Water Reclamation System For Electrolux Fabric Care Reliability Lab

Chandler Horton, Gabe Martinez, Samuel Norvell, Tyler Salisbury, Jeremie Tuzizila

Facility Mentor: Steve Kiser | Industry Supporters: Anthony Luñkin, Richard Hudson, Rajesh Patel

Description of Problem

The Industry Supporter for the ELEC FABRIC project is Electrolux, a premier global appliance manufacturer. Electrolux is a socially responsible company, committed to both consumer satisfaction and sustainability. Electrolux tasked the team with developing a greywater reuse system for the washing machine testing performed at their Fabric Care and Reliability Lab.

**Reverse Osmosis**
- Total hardness of 20 ppm
- Remove target contaminants**
- At least 50% water reuse

**UF**
- Design assumptions:
  - Facility Water Demand: 64 washers operating at approximately 60% capacity.
  - Total Water Hardness within acceptable limits before treatment.
  - Normal pH level (6-9).

Design Assumptions

Facility Water Demand:
- 64 washers operating at approximately 60% capacity.
- Variable flow=variable demand.
- Based on utility data facility demand an estimated annual water consumption of 3.75 million gallons.

Filtration Techniques

**Reverse Osmosis**
- Pressure driven
- Greater removal efficiency (TDS and Turbidity)
- Produces nearly pure water
- Lower flux rate
- More membrane are required
- More expensive

**UF**
- Removes TSS
- Membrane based
- Crossflow tubular membranes
- CIP
- Flow driven
- Passed detergent
- Greater flux rate
- Less membrane are required
- Smaller pump
- Cheaper system

System Details

**Electrical Specifications**
- 230 Volt 3 Phase 60 Hz AC input primary pump
- 120 Volt AC input for secondary pump
- 12 Volt DC input for microcontroller
- 4 PLS-092A-3PPH Float sensors
- 2 BV86TV-XR33-J Solenoids
- 4 Digiten Flow meter sensors
- Teco Westinghouse E510 VFD
- Protection circuit from wall to VFD
- Custom built controller using the STM32F411Re MCU Dev. Board
- Simulink Embedded Coder used to generate C/C++ code
- Informative user interface
- Autonomous functionality

**Mechanical Specifications**
- ¼" Stainless Steel NPT Plumbing
- 2HP Motor
- 300+ PSI
- Pressure Relief Valve
- Needle Valve
- Pressure Gauges

Large-Scale Payback Analysis

**Reverse Osmosis**

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Yearly Savings</th>
<th>Cumulative Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$13,409.96</td>
<td>$13,409.96</td>
</tr>
<tr>
<td>2</td>
<td>$20,787.97</td>
<td>$34,197.93</td>
</tr>
<tr>
<td>3</td>
<td>$27,065.93</td>
<td>$61,263.86</td>
</tr>
<tr>
<td>4</td>
<td>$33,343.89</td>
<td>$94,607.75</td>
</tr>
<tr>
<td>5</td>
<td>$39,621.83</td>
<td>$134,229.68</td>
</tr>
<tr>
<td>6</td>
<td>$45,899.77</td>
<td>$180,129.45</td>
</tr>
<tr>
<td>7</td>
<td>$52,177.71</td>
<td>$228,307.16</td>
</tr>
<tr>
<td>8</td>
<td>$58,455.65</td>
<td>$280,762.81</td>
</tr>
<tr>
<td>9</td>
<td>$64,733.59</td>
<td>$333,596.40</td>
</tr>
<tr>
<td>10</td>
<td>$71,011.53</td>
<td>$384,608.03</td>
</tr>
</tbody>
</table>

**UF**

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Yearly Savings</th>
<th>Cumulative Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$19,486.36</td>
<td>$19,486.36</td>
</tr>
<tr>
<td>2</td>
<td>$26,873.87</td>
<td>$46,360.23</td>
</tr>
<tr>
<td>3</td>
<td>$34,261.38</td>
<td>$80,621.61</td>
</tr>
<tr>
<td>4</td>
<td>$41,658.89</td>
<td>$122,220.50</td>
</tr>
<tr>
<td>5</td>
<td>$49,056.31</td>
<td>$161,276.81</td>
</tr>
<tr>
<td>6</td>
<td>$56,453.72</td>
<td>$209,730.53</td>
</tr>
<tr>
<td>7</td>
<td>$63,851.13</td>
<td>$259,181.66</td>
</tr>
<tr>
<td>8</td>
<td>$71,248.54</td>
<td>$308,429.10</td>
</tr>
<tr>
<td>9</td>
<td>$78,645.95</td>
<td>$357,075.05</td>
</tr>
<tr>
<td>10</td>
<td>$86,043.36</td>
<td>$406,121.41</td>
</tr>
</tbody>
</table>

Sustainability Benefits

- Water Reclamation System For 15,000 lbs. of laundry
- Drought prevention, water conservation, groundwater/surface water preservation
- More water availability, setting precedent for industry
- Cleaning load reduced, less plastic being disposed of (packaging)
- High nutrient water contaminating waterways

Certifications

- NSF/ANSI 350
- LEED BD+C

Testing Results

- Net Yearly Savings
- Cumulative Savings

Why PCI Membranes?

- Over 50 years of experience
- Tubular Crossflow Technology