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>100</td>
<td>3</td>
<td>97%</td>
</tr>
</tbody>
</table>

Table 1: Water quality data generated by Zalco Laboratories, Sampled on February 18th, 2015

2015 field test on East Bakersfield Produced water
EWS Architecture

• First Stage:
  - Single Step Extraction™ (SSE)
  - Direct contact key to real-time operation
  - Proprietary design of anode nested inside cathode.
  - Choice of donating or non-donating modes.

First Stage: contaminated water travels through a series of electrically-charged tubes.
EWS Architecture

• Second Stage:
  – Concentrated material is drawn into flotation tank.
  – Hydrolysis causes micro-bubble cloud.
  – Material pushed to surface for removal.
• The entire process is continuous and scalable.
2017: Where We Stand

- Now entering commercial scale around the world with licensees and joint venture partners.
- Acquiring profitable companies in the water treatment industry to build manufacturing and distribution capabilities.
- In 2016, developed a next-gen Advanced Oxidation Process, AOx™.
- Now rolling out AOx in combination with EWS.
Landfill Leachate

- Rain water percolated through a landfill’s refuse layer.
- Extremely high concentration
  - COD
  - Heavy metals
  - Pesticides, herbicides
  - Ammonia
What Is The Solution?

- Currently: membranes, bioreactors, filters...

- Advanced Oxidation Process (AOP) is the modern solution:

\[
\begin{align*}
\text{Organic Compounds} & \xrightarrow{\text{OH}^\cdot} \text{Intermediates (Aldehydes, Carboxylic Acids)} & \xrightarrow{\text{OH}^\cdot} \text{CO}_2 + \text{H}_2\text{O} \\
\text{H}_2\text{O} & & \text{H}_2\text{O}
\end{align*}
\]

Hydroxyl Radical (OH\(^\cdot\)) is strongest oxidant used in water treatment.

Hydroxyl Radical is non-selective and reacts fast with many compounds.

Source: APT Water
What Can AOP Do?

- Degrade all organic compounds, including the recalcitrant ones (e.g. drugs, pesticides, endocrine disruptors etc.) all the way to mineralization.
- Successfully deactivate bacteria, viruses etc.
- Oxidize heavy metals.
- Degrade ammonia

Source: SSWM: Advanced Oxidation Processes
OriginClear’s Next-Gen AOP

- Patent filed March 2016 for Advanced Oxidation.
  - Additional patents & trade secrets.
- No reagent injection
- AOx is a strictly electro-catalytic process for broad range oxidation: indirect and direct oxidation.

**AOx is the low-maintenance, energy-efficient, real-time way to address the wide array of contaminants in landfill leachate.**
OriginClear’s Next-Gen AOP

DC Power Supply

Treated Water

H2 Reduced Gas

Inorganic, Gas, Oxidized Species

Indirect Oxidation

Anode Surface Oxidation

Anode

Direct oxidation

ROS

Waste Water COD,BOD

Cathode Surface Reduction

Cathode

Oxidation
AOx Architecture

• Inherits two-stage architecture from Electro Water Separation.

• Stage 1: Direct Oxidation (DO).
  – Water travels through a long series of tubes, bathed in continuous electrical field.
A0x Architecture (cont’d)

• Stage 2: Indirect Oxidation (IO).
  – Water comes out of tubes into tank with electrodes in a mesh configuration lining the bottom of the tank, creating gaseous cloud in the water.
  – These stages can be run separately or in combination.

Mesh electrodes used for Indirect Oxidation
Introducing…

Landfill leachate treatment
Leachate treatment: In the lab

• OriginClear in-house test equipment
  – Kunshan, China
  – Los Angeles, CA

• Joint R&D projects
  – Florida Atlantic University, USA
  – ENSIL-ENSCI, France
Leachate treatment: On site pilot

- Complete treatment chain demonstration done in Shenyang, China.
## Leachate treatment: various results

