Success Stories in Finishing: Case Study Forum

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Minnesota Technical Assistance Program
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Overview

MnTAP Background and Process Efficiency

Finishing Case Study Presentations

- Roopesh Pushpala, Nordicware
  - Paint Line Efficiencies
- Kevin Hautala, Graco
  - Powder and Liquid Systems
- Joe Young, ATMS / DJ Powder Coating
  - Temperature Monitoring Improvements
- Lin Peterson, Henkel and Don Koopman, AGCO
  - Masking Improvements
Minnesota Technical Assistance Program
Minnesota Technical Assistance Program

• We work with industrial businesses on sustainability projects.
  • Technical Assistance, Intern Program, Special Projects
Technical Assistance

• State-wide, non-regulatory, no-cost, confidential technical assistance to Minnesota industrial businesses
  • Waste, water, energy assessments
  • Source reduction opportunities
  • Grant project scoping
  • Confidential regulatory questions

• Technical staff with backgrounds in engineering, science and industry with a passion for efficiency and the environment
2017 Intern-Proposed Solutions

- Water: 272,000,000 gallons
- Waste: 1,000,000 lbs
- Chemical: 230,000 lbs
- Energy: 9,600,000 kWh
- Fuel: 88,000 therms
- Savings: $1,600,000 USD
Special Projects

• Often grant funded sustainability projects that involve identifying and implementing opportunities for Minnesota.

• Often for industry, occasionally for other groups
  • E3 and Lean for Painters and Coaters (completed)
  • Wastewater Treatment Energy Efficiency (completed)
  • Wastewater Treatment Nutrient Removal
  • Food Processing Efficiency
  • Air Quality and Cleaning Chemicals
  • Water Conservation
E3: Energy, Economy, and the Environment

Can we complete a project with industrial painters that will save energy and reduce environmental impacts while simultaneously making these businesses more profitable?

• Lean and value stream mapping (footprinting)
• Process flow improvements to address bottlenecks + lead time
• Process efficiency improvements to save energy and reduce waste
Value Stream Mapping

**Information flows**
- Supplier to Production control
- Production control to Customer
- Customer to Supplier

**Material flows**
- Weekly order from Supplier to Process A
- Process A to Process B
- Process B to Process C
- Process C to Shipping
- Monthly order from Customer to Supplier

**Lead time ladder**
- 6 days for 300 sec
- 4 days for 45 sec
- 1 day for 240 sec
- 3 days for production lead time = 14 days
- Processing time = 585 sec

By DanielPenfield (Own work) [CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons
Process Flow Improvements

Current setup:
A: 300s / part
B: 45s / part
C: 240s / part
Produces 1 part every 300s.

Better setup:
6A: 50s / part
B: 45s / part
5C: 48s / part
Produces 1 part every 50s.

Balanced product flow can help reduce extra building time which will ultimately reduce energy per part.
Current setup:
1: 6 days WIP
2: 4 days WIP
3: 1 days WIP
4: 3 days WIP
~14 day lead time

Better setup:
1: 1 day WIP
2: .5 day WIP
3: .5 day WIP
4: .5 day WIP
~2.5 day lead time

Shorter lead times can help make Minnesota businesses more competitive and effective.
Lean Partners

Manufacturer’s Alliance:
  • Training to share lean concepts with your organization.

Enterprise Minnesota:
  • Lead value stream mapping and implementation events at your business.

MnTAP:
  • Focus is process efficiency, minor lean capabilities.
Process Efficiency: Energy

- **Compressed Air**
  - **Pneumatic to electric equipment.**
    - Compressed air uses 10 times more energy.
    - Pneumatic to Electric Tool Calculator at z.umn.edu/ToolCalc
    - Example: 3, 5” sanders used 4 hours per day, 250 days per year
      - Switching from pneumatic to electric will save roughly 42,000 kWh, $3,000 per year with a 3 month payback period for purchasing electric sanders.

- **Leak audits**
  - Some electric utilities have programs to help finance leak audits.

