The Green Manufacturing Initiative GMI & Industrial Consortium GMIC

Semi-Annual Meeting

WELCOME!

Dr. David J. Meade, PhD – Associate Director
Agenda

Breakfast / Networking
Introductions
Ice-breaker game 😊
Technical presentations
Closure / Members only meeting
Lean game
...to break the ice
Standard Pig

Let’s play!
Objectives

Illustrate the importance of correctly documenting Standardized Work Instructions in clear, concise terms that are easy to read, understand, and teach to others.

Demonstrate the importance of performing work specifically as outlined by the Standardized Work Instructions.
Getting started...

Exercises

Instructions provided

No questions asked
Exercise #1

1) Take handout #1
2) Draw a pig on handout #1
3) Name your pig
4) Post your pig on the wall
Exercise #2

1) Utilizing handout #1, draw another pig
2) Use the visual aids provided in handout #2
3) Name your new pig
4) Post your new pig on the wall immediately below your original pig drawing
Exercise #3

1) Utilizing handout #1, draw another pig
2) Use the visual aids provided in handout #2
3) Use also the steps provided in handout #3
4) Name your new pig
5) Post your new pig on the wall immediately below your second pig drawing
Exercise #4

1) Repeat exercise #3
2) Utilizing handout #1, draw another pig
3) Use the visual aids provided in handout #2
4) Use also the steps provided in handout #3
5) Name your new pig
6) Post your new pig on the wall immediately below your third pig drawing
We’ve drawn a standard pig
We’ve named our pigs
We’ve posted our pigs on the wall

Now, list some advantages of standardizing
Advantages of Standardized Work

✓ The basis for **continual improvement**
✓ A powerful tool for **eliminating waste**
✓ A method of **building-in quality**
✓ **Simple, clear & visual** documents showing a **standard method** of doing a job
✓ **Results are consistent**
✓ Live and continuously updated documentation, owned by the team
✓ Ensures correct use of tools and machines
✓ Shows safe work, based on human movements
Technical presentations
Handling Damage

Board Defects

Josef Imesch, EM
Marylin Glass-Hedges, IE, EM
Michael Saldaña, EM
Shaun Shields, ChemE
Overview

• **Objective:** Reduce board defects and handling damage
• **Simultaneously observing and implementing changes**
• **Checking implementations for progress**
Defects Vary

- In Line Vertical Dent
- Deep Scratch
- Incomplete Edge Banding
- Chip Outs
Plan of Attack

• Begin in each fabrication (FAB) cell
  – Cabinet
  – SMOH
  – Pedestal
  – Desk

• Move through value stream
  – Finishing Line
  – Issues
  – Assembly
Cabinet Cell

• Main issue: Bumping parts @ second edge bander
  – Operators occupied when bumping occurs
  – Vertical in-line dents
• Highest defect rate
SMOH Cell

• Main issue: Space
• Unique issue: Edge band riding off edge
• Chip outs more common vs. other cells
Pedestal Cell

- Edge banders back to back
  - Batching before CNC
  - CNC is bottleneck
- Boards stack = no bumping
- Lowest defect occurrence
Desk Cell

• Only 1 edge bander
  – Lower volume cell
• Spins parts to hand sand corners
  – Parts bump
  – Surfaces more scuffed & scratched
Common Issues

- Bumping Parts, dents
- Chip outs
- Hand sanding after edge banding
- Glue Build Up
- Finger-joints
Finishing Line

• Two main handling areas: loading and unloading
• ‘Dropping’ parts
• Parts in and out of rack
Going Forward...

• Began to evaluate standard work
  – Prevent cell specific defects
  – What to do when a defect occurs

• Spacing of parts in edge banders
Questions, comments, suggestions???

