Water Recovery & Reuse in Garment Manufacturing
Presentation Overview

- Industrial Wastewater Treatment Challenges
- UOP XCeed™ Immobilized Cell Bioreactor technology
- Garment Manufacturing Case Study Data
Production Challenges

- Textile production requires significant volumes of water
- Availability and cost of fresh water can limit production
- Wastewater contains high levels of BOD and COD that must be removed for internal reuse
- Operational cost to treat wastewater for internal reuse can be prohibitive

Production and cost challenges drive need for advanced, efficient biological wastewater treatment
XCeed™ Bioreactor Technology

COMPARTMENTALIZED, PLUG-FLOW DESIGN

High efficiency in a compact design
Key Components

**Bioreactor**
Contains…

**Bio-catalyst**
(Microbes which densely populate the mixed-media)

**Bio-catalyst Support**
(Close-up of mixed-media foam)

Proprietary mixed-media packing
Longer solids retention time promotes:
1) Growth of higher life forms
2) 70-80% less sludge

100 Moles Carbon
As Substrate

40 Moles Carbon
As Microbial Biomass

16 Moles Carbon
As Anaerobes & Protozoa
(rotifers, ciliates & flagellates)

60 Moles Carbon
As CO₂

24 Moles Carbon
As CO₂

16 Moles Carbon
As Anaerobes & Protozoa

9.6 Moles Carbon
As CO₂

6.4 Moles Carbon
As Eukaryotic Biomass
(nematodes, flatworms & mites)

93.6 Total Moles Carbon As CO₂

Conventional Biological Treatment

XCeed™ Bioreactor

60 Moles Carbon
As CO₂

+
Garment Manufacturing Case Study

- Operations in water-constrained area in Latin America
- Local community water supply was impacted by manufacturing water demands
  - Facility implemented water reuse system for finishing operations
Water Reuse System

Primary Treatment:
solids, fibers, and color removal

Secondary Treatment:
organics removal

Tertiary Treatment:
TSS and color removal, when necessary

Equalization Basin

XCeed™ Bioreactor

Washers

Collection

Clean Water

To Point of Discharge

To Closed-Loop Process
Bioreactor System Parameters

- MLSS > 10,000 ppm
- Biomass retention time > 60 days
- Sludge yield: 0.07 – 0.12 kg biomass/kg BOD$_5$ consumed
- Biomass loading: 3.5 – 4.8 kg BOD$_5$/m$^3$/day
- HRT: 3 – 9 hours
- Energy consumption: ~ 25 kw/hr
## System Performance

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Raw Process Effluent</th>
<th>Primary DAF Effluent</th>
<th>Bioreactor Effluent</th>
<th>Secondary DAF Effluent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow (gpm)</td>
<td>200-400</td>
<td>200-400</td>
<td>200-400</td>
<td>200-400</td>
</tr>
<tr>
<td>COD (mg/L)</td>
<td>800-1,000</td>
<td>300-500</td>
<td>100-150</td>
<td>100-150</td>
</tr>
<tr>
<td>BOD (mg/L)</td>
<td>250-350</td>
<td>200-300</td>
<td>0-35</td>
<td>0-25</td>
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<tr>
<td>Turbidity (NTUs)</td>
<td>200-300</td>
<td>50-100</td>
<td>75-125</td>
<td>25-50</td>
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<tr>
<td>Color (PtCo)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finishing</td>
<td>300-400</td>
<td>100-150</td>
<td>75-90</td>
<td>40-60</td>
</tr>
<tr>
<td>Dyeing &amp; Finish.</td>
<td>1250-3500</td>
<td>500-800</td>
<td>300-600</td>
<td>100-150*</td>
</tr>
<tr>
<td>pH (S.U.)</td>
<td>8.0-9.5</td>
<td>7.5-9.0</td>
<td>7.5-8.5</td>
<td>7.5-8.5</td>
</tr>
<tr>
<td>TDS (mg/L)</td>
<td>600-1200</td>
<td>600-1200</td>
<td>600-1200</td>
<td>600-1200</td>
</tr>
</tbody>
</table>

* Hypochlorite post-treatment polishing
Outcomes

• Garment manufacturing facility recovered 80-90% of wastewater for reuse
• Product quality maintained following implementation of water reuse
• Production bottleneck issues associated with water supply were eliminated
• Order backlog was reduced and orders could be filled on demand
• Questions