- **Compressed Air Setpoints**
  - A 2 psi reduction results in a 1% compressor energy savings.
  - Goal is to set your compressor slightly higher than your highest pressure requirement.
Process Efficiency: Energy

- Curing Ovens
  - Temperature Setpoints
    - Low cure paints
  - Cure Time
    - Know how long your parts and paints need to cure. Can you cure smaller parts for a shorter time? Cure time reductions save fuel.

- Ventilation
  - Meeting ventilation requirements and providing clean air to staff is very important.
    - If ventilation is too high, may be sending extra conditioned air out of your facility.
Process Efficiency: Waste Reduction

• Transfer Efficiency
  • Painter Training
    • Paint techniques
    • Paint system setpoints for even spray pattern.

• Paint Management
  • Paint order waste
    • Example: Minimum order is 5 gallons, only need 3 for the paint job, and it’s a custom color.
      • Two extra gallons clutters paint room for a year and then gets thrown away.
      • Can we instead order only what we need, or find a use for the remaining paint?
Process Efficiency: General Strategy

- Is there equipment that can be turned off or tuned to run at lower setpoints?
  - At nights?
  - On weekends?
  - During breaks in production?

- Does the production create waste? Why? Can it be reduced?

- Can we so something useful with the remaining waste streams?
  - Waste heat recovery
  - Recyclable materials
E3 in Paint Project Results:

- Energy Savings: 61,300 tons CO$_2$e per year
- Water Savings: 9,000,000 gallons per year
- Hazardous Material: 57,000 pounds per year
- Financial Benefit: $262,000 per year
- Number: 3 assessments
Thank You

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Senior Engineer
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Process Engineering: Paint Transfer & Energy Efficiency
Nordic Ware, St. Louis Park
Roopesh Pushpala

MnTAP Advisor: Paul Pagel
Nordic Ware Supervisors: Bette Danielson, Tony Fisher
Company Background

• Leading manufacturer of kitchenware products since 1946

• Cookware manufacturer
  • Metal fabrication
  • Coatings applications
  • Plastics molding

• Wide range of products including castings, formed and molded products

https://www.nordicware.com/
Project Overview

- Opportunities to increase transfer efficiencies of the spray painting
- Process improvement through the coating line
- Optimize the washer processes
- Conserve energy while increasing the production throughput
Coating Applications

Analysis

- Transfer efficiency in coating lines
  - Surface area, coating thickness, paint used

- Process in coating applications
  - Working of compliant spray guns and delivery of the coating.
  - Belt speed, rotating speed and air pressure related to output.

- Opportunity to improve
  - Chain on edge without spinning
  - Electrostatic spray guns
  - Overhead line
**Approach**

Estimated the present transfer efficiency in coating lines

- Calculated the surface area of the grills, wok and Texas skillet.
- Test runs to find the MIL thickness on the parts.
- Paint usage for a specific part or batch of parts.

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Surface Area (sq in.)</th>
<th>MIL thickness</th>
<th>Transfer Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversible Grills</td>
<td>595.59</td>
<td>1.165</td>
<td>42.30%</td>
</tr>
<tr>
<td>7 quart Wok</td>
<td>214.74</td>
<td>0.9225</td>
<td>52.71%</td>
</tr>
<tr>
<td>12” Texas Skillet</td>
<td>206.64</td>
<td>0.815</td>
<td>71.77%</td>
</tr>
</tbody>
</table>

**Findings**

- Transfer efficiency for grills: 42.3%
- Orientator
- Present line with infrared (IR) partial bake and existing oven
- Overhead line with IR cure
Recommendations

Present lines without spinning with an Orientator

- Productivity remains the same
- Potential transfer efficiency: 53%
- Potential annual savings on paint: $56,900

Overhead line with electrostatic spray and IR cure

- Load up to 6 parts on a fixture
- Electrostatic guns in the overhead line
- Fewer touches and smaller system footprint
- Potential transfer efficiency: 70%
- Potential annual savings: $367,000
## Recommendations – Potential Annual Savings