THANK YOU!
COMPRESSED AIR LEAK STUDY

COLLINS WEKESA
SHAUN P SHIELDS
Background

• DENSO wastewater treatment plant
  – Removes heavy metals from process water
  – Prepares wastewater for municipal treatment

• Compressed air use
  – Operate machinery
  – Aeration/mixing operations
  – Pneumatic control systems
Objectives

• Compressed air leak survey
  – Detection and tagging leaks
  – Leak analysis
• Review and study of compressed air parts
  – Find alternative parts
  – Compare based on price, design, and other factors
• Compile a maintenance program
  – Construct preventative maintenance schedules
  – Comprehensive of compressed air system
Compressed Air Leak Survey
Air Leak Detection

- Two main methods for leak detection
  - Soap method
    - Simple and low cost
    - No leak quantification
    - Can be labor intensive and impractical
  - Ultrasonic detection
    - Fast to train and use
    - Can quantify escaping air
    - Able to detect leaks from a distance
    - Requires a capital investment
Methodology

• Ultrasonic Detection Method
  – Ultra Probe 3000
• Comprehensive leak survey of wastewater treatment plant
•Leaks were tagged and marked according to severity

<table>
<thead>
<tr>
<th>Level</th>
<th>Leak Size in CFM</th>
<th>Leak Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.01 – 0.5</td>
<td>Small</td>
</tr>
<tr>
<td>2</td>
<td>0.5 – 2.5</td>
<td>Medium</td>
</tr>
<tr>
<td>3</td>
<td>2.5 – 10</td>
<td>High</td>
</tr>
</tbody>
</table>

• Leaks were analyzed with the help of UE systems DMS software
Summary

Compressed Air Leak Summary

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Leaks</td>
<td>11</td>
</tr>
<tr>
<td>Potential Cost Avoidance</td>
<td>$1,851</td>
</tr>
<tr>
<td>Potential Energy Avoidance (KWh)</td>
<td>21,783</td>
</tr>
<tr>
<td>Potential GHG Avoidance (tons)</td>
<td>16.1</td>
</tr>
</tbody>
</table>

Compressed Air Leak Sources

- Regulators
- Endpoint Applications
- Push to Connect Fittings
- Pressure Gauge Leak
- Metal Elbow Fittings
Compressed Air Maintenance Program
Compressed Air Systems

Maintenance Program

Compressor

Air Dryer

In-line Elements
• Filters
• Regulators
• Lubricators
• Valves
• Piping

End-point Applications

Components of Maintenance Program
• Schedules for preventative action
  • Inspection
  • Adjustments
  • Replacement
• Troubleshooting of common problems

Components of Maintenance Program
• Schedules for preventative action
  • Inspection
  • Adjustments
  • Replacement
• Troubleshooting of common problems
Compressor and Dryer

• Filters
  – Pressure drop across filter to be monitored
  – Can drastically increase power consumption

• Lubrication
  – Regular intervals for replacement and refilling
  – Ensures efficient operation

• Mechanical/Miscellaneous
  – Inspection and preventative maintenance
  – Prolong operation life and reduce power consumption
In-line Elements

• Filters, Regulators, Lubricators (FRLs)
  – Regular inspection required
    • Replacing filters
    • Refilling lubricant
    • Rebuilding/cleaning parts

• Piping, fittings, and distribution system
  – Regular air leak surveys
  – Identify and repair leaks on a continual basis
## Maintenance Schedule

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly (125 hrs)</th>
<th>6 Months (1000 hrs)</th>
<th>Annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check Pump Oil Level</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil Leak Inspection</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain water in tank</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspect all air leaks (Daily basis check leaks on Compressor, Monthly basis check leaks on all pipelines)</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Inspect belts</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check air filters, clean or replace</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check dirt accumulation on cooler</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Check and tighten all bolts</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Check safety relief valve</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Change oil filter element &amp; clean oil return strainer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Change Compressor Lubricant (AEON 4000)</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Check Condition of hoses</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Change Oil separator</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Change inlet valve seals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Service Pump or Engine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Maintenance Outcomes

• Extended life of machinery and parts
• Reduced energy consumption
  – Reducing pressure drop through equipment
  – Continual identification and repair of leaks
  – Higher mechanical efficiency
Compressed Air Parts Review
Parts Review

