Foundry Sand Reuse in Iowa

Best Practices & Regulatory Compliance

Abrasive Removal Services (ARS)

Kelley, Iowa

Phone: (515) 720-7081 | Email: team@abrasiveremovalservices.com

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3. Key Concepts and Definitions

What is Foundry Sand?

Foundry sand is a high-quality silica sand used by metal casting facilities to make molds for shaping molten metal into parts. After repeated use, the sand becomes "spent" and needs to be replaced — creating a large volume of by-product material.

What is Beneficial Reuse?

Beneficial reuse means finding safe, productive ways to repurpose industrial by-products (like foundry sand) instead of throwing them away. It protects the environment, saves natural resources, and cuts disposal costs. In Iowa, beneficial reuse helps businesses lower expenses and communities build infrastructure more sustainably.

Examples of beneficial reuse for foundry sand include:

- Replacing mined sand in concrete or road base

- Using sand as daily cover at landfills
- Mixing into manufactured soils for landscaping

What is a TCLP Test?

TCLP stands for Toxicity Characteristic Leaching Procedure — a laboratory test required by the U.S. EPA to find out if a waste material might release harmful contaminants into groundwater.

How a TCLP test works:

- A sample of the material is soaked in a mild acidic solution that simulates rainwater or landfill conditions.
- Scientists measure what chemicals "leach out" of the sample into the fluid.
- If dangerous levels of metals (like lead) or chemicals are found, the material is classified as hazardous waste and must be managed under strict regulations.

If the material passes the TCLP test (meaning contaminants are below federal limits), it can be reused safely under environmental rules.

Why Should Readers Care About Foundry Sand Reuse?

- Environmental Protection: Reuse reduces waste sent to landfills and conserves natural sand resources, which are expensive and limited.
- Cost Savings: Foundries, cities, and contractors save money by reusing sand instead of buying new materials or paying high disposal fees.
- Public Safety: Proper testing (like TCLP) ensures that reused sand does not threaten drinking water, soil, or the environment.
- Economic Growth: Reuse projects create jobs, strengthen recycling industries, and make local construction and public works projects more affordable.

4. Regulatory Guidelines

Iowa DNR Regulations

The Iowa Department of Natural Resources (DNR) manages beneficial reuse through its Beneficial Use Determination (BUD) program. Under Iowa Administrative Code (IAC) 567-108, spent foundry sand, particularly from iron and steel foundries, is “universally approved” for several reuse applications without needing an individual permit if the sand meets certain environmental safety conditions.

Approved uses for spent foundry sand include:

- Raw material for construction products (e.g., in asphalt or concrete)

- Landfill engineering material (e.g., drainage layers, daily cover)
- Structural fill and subbase (e.g., road building)
- Emergency uses (e.g., sandbags for flood control)

Key regulatory points:

- Foundry sand must not exhibit hazardous characteristics. Testing proof (typically via TCLP) is required.
- Pre-approval applies mainly to silica-based sands from ferrous foundries (iron, steel).
- Non-ferrous foundry sands (e.g., from brass or bronze foundries) are not automatically approved, because they may contain elevated levels of lead and other heavy metals.
- Unlisted uses or non-ferrous sands require case-by-case site-specific BUD applications.

Landfill Fee Exemption: Iowa law allows foundry sand used as landfill daily cover to be exempt from the $4.25/ton state landfill surcharge, creating an economic incentive for sand reuse.

Federal EPA Guidelines

At the national level, the U.S. EPA encourages the reuse of spent foundry sands from iron, steel, and aluminum foundries. EPA's major documents include:

- Risk Assessment for Spent Foundry Sands in Soil-Related Applications (2014)
- Sustainable Materials Management Program resources.

EPA concluded that silica-based sands from iron, steel, and aluminum foundries can be safely reused in soil blends, construction materials, and road bases.

EPA does not federally regulate beneficial reuse of non-hazardous foundry sands but defers regulatory authority to states like Iowa.

Local Ordinances

Most cities and counties in Iowa defer to Iowa DNR’s framework regarding foundry sand reuse. Some municipalities may require additional notifications or approvals for larger volume projects (especially for uses near sensitive areas like wetlands).

However, if a reuse project complies with Iowa’s BUD program, local additional permitting is rare.

5. Reuse Applications and Iowa Examples

Beneficial reuse of foundry sand in Iowa takes multiple forms depending on material properties, project goals, and DNR approvals. Real-world applications have been proven across industries, especially construction and landfill operations.

Common Beneficial Reuses

Reuse Application	Description	Iowa Examples or Status
Road Base & Fill	Substitute for sand/aggregate in road subbase, embankments, and structural fill. Provides bulk and drainage.	Allowed by Iowa DNR (no permit needed). Used in local projects such as under parking lots and city roads. Grede diverted 5,600+ tons for an airport fill project; similar uses are adopted case-by-case.
Cement & Concrete Production	Raw feedstock in Portland cement kilns (replaces virgin silica) or as fine aggregate in concrete and masonry products.	Holcim Mason City plant uses approximately 75,000 tons/year from Iowa and regional foundries. EPA-supported trials show foundry sand replacing 20% of concrete mix without loss of strength.
Landfill Uses	Daily cover (usually sand-soil mix), interim cover, or drainage layer material in liners and leachate systems.	Widely practiced. Dubuque landfill uses local foundry sand as daily cover (50/50 mix), exempt from landfill fees. Scott County landfill saved $50,000 using dredge/foundry sand in an underdrain.
Soil Amendment	Blend into topsoil, manufactured soil, or potting media to improve drainage. Typically limited to ferrous/aluminum sands with low contaminants.	Supported by EPA/USDA study (safe at up to 50% sand content). Not yet widely practiced in Iowa; potential growth area. Indiana successful pilot: peat moss + foundry sand potting soil.
Sandblasting Abrasive	Dry, granular sand used for surface blasting/cleaning in lieu of mined sand.	Allowed by Iowa rules. Some foundries supply clean spent core sand for blasting large metal parts. Must be free of lead and sized appropriately.
Other Innovative Uses	Cattle bedding, snow/ice control sand, other experimental uses.	Exploratory. One Iowa foundry's sister plant used 150 tons of foundry sand as cattle bedding after chemical safety confirmation. Subject to DNR case-by-case approval.

