History of Odor Abatement Efforts At Two Ductile Iron Foundries

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Gregg Industries was issued a Notice of Violation for Nuisance Odors - Nov 2005

Background

Gregg is a Shell Core Foundry

An odor scrubber was installed as a joint venture sponsored by the South Coast Air Quality Management District, California Air Research Board and Gregg Industries. Became operational in 2004.

The odor scrubber reduced the number of odor complaints significantly after start-up.

Notice of Violation for Nuisance Odors- November 2005 Background Continued.

The foundry had a small organic resin no-bake line used for prototype castings and customer casting qualification.

A decision was made to significantly increase production on this line.

Odor complaints increased dramatically when the no-bake production increased.

Notice of Violation for Nuisance Odors
Background continued

Afternoon winds from the open south side of the foundry forced odors from the production no-bake area into the shell core room then out the doors and into the community. No-bake resin odors are similar to the shell odors. The foundry management and the AQMD misdiagnosed the root issue and assumed the odor scrubber was not working. During this period, some core machines were relocated and the odor scrubber ducting stopped efficiently pulling odors into the system. This increased the non-treated fugitive odors.

Root Issues Starting with the 2005 Notice of Violation for Odors Background Continued.

The combination of odors seemed to be synergistic and the overall odor level increased dramatically multiple times. Traditional thinking tried to place blame on **only one** issue. Silicate was successfully trialed as a low emission replacement for the phenolic-urethane resin. Even though the silicate improved casting quality and was lower priced, a decision was made to not convert the line to it at that time. After six months the decision was finally made to switch to the highly modified sodium silicate binder.

Maybe the most notable issue was…

Due to what we believe was a misunderstanding, the foundry began to “spike” the sand systems with excessive amounts of the organic greensand additives Sea Coal and Wood Flour.

Corrective Actions - Advanced Oxidation

Returned the peroxide to the correct dose.

Correctly relocated ducting to new locations.

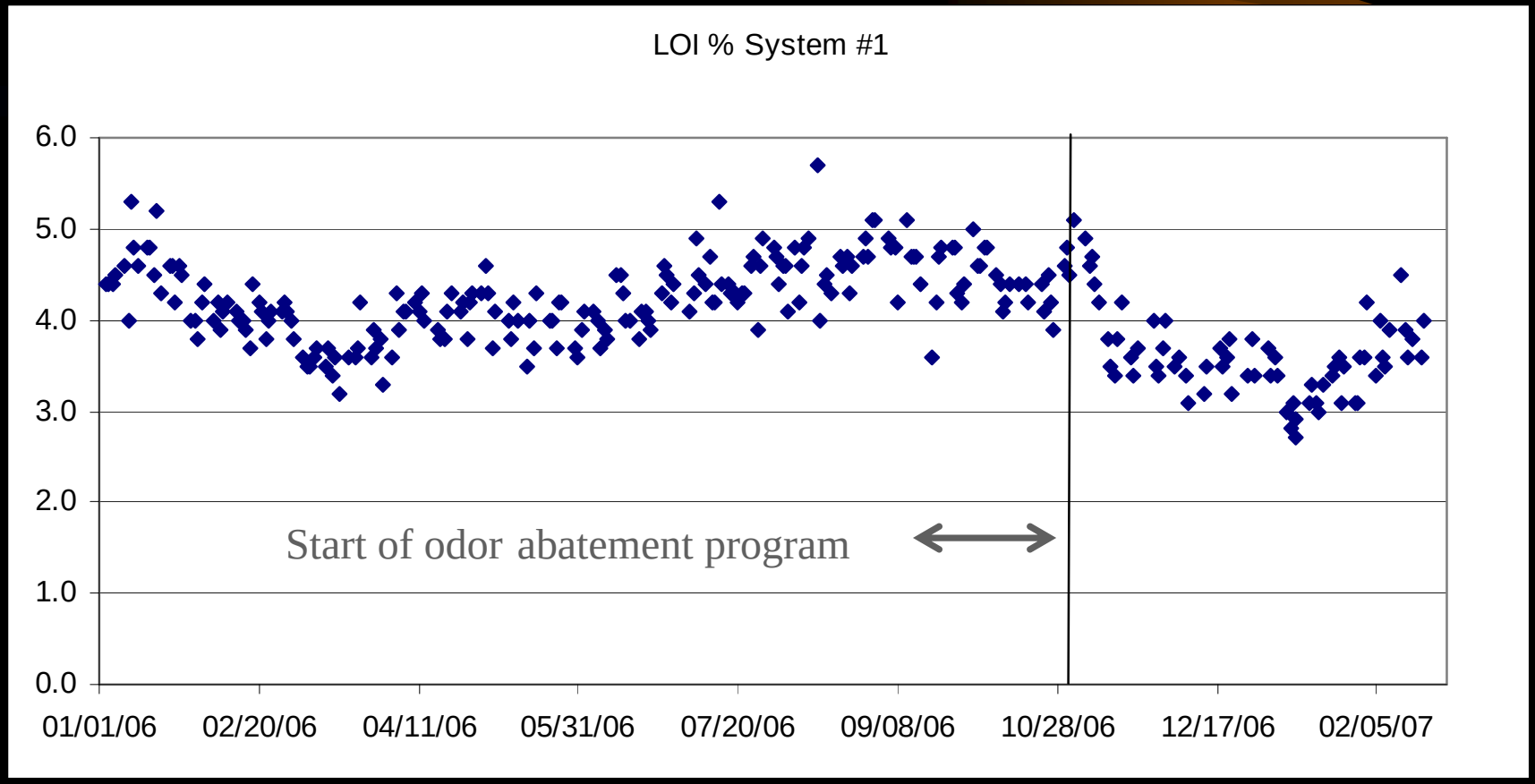
Automated the peroxide system dosage verification.