• Several types of compressed air parts studied
  – Tubing
  – Fittings
  – Valves

• Parts analyzed based on several criteria
  – Price
  – Specifications
  – Warranty
### Part types and alternatives

<table>
<thead>
<tr>
<th>Part type:</th>
<th>Current Seller</th>
<th>Cost $</th>
<th>Alternative Seller</th>
<th>Cost $</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 Tubing N6MBLK500 or N6MBLK100</td>
<td>SMC</td>
<td>$0.18/ft</td>
<td>Automation Direct: NITRA Nylon</td>
<td>$0.17/ft</td>
<td>Nitra Nylon is cheaper than Automation Direct and offers a 1 yr warranty.</td>
</tr>
<tr>
<td>SMC T0604</td>
<td>SMC</td>
<td>$1.0875/M</td>
<td>FreelinWade Polyethylene LLDPE-071 Part No. 1A-071-01</td>
<td>$0.43/M</td>
<td>Freelinwade polyethylene is the best alternative for 6mm tubing N6MBLK500</td>
</tr>
<tr>
<td>Part type:</td>
<td>Current Seller</td>
<td>Cost $</td>
<td>Alternative Seller</td>
<td>Cost $</td>
<td>Advantages</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------</td>
<td>--------</td>
<td>-------------------</td>
<td>--------</td>
<td>------------</td>
</tr>
<tr>
<td>Male Connector 12 mm Tube to ¼ in Pipe</td>
<td>SMC Male Connector KQ2H12-02NS</td>
<td>$3.93/fitting, 10 per pack minimum</td>
<td>Automation Direct: NITRA Ms12M-12R</td>
<td>$9.50/pack of 5 $1.90/fitting</td>
<td>Nitra is cheaper by $2.00/fitting and offers a 1 yr warranty compared to SMC.</td>
</tr>
<tr>
<td>5 Port Solenoid Valve</td>
<td>SMC VQ4200-5</td>
<td>$81.45</td>
<td>NITRA Pneumatic Directional Control Solenoid AVS-5221</td>
<td>$40.50</td>
<td>Nitra is cheaper than SMC by half price and offers a 2 yr warranty the only difference is SMC has a slower response time compared to Nitra hence more durable.</td>
</tr>
<tr>
<td>Elbow 90° Male Connector to Tubing</td>
<td>SMC Elbow Male KQ2L06-M5N</td>
<td>$3.70/fitting Packages of 10 minimum</td>
<td>Automation Direct Nitra ME6M-M5</td>
<td>$7.25/ Pack of 5 $1.45/fitting</td>
<td>Nitra fitting is cheaper by $2.25 and offers a 1yr warranty compared to SMC</td>
</tr>
<tr>
<td>Part type:</td>
<td>Current Seller</td>
<td>Cost $</td>
<td>Alternative Seller</td>
<td>Cost $</td>
<td>Advantages</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------</td>
<td>--------</td>
<td>---------------------------------------------</td>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ELBOW MALE</td>
<td>SMC</td>
<td>$4.22/piece</td>
<td>NITRA stainless steel pneumatic push-to-connect fittings</td>
<td>$29.0/piece</td>
<td>SMC is cheaper than Nitra. The difference is Nitra is made of steel and withholds higher pressure than SMC.</td>
</tr>
<tr>
<td>KQ2L08-02NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONN MALE</td>
<td>SMC</td>
<td>$2.66/piece</td>
<td>NITRA pneumatic push-to-connect male straight air fitting</td>
<td>$5.25 for 5 pieces</td>
<td>Nitra fittings is cheaper than SMC by $1.61/piece and offers a 1yr warranty</td>
</tr>
<tr>
<td>KQ2H07-34NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Straight union</td>
<td>SMC</td>
<td>$4.06/piece</td>
<td>NITRA pneumatic</td>
<td>$8.25 for a 5 pack</td>
<td>Nitra fittings is $3.00 cheaper than SMC and offers a one year warranty</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finger Valve 6mm</td>
<td>SMC</td>
<td>$9.30/fitting</td>
<td>Automation Direct:NITRA Flow Valve FVU6M</td>
<td>$7/fitting</td>
<td>Automation direct is cheaper than SMC and offers a 1 yr warranty</td>
</tr>
<tr>
<td>VHK3-06F-06F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Parts Study Outcomes