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Paint Reduction</th>
<th>VOC Reduction</th>
<th>Labor Reduction</th>
<th>Increase in Production</th>
<th>Savings</th>
<th>Investment</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead Line with IR Oven</td>
<td>3,300 gallons</td>
<td>6.80 tons</td>
<td>75%</td>
<td>200%</td>
<td>$367,000</td>
<td>$475,000</td>
<td>1.3 years</td>
<td>Recommended</td>
</tr>
<tr>
<td>Single Pass Line</td>
<td>2,500 gallons</td>
<td>5.11 tons</td>
<td>37.5%</td>
<td>-</td>
<td>$226,000</td>
<td>$420,000</td>
<td>2 years</td>
<td>Needs further analysis</td>
</tr>
<tr>
<td>IR Bake and Existing Oven</td>
<td>2,500 gallons</td>
<td>5.11 tons</td>
<td>37.5%</td>
<td>-</td>
<td>$189,000</td>
<td>TBD</td>
<td>TBD</td>
<td>Needs further analysis</td>
</tr>
<tr>
<td>Without Rotation</td>
<td>1,700 gallons</td>
<td>3.54 tons</td>
<td>-</td>
<td>-</td>
<td>$56,900</td>
<td>-</td>
<td>Immediate</td>
<td>Needs further analysis</td>
</tr>
</tbody>
</table>
Orientator Implementation - Backsplash

- 90 degree turns within the booth
- Full paint coverage in one booth
- Transfer Efficiency:
  - Base Coat: 55%
  - Top Coat: 73%
- Total Paint Savings: 1433 gallons
- VOC Savings: 1.7 tons
- Total Cost Savings: $109,000
Washer Analysis

• Working process
  • Wash (1), rinse (2&3) and dryer, air knife
  • Belt speed, water consumption

• Optimize the washing process
  • Foam in the rinse tank
  • High water use

• Opportunity to improve
  • Eliminate foam
  • Efficient use of air knife
  • Upgrade spray nozzles
Findings

• Foam formation in stage 2 due to soft water
• Initial washer settings
• 6 GPM with present nozzles
• Spots due to the residue formation

<table>
<thead>
<tr>
<th>Washer 1 &amp; 2</th>
<th>Air Knife</th>
<th>Rinse Pressure (psi)</th>
<th>Water used (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Top</td>
<td>Bottom</td>
</tr>
<tr>
<td>Initial</td>
<td>12 inches</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>
Recommendations

• Pressure of the nozzles in stage 2 & 3

• Air knife height adjustment - 4 inches

• Conductivity of the deionized (DI) tank

• City water usage in stage 2

• Low volume high pressure nozzles - 0.3 GPM

• Standard work procedure
## Recommendations – Potential Annual Savings

<table>
<thead>
<tr>
<th>Optimize Washer</th>
<th>Reduction</th>
<th>Savings</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water &amp; Sewer</td>
<td>9,093,000 gallons</td>
<td>$57,400</td>
<td>Implemented</td>
</tr>
<tr>
<td>Softener Salt</td>
<td>28.5 tons</td>
<td>$7,800</td>
<td>Implemented</td>
</tr>
<tr>
<td>DI Recharge</td>
<td>9 tanks</td>
<td>$21,200</td>
<td>Implemented</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$86,400</strong></td>
<td></td>
</tr>
</tbody>
</table>
## Summary – Potential Annual Savings

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Reduction</th>
<th>Savings</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implement Overhead Line with IR Oven</td>
<td>3,300 gallons of paint 6.80 tons of VOC 75% Labor</td>
<td>$367,000</td>
<td>Recommended</td>
</tr>
<tr>
<td>Implement Orientator on OSI 3</td>
<td>3,000 gallons of paint 6.4 tons of VOC</td>
<td>$190,000</td>
<td>Implemented</td>
</tr>
<tr>
<td>Optimize Washer Operation</td>
<td>9,093,000 gallons of water 28.5 tons of salt 9 DI tanks</td>
<td>$86,400</td>
<td>Implemented</td>
</tr>
<tr>
<td>Standard Work</td>
<td>Defects in working process</td>
<td>-</td>
<td>In Process</td>
</tr>
<tr>
<td>Total Savings</td>
<td></td>
<td>$276,400</td>
<td>Implemented</td>
</tr>
</tbody>
</table>
Next Steps

- Planning and implementation of the new coating line
- Lean principles for coating processes
- Automation within the facility
- Efficient process flow through
Thank you ...
Graco Riverside Factory

