Joint Case Study: Conserving Energy through water management.

Mary Ellen Mika, Supply Chain Manager, Steelcase
Keith Lane, Regional Account Director, DuBois Chemicals

3 December 2008
Environmental Footprint Reduction Goal for Steelcase…. 

By our 100th anniversary (2012) we are committed to reducing water and energy use (among many other environmental metrics) by at least 25%.
Water Reduction Progress at Steelcase

Water Consumption

- Water supply (gals/qtr)
- Max water to meet 2012 goal
- Current Water Qtr
- NDN (K USD)
Energy Reduction Progress at Steelcase (shown as GHG reduction)

Green House Gas Emissions

Q1 '06 Q2 '06 Q3 '06 Q4 '06 Q1 '07 Q2 '07 Q3 '07 Q4 '07 Q1 '08 Q2 '08 Q3 '08 Q4 '08 Q1 '09 Q2 '09 Q3 '09 Q4 '09 Q1 '10 Q2 '10 Q3 '10 Q4 '10 Q1 '11 Q2 '11 Q3 '11 Q4 '11 Q1 '12

Tonnes green house gas

$0 $200,000 $400,000 $600,000 $800,000 $1,000,000 $1,200,000 $1,400,000

20,000.00 40,000.00 60,000.00 80,000.00 100,000.00 120,000.00

Gasoline (tonnes CO2 eqv)
Propane (tonnes CO2 eqv)
Jet Fuel (tonnes CO2 eqv)
Diesel fuel (tonnes CO2 eqv)
Coal (tonnes CO2 eqv)
Electricity (indirect tonnes CO2 eqv)
Natural gas (tonnes CO2 eqv)
Water = Energy

• Water savings just one factor in Energy savings equation.

• Total Cost of Ownership encompasses process as a whole to take advantage of synergies.

• Other factors contributing to energy savings are
  – fewer chemical stages
  – chemicals with lower design operating temps
  – counter flow system raising temperature throughout
  – lower overall temperature reducing water loss due to evaporation
Items that Reduce Water Consumption

less evaporation

elimination of inputs/outputs

100% re-use of water in any number of stages

make up of chemical stages with water from following stage
Items that Reduce Energy Consumption

Lowering of “delta T” by reducing heat required in chemical stages.

Pre wash (where able to use) raising temperature of process parts with otherwise “cast off” heat.

Raising of “delta T” by using carry over heated fluid from chemical stages for there make up instead of cold water supply.

Reducing min/max temperature differential in system through water reuse of water from one input (last stage in system).
Steelcase - Atlanta Plant - STD. washer

Pretreatment Washer - Current State as of: 06-11-07

- Evaporation to atmosphere
- City Water
- Processed RO water - Virgin arch, counterflow make up
- Heat Energy added to process
- Counter flow make up
- Process flow to drain

## Diagram

```
<table>
<thead>
<tr>
<th>Conc</th>
<th>pH</th>
<th>Temp</th>
<th>Cond</th>
<th>Flow, GPM</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>140-145</td>
<td>105</td>
<td>10 gpm</td>
<td>10 gpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>140+</td>
<td>100</td>
<td>5-6 gpm</td>
<td>5-6 gpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80</td>
<td>88</td>
<td>4+ make up</td>
<td>1 gpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 gpm</td>
<td></td>
<td>1 gpm from 5</td>
<td>6 gpm</td>
</tr>
</tbody>
</table>
```

overflow basin
Steelcase - Atlanta Plant - Standard washer

Pretreatment Washer - Start up plan

- City Water
- Processed RO water - Virgin arch, counterflow make up
- Heat - Energy added to process
- Counter flow make up - fed as needed - to chemical stage(s)
- Process flow to drain
- Process make up (as needed) from pressure side of pump

**NOTE:** Information in boxes projected for comparison purposes.

<table>
<thead>
<tr>
<th>Conc</th>
<th>pH</th>
<th>Temp</th>
<th>Cond</th>
<th>Flow, GPM</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>80-90</td>
<td>85-105</td>
<td>85-95</td>
<td>75-85</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c-flow from 4</td>
<td>c-flow from 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Cost Reduction Summary

### Projected "TCO" Summary - Ped Line Washer - Updated 12-31-07

<table>
<thead>
<tr>
<th>Metric</th>
<th>KPI</th>
<th>Time Frame</th>
<th>Basis for Reduction</th>
<th>Percent Reduction</th>
<th>$'s per Unit</th>
<th>Financial Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY</td>
<td>BTU's</td>
<td>annual</td>
<td>Stg 3 temp reduction 149 to 110 Stg 1 turn burner off</td>
<td>-50%</td>
<td>$1.18 / CCF *</td>
<td>$(173,082.52)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LABOR</td>
<td>menu items</td>
<td>annual</td>
<td>Impact of RO water on process eliminating &quot;hard&quot; scale &amp; sludge</td>
<td>-69%</td>
<td>per &quot;event&quot; **</td>
<td>$(14,978.60)</td>
</tr>
<tr>
<td>WATER / SEWAGE</td>
<td>Gallons, US</td>
<td>annual</td>
<td>100% use &amp; reuse of &quot;purified&quot; water (via counter flow) current at approx. 6,000,000 gal/yr fewer chemical charge-ups lower chemical concentrations fewer chemical stage</td>
<td>-89%</td>
<td>$3.00 / CCF ***</td>
<td>$(21,176.32)</td>
</tr>
<tr>
<td>PROCESS CHEMICALS</td>
<td>Gallons, US</td>
<td>annual</td>
<td></td>
<td>-10%</td>
<td>$3.00 to $5.00 per Gal., premium</td>
<td>$(5,000.00)</td>
</tr>
</tbody>
</table>

"TCO" (Total Cost of Ownership) impact on Steelcase $ (214,237.44)

"TCO" (Total Cost of Ownership) impact on a Steelcase "production hour" $ (107.12)
Technical Challenges to Overcome

• Lower overall temps...lower flows... neutral pHs...
  leaves potential for more bio growth issues.

• Counter flow system advantage of reuse also leaves all waters
  going to all stages so issues like bio will end up everywhere...
  these issues are very manageable but do
  require attention and an action plan.
In conclusion...

The enormous benefits of a total cost of ownership focus far outweigh the obstacles to overcome, including personal, professional, and the technical issues previously mentioned.

thank you.