- Several alternative parts were identified
  - Similar or improved specifications
  - Lower price and warranty provided
- Sparse technical data regarding durability and cost analysis
  - Several design alternatives and material options
  - Experimental investigation may yield improved analysis
    - Assess lifetime of compressed air parts
    - Cost of use
    - Cause of leak or failure
- Recommend DENSO observe the use of recommended parts
  - Compare to previous parts
  - Compare costs
Conclusions

• Compressed Air Leak Survey
  – Identified 11 leaks
  – Potential savings of $1,851

• Maintenance Program
  – Developed schedule for preventative maintenance
  – Ensure efficient operation of system

• Compressed Air Parts Study
  – Alternative parts and fittings found
  – Lower cost and warranty provide savings opportunity
Questions, comments, suggestions???

THANK YOU!
Standard Work Instructions
For hanging operation at Powder Coat Line

Michael E. Saldaña EM (Speaker)
Marylin N. Glass-Hedges IE EM
Benedicto J. Hernández CE
Josef D. Imesch EM
Problem statement

• No standard work (SW) instructions for all products, outdated, not controlled
  – Poor training system for this cell – Employees have freedom to choose how to hang parts
  – Unnecessary work-in-process (WIP) at assembly
  – Decreases productivity rate – Bottleneck operation
  – Increases defect rate – process wastes not obvious
  – Not designated person for creating/controlling SW
Why SW instructions?

- Easy identification of wastes

<table>
<thead>
<tr>
<th>D</th>
<th>Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>Overproduction</td>
</tr>
<tr>
<td>W</td>
<td>Waiting</td>
</tr>
<tr>
<td>N</td>
<td>Non-Utilized Talent</td>
</tr>
<tr>
<td>T</td>
<td>Transportation</td>
</tr>
<tr>
<td>I</td>
<td>Inventory</td>
</tr>
<tr>
<td>M</td>
<td>Motion</td>
</tr>
<tr>
<td>E</td>
<td>Extra-Processing</td>
</tr>
</tbody>
</table>
Goal of the Project

• Create SW instructions
  – Ensure access to line associates
  – Instructions will be used for training existing and new coming employees
  – Assign SW instructions champions
  – Motivate *kaizen* (continuous improvement)
Paint process overview

- E-Coat
- Hang on the line
- Base Coat
- Top Coat
- Assembly
- Finished Good Inventory
- Customer
- Mil Tester

Where the project is focusing

Biggest impact
Note the differences?
Example of defects
Areas to focus on
How it will reduce WIP
How is it going to look like?
Where are we now?

- Defined current state
- Final design of SW instructions document
- Completed hooks inventory

Moving forward

- Build small SW instructions sample
- *Run* samples by paint line team
- Train associates to new standards
- Build more samples, repeat process
- Build SW instructions for all products
THANK YOU!

Questions, comments, suggestions???
The E³ Sustainable Supply Chain Alliance Grant

Economy, Energy & Environment

Marylin N. Glass-Hedges, IE EM
Graduate Research Assistant & Project Manager, GMIC
Industrial Engineering PhD Candidate, WMU
The Michigan Department of Environmental Quality (MDEQ) partnered with Western Michigan University’s (WMU) Green Manufacturing Industrial Consortium (GMIC) in spring 2013 to engage student-interns from the College of Engineering and Applied Science (CEAS) to assist companies in waste minimization projects, by conducting on-site assessments, reporting recommendations to company management and providing implementation assistance.

