

Number 114  
February 2007

# Waste and Cost Reduction Opportunities for Foundries

The metal casting industry has worked at developing pollution prevention (P2) techniques and technologies for years, with success especially in foundry sand management and wastewater reductions. Recent advances in resin formulations, energy cost savings and a number of other areas, make P2 efforts more valuable than ever. Metal casting facilities may find significant waste and cost reductions possible today by reexamining opportunities to make process and material changes.

The first step to reducing wastes is to evaluate the waste stream and all component material flows. Switching or substituting hazardous materials with non-hazardous materials can help improve safety and reduce disposal costs.

## New Resin Formulations

Traditional mold/core-making resins usually contain organic compounds such as formaldehyde, resorcinol, isocyanates, phenols and various catalysts, including metals such as lead or zinc. A typical formulation, such as a phenolic urethane binder, uses a phenolic resin prepared by reacting a phenol, aldehyde, bisphenol-A-tar, and a divalent metal catalyst.

Recent advances in green chemistry have produced cost-effective

## Pollution Prevention Opportunities for Foundries

- alternative resins, catalysts, washes and release agents;
- scrap/raw material specification, storage and handling;
- advanced melting, holding and cooling;
- innovative molding;
- sand reuse/recycling;
- byproducts recovery/reuse;
- water conservation; and
- energy efficiency.

alternative resins with lower environmental and worker health impacts. Some of these materials have been innovative designs of substances based on waste materials from other industrial processes, such as paper making and food processing.

An excellent example of this is the protein-based alternative core resin GMBOND®, originally developed from a food processing waste product. This resin is a renewable, less toxic and more economical binder material which can be used in many industrial applications.

The following case study illustrates the emission reductions and cost savings of using this material.

## Pride Cast Metals, Inc. Cincinnati, OH- GMBOND® Cores

Using pre-made cores molded with GMBOND® sand binder, Pride Cast Metals was able to:

- achieve significantly lower costs per casting;
- significantly reduce toxic emissions released during the casting process;
- significantly reduce the time spent manually removing cores, thereby increasing the number of castings processed; and
- maintain good surface finish.

Significant emission reductions and cost savings are not mutually exclusive principles. In this case, operating costs were reduced by switching materials. Companies who continually practice P2 find new ways to save money and improve product quality.

## Alternative Mold Washes & Release Agents

### Water-based Formulations

Water-based mold and core washes are environmentally friendly alternatives to alcohol and other organic compounds. The water-based washes are much safer for employees and can drastically reduce emissions of volatile organic compounds (VOCs) such as chlorofluorocarbons and 1,1,1-trichloroethane.

---

# Waste and Cost Reduction Opportunities for Foundries

---

Water-based formulations may have economic savings over solvents, especially when considering emission permitting or control costs. The following case study illustrates how water-based washes, combined with cost-effective drying techniques such as infrared lamps, can increase production beyond what conventional agents like alcohol could achieve.

## Mold drying case study at Decatur Foundry

Decatur replaced electric-resistance ovens with infrared/forced air units. Instead of warming the air in contact with the mold's surface, the new short-wavelength infrared systems radiate heat directly to the surface of the mold, quickly driving out moisture. In addition, the system requires no warm-up time, so it is only on when in use.

Achievements:

- decreased drying time by 85 percent;
- reduced annual energy consumption by 120 MWh, or \$9,000;
- eliminated organic solvents and improved product quality, which virtually eliminated the need for additional polishing;
- reduced mold failure rates;
- freed up floor space; and
- eliminated the drying bottle neck, reduced labor costs and increased productivity.

Replacement cost on the first production line was \$12,000. With enhanced efficiency and productivity, Decatur added two new lines,

increasing employment by 13 percent and annual sales from \$5.9 to \$10 million.

## Other Process Options and Opportunities

### CO<sub>2</sub> cleaning

Carbon dioxide (CO<sub>2</sub>) is a cost-effective replacement for organic solvent cleaners and has been found to be faster and more effective in a wide variety of cleaning scenarios.

### Case Corporation

Case Corporation replaced solvent cleaners with a CO<sub>2</sub> pelletizer-blasting unit.

Achievements:

- eliminated use of methyl alcohol (a flammable solvent) and methylene chloride (a potential carcinogen), and consequently reduced VOC air emissions;
- reduced cleaning time by approximately 50 percent; and
- reduced annual labor and cleaner costs by \$69,000.

### New Ceramic Composite Dies

The metal casting industry has long been hampered by the high cost and short life of casting dies. Steel dies often fail prematurely due to metal fatigue, cracking, corrosion, erosion, oxidation, heat checking and soldering.

Advantages of ceramic composite dies:

- offers resistance to corrosion, erosion, oxidation, thermal fatigue and cracking
- provides stability when exposed to molten metals;

- two to five times harder than tool steels, resulting in five to 10 times longer die life;
- longer life of ceramic dies reduces the amount of waste produced by failed tool steel casting dies; and
- ceramic dies produce fewer casting rejections, reducing the energy needed to recycle the rejected castings.

## Reducing Foundry Scrap

Techniques to reduce scrap, an important goal for foundries, have been evaluated and refined over time. Companies that remain vigilant at continual improvement strategies to address their scrap increase efficiency and profitability. Good procurement strategies, testing/sampling of incoming materials, proper storage/handling and blending/melting techniques should be re-examined at regular intervals.

## Recycling Scrap Metal

The metal casting industry is one of the largest recyclers in North America, using scrap metal as 85 percent of its feedstock for ferrous casting. The industry diverts roughly 15 to 20 million tons of scrap metal from disposal at U.S. landfills each year.

