Foundry Optimization for Air Quality Improvement Smith Foundry

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Driven to Discoversm



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Company Background

- Specialize in low/medium production of ductile and gray iron castings
- Use sand as molds and cores to shape their castings
- Located in Minneapolis (Phillips area) <u>SMITH FOUNDRY CO.</u>







Process

Sand Preparation



+ Clay, water, and additives



Green sand







Cope and drag of a mold









+ Chemical binders

















Pouring and cooling

M<u>n</u> TAP





Shakeout

Separator



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Dust bag





Mn





Incentives for Change

- OSHA regulations
- Committed to the community/neighborhood
- Employees health
- Profitability:
 - Reduce operating costs
 - Eliminate defects
 - Speed up production





Approach to the Project

- Learn the production process
- Talk to operators and employees
- Identify areas for pollution & waste reduction, and efficiency improvement
- Set up meetings with vendors & experts
 - Baseline data needed
 - Recommendations
- Quantify inputs, outputs, and costs
- Request samples & Quotes
- Test samples



Background & Solutions



1) Core Sand Binders

- Two resins are mixed with the sand
- Binding effect is activated by catalyst
- Two systems:
 - 1) Fast-cure
 - 2) Slow-cure
- Annual usage (fast-cure):
 - 3000 lb. of resins
 - 50 lb. catalyst



Why Seek Alternative Binders ?

- The <u>conventional binders</u> causes:
 - 268 lb. VOCs
 - 279 lb. Carbon monoxide
 - 54 lb. HAPs
 - 80 lb. Particulate matters

(Every year)



Alternative Binders Reduction

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 - 268 lb. VOCs
 - 279 lb. Carbon monoxide
 - 54 lb. HAPs
 - 80 lb. Particulate matters

(Every year)



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Recommendation – Sand Binders

Pollution Reduction Option	Pollution Reduced	Implementation Cost	Cost Savings/Yr.	Payback Period	Status
Switch to alternative binders	49 lb. VOCs, 74 lb. CO, 11 lb. HAPs, and 47 lb. PM	\$0	\$900	Immediate	Recommended

• Benefits:

- Improved air quality
- Savings



2) Blackwater System

- Background:
 - Dust-collectors at shakeout and muller areas
 - The dust/sand has clay that is wasted
- Cost of clay:
 - \$330/ton (\$80,000/yr.)
- How it works:
 - Restores binding effect of clay
 - Replace conventional water source





Recommendation – Blackwater System

Waste Reduction Option	Waste Reduced	Implementation Cost	Cost Savings/Yr.	Payback Period	Status
Blackwater system	60 tons clay, 250 tons silica sand, and 19% VOCs during pouring, cooling, and shakeout.	\$250,000	\$30,000	8.3 Years	Under review

- A study "Reining in Costs, Controlling Emissions" shows:
 - 26-60 % Clay and coal
 - 20-27 % Silica sand
 - 19-70 % VOC during pouring, cooling, and shakeout

- So far:
 - Collected baseline data
 - Sent samples of dust/sand for analysis
 - Contact provider for next steps

The study by:

Rose Torielli, Fred Cannon, Robert Voigt, Penn State Univ., University Park, Pennsylvania; Timothy Considine, Univ. of Wyoming, Laramie, Wyoming; James Furness, Furness Newburge Inc., Versailles, Kentucky; John Fox, Lehigh Univ., Bethlehem, Pennsylvania; Jeff Goudzwaard, Neenah Industries Inc., Neenah, Wisconsin; and He Huang, URS Corp., Philadelphia



3) Mulling Machine

- Currently:
 - Mixing for 90 seconds before discharging batches
- Problem:
 - Under/Over mulling
 - Wasted energy
 - Wasted time
- Opportunity:
 - Install Mull-to-Energy system
- How it works:
 - Sensors tracking the energy added per batch
 - Discharge batch when energy reaches a plateau



Time

Recommendation – "Mull-to-Energy"

Waste Reduction Option	Waste Reduced	Implementation Cost	Cost Savings/Yr.	Payback Period	Status
Mull-to-Energy System	120,000 kWh	\$30,000	\$8,400	3.6 Yrs.	Recommended

- So far:
 - Traced energy by data logger
 - Contacted system provider for recommendation
- Potential Savings:
 - Energy

waste

- Time
- More consistent sand molds reduce molding defects and





4) Optimizing Sand Handling

• Currently:

- Conveying system contains many 90-degree elbows
- Conveyed at 12-15 psi

• Problem:

- Silica sand grains can fracture as low as 10 psi
- 2% of sand breaks down to inhalable particles

• Opportunity:

 Replace with sweeps to reduce conveying pressure



Recommendation – Optimizing Sand Handling

Waste Reduction Option	Waste Reduced	Implementation Cost	Cost Savings/Yr	Payback Period	Status
Optimizing piping design for new Silica Sand	25 tons silica sand	\$4,200	\$1,825	2.3 years	Under review

- Benefits:
 - Longer sand life
 - Reduced airborne particulate
 - Less dust to be collected and disposed
- So Far:
 - Scanning Electron Microscopy (SEM) test of sand before and after conveying
 - Check grains fracture

<10 psi

Opportunity



5) Pneumatic to Electric Tools

- Currently:
 - Compressed air grinders
- Problem:
 - Wasted energy
- Opportunity:
 - Electric tools



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Recommendation – Pneumatic to Electric

Waste Reduction Option	Waste Reduced	Implementation Cost	Cost Savings/Yr.	Payback Period	Status
Switch from pneumatic to electric tools	170,000 kWh	\$3,200	\$12,000	2 Months	Recommended

- Status:
 - Recommend testing before switching



Benefits Table

Waste Reduction Option	Waste Reduced	Implementation Cost	Cost Savings/Yr	Payback Period	Status
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Personal Benefit

- Experienced a new working environment & industry
- Interacted with people from the industry
- Reduced the gap between academic studies and real life practice
- Discovered that small changes can equal huge benefits





Any QUESTIONS ?