The MDEQ and the U.S. Environmental Protection Agency (EPA) are supporting companies in Michigan that want to

- Track their environmental outputs including energy efficiency, waste reduction at the source and related cost savings;
- Engage in process changes or modifications that increase efficiency in their use of raw materials, energy, and water;
- Provide estimated reductions of greenhouse gas (GHG) emissions to mitigate their impact on climate change, and resources usage; and
- Integrate the cost benefit of environmental output tracking into workforce training and business management.
Air National Guard
100th Airlift Wing, Battle Creek MI Facility
Project outline

Objectives
- Identify and catalogue all materials
- Identify and pursue outlets for materials
  - Re-use
  - Recycle
- Track progress and re-evaluate efforts

Metrics
- Total material diverted off base
  - Weight/volume
  - Material outcome
    - Re-use
    - Recycle
    - Waste to Heat
    - Landfill
- Cost savings
## Diverted materials

**Efforts to continue**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount (lbs)</th>
<th>Outlet</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Fighting Foam</td>
<td>11,869</td>
<td>Transfer to military base</td>
<td>32%</td>
</tr>
<tr>
<td>De-icer</td>
<td>3,652</td>
<td>Recycle-EQ</td>
<td>10%</td>
</tr>
<tr>
<td>Specialty Chemicals</td>
<td>240</td>
<td>Donation</td>
<td>0.7%</td>
</tr>
<tr>
<td>Used Oil</td>
<td>4,150</td>
<td>Contracted Disposal</td>
<td>11%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19,911</strong></td>
<td></td>
<td><strong>54%</strong></td>
</tr>
</tbody>
</table>
DENSO, North America
Battle Creek MI Facility
Objective

• Move up the waste disposal hierarchy
Costs & Savings

WtE Diversion

• 2012 waste records
• 69% or 191 tons **divertible** per year
• $76 per ton, WtE cost
• Up to **$14,516 savings** per year

Cash for Trash

• Paper
• Cardboard
• Plastics
• Metals
• Refundables
• Some recyclables hauled at no charge!
• Value determined by the material
• Up to **$29,563 in recoverable dollars** per year
• **$44,000 in total savings!**

Recycling

• Quote services
• Track costs and material weights as services are provided
Environmental impact

...same as 100 tons of waste sent to the landfill.

### GHG Emissions Analysis — Summary Report

7/28/2014

_GHG Emissions Analysis — Summary Report_

(Version 13, 6/14)

Analysis of GHG Emissions from Waste Management for DENS0 (Battle Creek, MI USA)

Prepared by Marilyn N. Glass-Hedges

| GHG Emissions from Baseline Waste Management Scenario (MTC02E): | 4 |
| GHG Emissions from Alternative Waste Management Scenario (MTC02E): | -276 |
| **Total Change in GHG Emissions: (MTC02E):** | -280 |

<table>
<thead>
<tr>
<th>Material</th>
<th>Baseline Scenario</th>
<th>Alternative Scenario</th>
<th>Change (Alt - Base) MTC02E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons Recycled</td>
<td>Tons Landfilled</td>
<td>Tons Combusted</td>
</tr>
<tr>
<td>Mixed Paper</td>
<td>0</td>
<td>0</td>
<td>37</td>
</tr>
<tr>
<td>(general)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed Metals</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Mixed Plastics</td>
<td>0</td>
<td>0</td>
<td>38</td>
</tr>
<tr>
<td>Mixed Recyclables</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Mixed Organics</td>
<td>N/A</td>
<td>0</td>
<td>65</td>
</tr>
</tbody>
</table>

Note: A negative value indicates an emission reduction; a positive value indicates an emission increase.

b) Emissions estimates provided by this model are intended to support voluntary GHG measurement and reporting initiatives.
c) Total emissions estimates provided by this model may not sum due to independent rounding.
Baseline
2012

42% Recycled 👍
58% Landfilled 😖

...and then, we dove in.
Where are we today?

91% landfill free!