Key scrap recycling program principles:

- develop vendor certification to ensure purchased scrap metal content;
- frequently test and verify scrap quality; and
- store scrap in dry, clean conditions.

---

# Waste and Cost Reduction Opportunities for Foundries

---

## Reducing Foundry Sand

Reducing foundry sand waste continues to be a major cost-saving opportunity area for many foundries. New formulations of binder materials increase the useable life of foundry sand. Sand recovery and reuse processes incorporate effective capture and segregation of unwanted materials from the waste sand stream. Effective capture systems make recovery less cumbersome and more profitable.

Foundry sand management options:

- **re-plumb the dust collector ducting on the casting metal gate cutoff saws to collect metal chips for easier recycling;**
- install a new bag house on the sand system to separate the sand system dust from the furnace dust;
- install a new screening system or magnetic separator on the main molding sand system surge hopper to continuously clean metal from the sand system;
- separate nonferrous foundry shot blast dust (often a hazardous waste stream) from other non-hazardous foundry and sand waste streams;
- install a magnetic separation system on the shot blast system to allow the metal dust to be recycled; and
- change the core sand knockout procedure to keep this sand from being mixed in with system sand prior to disposal.

## Water and Energy Conservation Opportunities

Water and energy conservation are areas where companies can continually make improvements and save money. The metal casting industry has collaborated with academia and government to find innovative ways to conserve water and energy, resulting in an abundance of case study and technology implementation information. Many projects have demonstrated short-term paybacks and significant long-term savings. Energy conservation in particular has the potential to yield long-term cost savings for companies who develop sound conservation strategies.

### Water Conservation Examples

In 1980, Columbia Steel Casting Company began implementing a variety of water-conservation measures. Innovations included cooling towers, reuse and recycling of water, converting to non-potable water sources, changing manufacturing processes and close monitoring. They have cut water use by 98 percent, saving 500 million gallons per year.

GM Saginaw Metal Casting Operations installed a closed-loop water recycle system, eliminating discharges to the Saginaw River. The plant reuses more than 20 million gallons per day of treated process water.

### Energy Efficiency

Energy efficiency is a significant issue for metal casting and every other energy intensive industry.

Companies that position themselves to be energy efficient will gain even greater competitive advantage as energy costs continue to rise.

Energy efficiency opportunities:

- replace heel melting furnaces used for iron induction with modern batch melters, which improves energy efficiency for this process by more than 32 percent;
- improve casting yield by five percent in all metal casting industries except ductile iron pipe, for an overall energy savings of 22.7 trillion Btus per year; and
- apply existing air/natural gas mixing methods to reduce ladle heating energy by 10 – 30 percent.

## Conclusion

Many opportunities exist for making significant waste and cost reductions in foundry operations. The opportunities outlined in this fact sheet have been collected from a wide variety of foundry industry, academic and government research efforts. These opportunities have been implemented by foundries successfully and have afforded significant cost savings.

Links to additional resources are provided in this fact sheet. If you have questions or need more information, contact Ohio EPA's Office of Compliance Assistance and Pollution Prevention for help at 800-329-7518. OCAPP can help you identify P2 opportunities at your facility.

---

# Waste and Cost Reduction Opportunities for Foundries

---

## Metal Casting References and Resources

*Casting Emission Reduction Program (CERP)*

<http://www.cerp-us.org/>

*Alternative Foundry Binders*

<http://www.epa.gov/ttn/atw/ifoundry/binders/meeting.html>

<http://www.epa.gov/ttn/atw/ifoundry/binders/hormel10-26-05.pdf>

*Alternative Mold Making Process*

<http://www.moderncasting.com/archive/WebOnly/1005/WebOnly1005.pdf>

[http://www.fosecomet.com/index.php?option=com\\_content&task=view&id=105&Itemid=155](http://www.fosecomet.com/index.php?option=com_content&task=view&id=105&Itemid=155)

*Energy Efficiency in Aluminum Melting*

[http://www.secat.net/docs/projects/Improving\\_Energy\\_Efficiency\\_in\\_Aluminum\\_Melting.pdf](http://www.secat.net/docs/projects/Improving_Energy_Efficiency_in_Aluminum_Melting.pdf)

*Melting Efficiency Improvement*

[http://www.eere.energy.gov/industry/metalcasting/pdfs/umr22\\_fs.pdf](http://www.eere.energy.gov/industry/metalcasting/pdfs/umr22_fs.pdf)

*Compressed Air System Improvement*

<http://www.p2pays.org/ref/32/31236.pdf>

*Energy Efficiency Toolkit for Manufacturers*

[http://www.fypower.org/pdf/manufacturer\\_toolkit.pdf](http://www.fypower.org/pdf/manufacturer_toolkit.pdf)

*Industrial Energy Assessment*

[http://iac.uwm.edu/Support/Resources/UWM\\_WI0475\\_Case\\_Study.pdf](http://iac.uwm.edu/Support/Resources/UWM_WI0475_Case_Study.pdf)

[http://iac.uwm.edu/Support/Resources/UWM\\_WI0454\\_Case\\_Study.pdf](http://iac.uwm.edu/Support/Resources/UWM_WI0454_Case_Study.pdf)

*EPA Office of Compliance Sector Notebook Project: Profile of the Metal Casting Industry.* October 1998. Office of Compliance Office of Enforcement and Compliance Assurance. U.S. Environmental Protection Agency

<http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/metcstsna.pdf>

*Ohio Cast Metals Association and Casting Industry Links*

<http://www.ohiocastmetals.org/industry/links.html>