Paint Line Success Stories
Paint Finishing Proportioner Upgrade

- Installed 2 Graco ProMix PD2K’s (2015)
  - 8 Colors (Urethane & Epoxy)
  - 1 Catalyst

- Reduction in waste
  - Flushing + Paint
  - $20,000 yearly material savings / shift
  - 70% Reduction in yearly waste
  - 10' of WIP hose compared to 40'

- Fast / Easy Color Changes
  - Push button color changes w/ recipes
  - Automatic flushing
  - 30 seconds to switch colors
  - Accurate 2k ratios
Pretreatment Wash Upgrades

• Variable Frequency Drives - added
  – Energy Savings & Rebate
  – Maintenance Reduction
  – Process Control

• Final Rinse Nozzle Size Reduction
  – Reduced DI water consumption

• Counter Back Flow Adjustments
  – Reduced water consumption
  – Reduction in cleaning / draining tanks
Powder Booth Install

- 1 Line – Powder + Liquid    Installed Q4 2016
- 20% Powder 80% Liquid
- Cost Savings – line density, material savings
- Bring outside service work internally
- Reclaim system – 97% material usage
Current Automation Project

Current Process

Future Process
Equipment & Benefits

- Fanuc P50i
- Graco PD2K
- Graco ProBell

- Labor Savings
- Material Savings
- Process Control
- Increased Line Density
- Ergonomic Improvements
- Emission VOC’s Reduction
Questions?
Candy Blue Chassis (Base - Candy - Clear)
# Line Speed Calculator

## Line Speed Calculator (LSC)

<table>
<thead>
<tr>
<th>OVEN CURE LENGTH (ft)</th>
<th>LINE SPEED (ft/min)</th>
<th>CURE TEMP (F)</th>
<th>CURVE TIME @ PMT</th>
<th>BUFFER CURVE TIME (SANDMAN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>4.5</td>
<td>400</td>
<td>[min] [sec]</td>
<td>[min] [sec]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 : 0</td>
<td>2 : 0</td>
</tr>
</tbody>
</table>

## Oven Results Before Optimization

<table>
<thead>
<tr>
<th>OVEN TIME TO PMT</th>
<th>CURRENT OVEN POSITION (ft)</th>
<th>TIME LEFT (min:sec)</th>
<th>TOTAL OVEN TIME (min:sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(min) [sec]</td>
<td>(min) [sec]</td>
<td>(min) [sec]</td>
<td>(min) [sec]</td>
</tr>
<tr>
<td>21 : 0</td>
<td>94.50</td>
<td>14 : 33</td>
<td>35 : 33</td>
</tr>
</tbody>
</table>

## Oven Results After Optimization

<table>
<thead>
<tr>
<th>OPTIMIZED LINE SPEED (ft/min)</th>
<th>OPTIMIZED OVEN TIME (min:sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.85</td>
<td>33 : 0</td>
</tr>
</tbody>
</table>

Numbers in black are inserted numbers in red are calculated.

## Optimization Results for Product

<table>
<thead>
<tr>
<th>PARTS</th>
<th>PARTS/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OVEN TIME DIFFERENCE (min:sec)</th>
<th>TOTAL TIME SAVED (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(min) [sec]</td>
<td>(min)</td>
</tr>
<tr>
<td>2 : 33</td>
<td>24</td>
</tr>
</tbody>
</table>