Lbs. YTD 2014

- Compost: 2438
- Landfill: 652
- Recycle: 1423

% / Lbs. YTD 2014

- Compost: 54%
- Landfill: 14%
- Recycle: 32%

Waste Tracking June 2014 (% of Total Weight)

- Compost: 52%
- Landfill: 9%
- Recycle: 16%
- Tyvek media: 3%
- Film: 1%
- 10¢ refunds: 0%
- Batteries: 0%
- Electronics: 0%
- Cigarette waste: 0%
- Ink cartridges: 0%
What’s the environmental impact?
EPA’s WARM Tool – GHG Emissions Reduction Analysis

A greenhouse gas (GHG) emission-reduction analysis was conducted using EPA’s WARM tool.

A total of 1 MTCO2E* yearly reduction was achieved!

*Metric ton carbon dioxide equivalent

...which is equivalent to 113 gallons of gasoline consumed.
Landscape Forms
Headquarters, Main Facility
When this project started, Landscape Forms was sending only 9.6% of their waste to the landfill.

The GMIC team alongside an army of associates from Landscape Forms—including upper managers—dived for two weeks, twice a day.

After sorting through two tons of waste, the team concluded that a significant diversion was possible.
The 42 cubic-yard compactor’s expected and actual hauls are shown below.

**2014 YTD (October) compactor pulls:** two.

2014 goal

2013

1/13  2/16  3/26  6/4  7/24  8/28  10/8  12/13  8 pulls

2013 goal

2012

13 pulls
Environmental impact

Diversion over two years
By the end of year 2013, only 5.7% of the waste was sent to the landfill. For 2014, the estimation is less than 3%.

2013 waste yd³

Emission reduction

GHG Emissions from Baseline Waste Management Scenario (MTCO2E): 1
GHG Emissions from Alternative Waste Management Scenario (MTCO2E): -34

Total Change: (MTCO2E): -35*

*A reduction of -35 metric tons of CO₂ equivalent per year is the same as 37,594 pounds of coal burned.

Waste count Fall 2012 Spring 2013 Fall 2013 Spring 2014
2 weeks 4,030.00 3,297.00 2,924.00 2,006.00
52 weeks 209,560.00 171,444.00 152,048.00 52,156.00

Tons -19.06 -9.70 -50.02
Pounds -157,404.00

Tons -78.78

Pounds of waste

Decrease

<table>
<thead>
<tr>
<th>Waste count</th>
<th>Fall 2012</th>
<th>Spring 2013</th>
<th>Fall 2013</th>
<th>Spring 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 weeks</td>
<td>4,030.00</td>
<td>3,297.00</td>
<td>2,924.00</td>
<td>2,006.00</td>
</tr>
<tr>
<td>52 weeks</td>
<td>209,560.00</td>
<td>171,444.00</td>
<td>152,048.00</td>
<td>52,156.00</td>
</tr>
<tr>
<td>Tons</td>
<td>104.78</td>
<td>85.72</td>
<td>76.02</td>
<td>26.00</td>
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</table>

<table>
<thead>
<tr>
<th>Decrease</th>
<th>Pounds</th>
<th>Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds</td>
<td>-38,116.00</td>
<td>-19.06</td>
</tr>
<tr>
<td>Tons</td>
<td>-99,892.00</td>
<td>-50.02</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Decrease '12 to '14</th>
<th>Pounds</th>
<th>Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds</td>
<td>-157,404.00</td>
<td>-78.78</td>
</tr>
</tbody>
</table>
Landscape Forms also knows that “Zero waste is not just about recycling and diversion from landfills, but about restructuring production and distribution systems to prevent waste from being manufactured in the first place” (Ryan Smith, Continuous Improvement Specialist).

This is why Landscape Forms pushes the envelope and engages in source reduction projects.

Initiative to reduce air foam
A non-recyclable material
In less than a year, 2012-2013, the company was able to reduce the use of air foam by 31%, realizing $6,445 in savings.