The stack height was raised to 65 feet.

Corrective Actions –
Smoldering Wood Odors

Eliminated the practice of using plywood bottom boards for no-bake operations . Molds are now placed on a bed of sand.
Eliminated the use of wood as spacers and weights.
Eliminated the use of wood flour through LOI monitoring and wet tensile testing to allow control much more precise soda ash additions.
An interesting note. Plywood is bonded with the same type phenolic resin as used in the shell core process. Smoldering wood odors are similar to the shell core odors. Same Resin?

Data Jan 1, 2006 to Feb 22, 2007 Showing Process Optimization & Variations Due to Foundry's Customer Requirements



Much of the short term variation shown here is due to "spiking" with additives, not bond formula changes.

Changed to the Low Emission Technology for making shell and other type of cores

Changed all shell sands to lowest emission material.

Ordered offsite shell core suppliers to also switch to this same material.
Tested and proved “Purge Superheat”. This allowed us to convert other organic chemical based core resins used at the foundry to highly modified sodium silicate based low emission technology.

Thermal Reclamation

Reclaimed shell core scrap sand at 100% was used to make the modified sodium silicate no-bake molds. The thermal reclaim system had thermocouple and other process control issues so the resin was not burned completely off. *This residual phenol resin* ***was one of the many contributors*** *to phenol odor complaints. It has been permanently shut-down.*

Enclosing the Foundry

Major and costly efforts have been made to use plastic curtains to block the wind from the south. This has helped to significantly reduce the afternoon and evening prevailing wind's tendency to blow odors out the building at ground level.

Results of Project

Sand related scrap reduced >30% when AO green sand system is “optimized for odors”.
Over 1 ½ years, the use of low odor shell resin allowed the green sand system compressive strength to rise >20%. (round grain, less dust, less ammonia)
Reduced total shell resin >20% due to better overall performance.
The highly modified silicate binder was ruled “exempt from New Source Review”

In Conclusion

- The root cause of overall odors is very complicated.
- Abatement efforts were inefficient due to placing blame on specific individual problems before fully understanding contributing factors.
- We discovered what we call “The Onion Effect”. We eliminate an odor and find it was masking another.
- It took a team using a systems troubleshooting and a root cause odor prevention approach.
- We ended up “blaming” the right things, but concentrated our efforts on what to do to fix and improve the conditions. This includes fundamental management, training and process changes that are still evolving.

Investing in the Future

Gregg Industries and Neenah Foundry Company has continued to investigate emerging low emission core technologies. Automated equipment was designed and built to generate high temperature compressed air to help replace odor producing organic resins with low emission water based core binder technology.