**Enter into the LSC numbers that are in black, the numbers in red are then calculated for you.**

- **OVEN CURE LENGTH** – Input the length of your oven for cure time
- **LINE SPEED** – Input the current line speed for product
- **CURE TEMPERATURE** - Input the manufacturer’s powder cure temperature
- **POWDER CURE TIME** - Input the manufacturer’s powder cure time
- **BUFFER CURE TIME** (sandman) – Input the buffer time of **YOUR CHOICE** to ensure powder is cured
- **OVEN TIME TO PMT** – Input the oven time recorded from ATMS software to reach PMT
- **CURRENT OVEN POSITION** – Calculates distance part has traveled to reach PMT
- **TIME LEFT** – Calculates time left after PMT for powder cure before optimization
- **TOTAL OVEN TIME** – Calculates oven time before optimization
- **OPTIMIZED LINE SPEED** - Calculates new optimized line speed
- **OPTIMIZED OVEN TIME** - Calculates new optimized oven time
- **PARTS** – Input the number of parts in current run
- **PARTS/ft** – Input the number of parts hung on your line per ft
- **OVEN TIME DIFFERENCE** – Calculates Cure time before optimization minus Cure time after optimization
- **TOTAL TIME SAVED** – Calculates total time saved on parts processed in current run
- **INTERIM LINE SPEED** – If line speed is to fast use the Interim line speed until the first parts exit the oven then switch to Optimized Line Speed
28 poles
20’ long poles
6 poles to a rack
3 Probes attached
Mag Inside bottom Right
Mag Inside Top Left
Clamp Top Left
Hi Rebecca and Joe,

I just wanted to touch base on one important piece of info that we were able to get from our trial run of the Box (and a determining factor in my decision to go ahead with the purchase of your equipment).

While we had The Box in house, we used it on many different parts. Some new and never to be seen again, some repeat and ongoing business. Where the data became vital was with regards to the repeat/ongoing business and the parts we finish for this customer.

These particular parts were steel fabricated railings of various sizes. Our batch oven is 24 feet in length so we are able to handle a combination of many parts and/or large parts all at once. Originally we were running these based on "experience" for 25 minutes once our interior thermometer would reach cure temp; this provided a bit more time for the part to get to cure temp and ensure we were keeping it at cure temp for manufacturer's recommended duration (12 mins@ 400f).

What The Box identified, that we otherwise wouldn't have been able to, is that we didn't need nearly that much time allowance for the heat ramp. These steel fabricated were getting to cure temp in 4-5 minutes instead of the 10-12 minutes we expected. With this data in hand we were able to save between 6-8 minutes per run! That equates to more than an hour of daily time savings that we've used to increase productivity while lowering cost/waste. Double win!! Thanks to The Box!

Paul Doucher Managing Director
www.columbuspowdercoat.com
ATMS

the BOX
Hot Melt Masking Sealant

Lin Peterson; Henkel Sales Engineer
Don Koopman; Mfg Engineer; AgCo Corporation; Jackson, MN
**SITUATION**

Jackson, MN. Annual Hot Melt Sales = $5K
Closed Oct; 2017

**CHALLENGES**

Shot blast media was getting embedded into joints in weldments. Almost impossible to get out. Hot melt solution: went from 1 hr/frame mask time to 5 min/frame.

**SOLUTIONS**

Products Used: Technomelt 8669, mounted melter on overhead jib, works slick!

Quality requirements: Mask stitch welds, lap joints, tubular weld joints, shot blast, then peel off afterwards before paint. (Credit card glue analogy)

Challenges of existing equipment / system for pretreatment: This is an out-of-the-box solution for an age-old problem of masking for shotblast media.

Other key elements for closing the business: Loaned hot melter and 25 lbs of glue, and let them play with it....

**VALUE CREATION**

Small application, but saved 1+ hr of masking time, and fixed the problem of shot blast media getting stuck in nooks and crannies of parts.
The hot melt seals off the threaded boss effectively keeping shot from plugging the threads. This in turn eliminated the use of compressed air and away from workers eyes.

Henkel Technomelt Tac 8669
Hot melt, use as a blast shot guard

The hot melt seals off large gaps as shown in these pictures.
Hot melt, use as a blast shot guard

No need to clean the parts before using.
Hot melt, use as a blast shot guard

After blast.
Hot melt, use as a blast shot guard

Now using it in tight spaces where we used to struggle using tape.
Hot melt, use as a blast shot guard
Thank You!

Finishing Case Study Presentations

• Robyn Aiken, BTD
  • Science and Art of Powder Coating

• Jon Vanyo, MnTAP
  • MnTAP and Process Efficiency

• Roopesh Pushpala, Nordicware
  • Paint Line Efficiencies

• Kevin Hautala, Graco
  • Powder and Liquid Systems

• Joe Young, ATMS / DJ Powder Coating
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