Other projects
- Wire ties
- Fill rods
- Hardware
- Sanding paper
- Waste tracking cell level
Zero Waste To Landfill Supplier Workshop via Steelcase’s Lean Supplier Network

The ZWTL Supplier Workshop took place this past August 22nd at Steelcase’s Kentwood Manufacturing Plant in Grand Rapids, Michigan. The GMI’s project manager acted as main speaker supported by Steelcase’s Environmental Performance Engineer (see picture on right). **Sixteen attendees from Steelcase’s Lean Supplier Network, representing twelve organizations, learned all about zero-landfill, why it is important, how to engage in recycling and waste reduction initiatives, and how to keep associates engaged to guarantee the program’s success.**

Other **topics** in the workshop included the following: instructions on how to conduct initial waste management audits, facility walk-throughs, waste bins mapping and waste assessments (a.k.a. dumpster dives); waste disposal forms, **how to contact service providers, waste haulers, recyclers and other partners, tips on how to improve waste management practices**; finally, various **case studies** were shared including Steelcase’s, discussing best recycling practices and ways to sustain improvements.
Veneer
Roughly 0.02 inches thick
The problem: *sand-throughs*
Sanding process, finishing line
Data Collection
Phase I

Sand-throughs (Count)

- Two-Side-B
- Two-Side-F
- One-Side

<table>
<thead>
<tr>
<th></th>
<th>Two-Side-B</th>
<th>Two-Side-F</th>
<th>One-Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Sand-throughs (Count)

- Warp
- Crack
- Top
- Edge
- Corner

<table>
<thead>
<tr>
<th></th>
<th>Warp</th>
<th>Crack</th>
<th>Top</th>
<th>Edge</th>
<th>Corner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Root-Cause Analysis
Phase II

Man
- Not measuring board thickness
- Special treatment of ‘hot racks’
- Communication between operators
- Pressure
- Calibration

Material
- Swelling
- Warp
- Uneven belt wear

Environment
- Swelling

Measurements
- Measuring board thickness
- Running 3 of 5 heads
- Pressure
- Calibration

Machine
- Uneven belt wear
- Warp
- Running 3 of 5 heads
- Calibration
- Loading patterns

Method

Sand-Throughs
Feasibility & Warpage Studies
Phase III

Simulation study of single piece loading
- Eliminate patterns
- More balanced finishing line

Warp Study
- Determine where warp occurs
- Quantify degree of warp

Sanding belt life extension experimentation
- Current State: Belt’s used for one 8 hour shift
- Potential State: Belt’s used for two 8 hour shifts
Upon implementation of changes

Expected 20% scrap rate reduction
   Or reduction by 1%

Boards: 250

Labor hours reduction: 375

Cost savings: ~$25,000
Other projects

**Bold Furniture** – Landfill Assessment

**DENSO** – Compressed Air Leaks Study

**Fabri-Kal** – Mobile Composting

**Fabri-Kal MMF** – Electric Oven Study, Energy Assessment, Zero Waste To Landfill

**Landscape Forms** – Energy Management System
   Senior Design Project
   Supported by RETAP
Lessons learned

Starting...
Have a plan!
Buy-in
Champion(s)
Accountability
Sustain change
Celebrate 😊

...moving forward
Waste reduction part of company’s DNA
Convenient recycling
Participation at all levels
A supply chain willing to work with you
Patience!
Final thoughts

The U.S. recycles/recovers 31% of its waste

Michigan, under 15%

The rest goes to landfills – $435mil worth of reusable material

Now what?!

It’s about more than taking the bottles and cans back to the store... WE have to do something!

Let’s take the next step!
Remember...

GREEN IS THE NEW BLACK

...and thank you!
Members only meeting

Thank you all for joining us today!
Status

4 consortium members – Fabri-Kal, Landscape Forms, Poly-Wood, Steelcase
2 partners – DENSO, Bold Furniture
Funding – Membership, independent projects

9 research assistants
12 open projects
Actively hiring new researchers
Compressed Air Leaks Study
Test durability of air nozzles and other fittings
Design of experiments (DOE)
Under guidance of WMU IE professor

Shared interest?
Open discussion

Project ideas
New areas of interest

Feedback
What works well
Address concerns