<table>
<thead>
<tr>
<th>Description</th>
<th>Initial COD mg/l</th>
<th>Initial NH₃ mg/l</th>
<th>Final COD mg/l</th>
<th>Final NH₃ mg/l</th>
<th>% COD removal</th>
<th>% NH₃ removal</th>
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</thead>
<tbody>
<tr>
<td><strong>MK (China)</strong></td>
<td>13,000</td>
<td>7,100</td>
<td>840</td>
<td>2,200</td>
<td>94%</td>
<td>69%</td>
</tr>
<tr>
<td><strong>HK (China)</strong></td>
<td>2,895</td>
<td>3,210*</td>
<td>656</td>
<td>11*</td>
<td>77%</td>
<td>97%*</td>
</tr>
<tr>
<td><strong>WW (M’sia)</strong></td>
<td>830</td>
<td>13</td>
<td>335</td>
<td>0</td>
<td>60%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>LG (China)</strong></td>
<td>2,975</td>
<td>3,500</td>
<td>1,000</td>
<td>610</td>
<td>66%</td>
<td>83%</td>
</tr>
<tr>
<td><strong>NY (China)</strong></td>
<td>2.058</td>
<td>23</td>
<td>204</td>
<td>0.5</td>
<td>90%</td>
<td>98%</td>
</tr>
<tr>
<td><strong>YY (China)</strong></td>
<td>67,584</td>
<td>10,460</td>
<td>16,477</td>
<td>402</td>
<td>76%</td>
<td>96%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>77%</td>
<td>90%</td>
</tr>
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</table>

* Measured parameter is Total Nitrogen
** After initial biological treatment
*** Acronyms (MK, HK, etc…) are internal references for projects
Leachate treatment: System implementation

The latest EWS:AOx™ process is adapted to improve leachate treatment performance.

EWS Electro Flotation:
Feed leachate will be mixed and feed to EWS Electro-flotation unit, majority of TSS, Oil & Grease, metal, non-soluble fraction of COD, TN and heavy metal will be removed. Similar to DAF process but with help of electro-induced microbubble, it has better separation and energy efficiency, in addition, it can partially oxidize some COD and TN.

AOx Advanced Oxidation:
After EWS process, effluent will be fed to AOx advanced oxidation unit where COD, Ammonia will be oxidized. Gas produced from this process will be collected and properly treated before discharging to atmosphere. After this treatment, we can achieve majority of TSS, Oil & Grease, heavy metal, COD and ammonia reduction.
Leachate treatment: System implementation

Advantages of EWS:AOx process

Simplified
Leachate treatment: System implementation

Advantages of EWS:AOx process

Improved Footprint
Leachate treatment: System implementation

Advantages of EWS:AOx process

Reasonable OpEx.
Conventional landfill leachate treatment cost is above US 10$ / m³

Simple system:
Low overall energy consumption
Few chemicals injection points
Easier logistics
Lower maintenance & operation

< 5 US$ / m³ *

* Labor and CapEx depreciation excluded
One more thing…
In-line removal of Glyphosate via advanced Oxidation

From 620 ppb to ND in 45 seconds.

**Certificate of Analysis**

**FINAL REPORT**

Sample Results

(Continued)

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<tbody>
<tr>
<td>POX-T0</td>
<td>Glyphosate</td>
<td>620</td>
<td>25 ug/l</td>
<td>08/25/17 00:12</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>POX-T1</td>
<td>Glyphosate</td>
<td>ND</td>
<td>5.0 ug/l</td>
<td>08/24/17 22:02</td>
<td></td>
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## Our Management Team

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riggs Eckelberry</td>
<td>Founding Chairman and CEO</td>
<td>Multiple dotcom exits including Yellowpages.com in 2004.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prepped CyberDefender for NASDAQ IPO mid 2000s.</td>
</tr>
<tr>
<td>Bill Charneski</td>
<td>President, OriginClear Group</td>
<td>15 years Dow Chemical in management, sales; acquisition and innovation track record.</td>
</tr>
<tr>
<td>Marc Stevens</td>
<td>President, Progressive Water Treatment</td>
<td>Over 15 years, built PWT into solid water player with outstanding reputation.</td>
</tr>
</tbody>
</table>
Thank You!