We are now managing the production of castings differently than we were in the past. The workers have learned new skills. To prevent odors, we know that what we've learned must become a pollution prevention program that is similar in function to safety training programs. Gregg's employee training programs were revamped.

Being “smarter” about odors

No foundry can be totally odor free with the technology available today. Gregg has made a major effort to identify the remaining odor sources.

New odor sources are being addressed as they are discovered. An example of this is the recent discovery of a common shell core-box mounting practice causing silicone rubber gasket material to overheat.

This is an ongoing work in process that will require constant vigilance by the foundry.

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Next Foundry

Grede Liberty

Grede Liberty is primarily a phenolic urethane (amine gas cured) cored green sand foundry pouring ductile and heat resistant iron castings (High Silicon Moly and Austenitic Ductile)

Problem Statement

While still a shell foundry, the neighborhood surrounding the foundry became sensitive to foundry odors. Switching the foundry to amine cured phenolic urethane cores did not solve the odor issues. The core process was adjacent to the sidewalk and within a few feet of a heavily traveled street.

Core Room Background

Liberty was primarily a shell mold and shell core foundry until 2002, with 65% of the tons poured on the shell mold line and the rest on the greensand molding lines.

Due to public and government pressure, Liberty shutdown the Shell molding line in 2002

Since then, the foundry has been 100% greensand molding and 90% phenolic urethane cores.

Core Room Background

- Liberty 2006:
  - 1,000 lbs of core sand per PWT
  - 95% PUCB core usage
  - 1.3% to 1.5% phenolic binder usage
  - Excessive use of additives
    - Red Iron Oxide
    - Macor
    - Chromite
    - Etc...

Changes in Core Room

- Increased PUCB gas and purge temperatures
- Installed Proportional compressed air valves for control of gas and purge pressures (added pressure ramping capability)
- Improved Amine usage through new DMEA injection equipment

Results from Changes in Core Room

- Core Sand Recipe Changes:
  - Reduced resin collar cores 1.3% to .9% resin
    - 11,000 lbs of resin reduction (7% reduction overall)
  - 290 individual recipe changes
    - Eliminated most of our Chromite usage
    - Reduce organic anti-vein additives (29% reduction overall)
    - Reduce Red Iron Oxide usage (43% reduction overall)
  - 52% reduction in DMEA consumption (reduced to 1.25 lbs per core sand ton range)
  - 38% improvement in gas cycle times
- Long way to go…..

Green Sand Background

- Liberty 2006:
  - 10.5 to 11.0 Mb clay levels
  - 4.0 LOI target
  - 18 to 20 psi Green Strengths
  - Sand Conditioning Agent additions of 5% of our total clay additions
  - No lignite coal additions
  - 1.5% cereal addition

Green Sand System Design Changes

Installed an Advanced Oxidation (AO) clay recycle black water system expandable to include sand reclamation. Over a period of several months, the % of clay recycled was increased resulting in improved green sand preparation mixing efficiencies and sand properties

Changes in the Green Sand System

- 1.5 lbs of Recycled clay and coal addition per gallon of water added to the mixer and sand cooling system
- 18% lignite addition of total carbonaceous additive
- Reduced Mb target to 9.0
- Reduced LOI target to 3.0

Results of Black Water Installation

- Bond Consumption is down 12.5%
- Coal Consumption is down 15.6%
- 90% reduction in sand conditioner usage
- Muller Efficiencies increased from mid 40% to mid 60% range prior to further reduction of Mb
- Green strengths increase to 25+ psi range
- Able to maintain shatter strengths without sand conditioner
- Improved blow-ability of the sand for the Sinto

Continuous Improvement Activities

- Odor reduction is a critical issue for Liberty's future
- Experimentation with low emission resin systems
- Continuing with formal and informal odor awareness programs and building relationships with the neighborhood

Conclusion: Be “Smarter” About Odors

Both foundries installed multiple new technologies to address their odor complaints.

At present, no foundry can be totally odor free, even with these advances in technology.

Each foundry must make a major effort to identify odor sources and discover ways to minimize the total odor load at any given time.

New odor sources must be addressed as they are uncovered.

Odor reduction is an ongoing work in progress requiring constant vigilance by all foundries.

Even if they don’t think they have a problem.


Questions?