Iowa Examples in Action

- Cement Kiln Reuse: Holcim's Mason City plant processes ~75,000 tons/year of spent foundry sand. Sourced regionally, including from Iowa foundries, this reuse saves virgin resources and cuts emissions.
- Road Construction Fill: Foundry sands have been used in highway projects for structural fill under roads. (e.g., projects near airports and industrial parks across Iowa.)
- Landfill Daily Cover: Dubuque landfill and Scott County landfill actively accept foundry sand, saving money and conserving native soils.

- Potential Soil Amendments: Pilot projects (especially from EPA studies) show blending foundry sand into topsoil improves drainage without heavy metal uptake by plants.
- Sandblasting and Niche Uses: Core sands have been diverted for industrial sandblasting jobs, substituting for more expensive commercial blasting media.

6. Environmental and Technical Considerations

Beneficial reuse of foundry sand requires careful understanding of material composition, contaminant risks, and environmental testing protocols to ensure safe and responsible outcomes.

Types of Foundry Sands

Ferrous Foundry Sands (Iron and Steel Castings):

- Typically high-purity silica sand bonded with clay (green sand) or chemical resins.
- Low in contaminants.
- EPA and Iowa DNR consider these the safest and most preferred for reuse.

Non-Ferrous Foundry Sands (Aluminum, Brass, Bronze Castings):

- Similar base sand but potential contamination from metal alloys.
- Brass/Bronze sands often contain elevated lead, requiring more stringent testing or stabilization before reuse.

Specialty Sands:

- Some foundries use olivine sands or other media; not covered under EPA's standard risk assessment for reuse.
- May alter soil pH or chemistry.

Contaminants of Concern

Contaminant	Source	Notes
Lead (Pb)	Brass/bronze alloys	Key concern; must not exceed TCLP leaching limit (5.0 mg/L).
Chromium (Cr)	Stainless steel alloys, pigments	Usually low and stable in ferrous foundries; not a major issue.
Phenols / Cresols	Phenolic resins (binder breakdown)	Organic compounds typically present in very low concentrations.

Contaminant	Source	Notes
PAHs	Burnt sea coal or resin residues	Detected at very low levels; below environmental risk thresholds.
Dust / Free Silica	Physical hazard from dry sand	Requires dust suppression measures during handling to protect workers.
pH / Salinity	Binders, chemical additives	Some foundry sands have slightly alkaline pH, generally not problematic unless used directly in soils.

Importance of TCLP Testing

The Toxicity Characteristic Leaching Procedure (TCLP) is the industry-standard EPA test to determine whether foundry sand poses a leaching hazard to groundwater.

- Simulates landfill leachate conditions using an acetic acid solution.
- Measures 8 key metals (Lead, Arsenic, Cadmium, Chromium, etc.).
- Passing TCLP = Sand is classified as non-hazardous.
- Ferrous foundry sands in Iowa typically pass TCLP easily.

If foundry sand fails TCLP (e.g., high lead from brass castings):

- It must be managed as hazardous waste, not reused without treatment.

Key for Iowa Reuse: All sands used in landfill cover, road base, concrete, etc., must pass TCLP and have supporting documentation.

Environmental Behavior of Foundry Sand

- Heavy metals in ferrous sands are generally immobilized in the sand matrix.
- Organics (e.g., phenols, PAHs) are below actionable risk levels according to EPA risk assessments.
- Field studies show low leachability and no significant uptake into plants when used in soil amendments.

Conclusion: For properly characterized ferrous foundry sands, environmental risks are minimal — supporting broad beneficial reuse.

7. Funding, Grants, and Incentives

State-Level Incentives

Solid Waste Alternatives Program (SWAP):

- Administered by Iowa DNR.
- Provides grants and low-interest loans for projects that reduce landfill waste.
- Foundry sand reuse projects qualify (e.g., setting up processing equipment, transportation initiatives).
- Requires a 25% cash match from the applicant.
- Awards are based on amount of waste diverted and project sustainability.

Iowa Waste Exchange (IWE):

- Free service offered by Iowa DNR.
- Matches foundries with end-users (e.g., contractors, landfill operators).
- Provides technical assistance, material characterization support, and regulatory navigation.
- No direct funding, but huge savings by helping foundries and users avoid disposal/purchase costs.

Landfill Fee Exemption:

- Iowa Code 455B.310(9) exempts foundry sand used as landfill daily cover from the $4.25/ton state landfill surcharge.
- Creates a significant cost advantage for landfills to accept and use foundry sand.

Property Tax Exemption for Recycling Equipment:

- Iowa allows full or partial property tax exemption for machinery primarily used for pollution control or recycling (Iowa Code 427.1(19)).
- Applies to sand reclamation units, screening equipment, or mixing machinery for reuse projects.
- Must be certified through Iowa DNR to qualify.

Federal-Level Opportunities

EPA Sustainable Materials Management Grants:

- Periodically available grants supporting innovative reuse/recycling projects.
- Can fund pilot projects, outreach campaigns, or infrastructure improvements related to foundry sand.

Federal Infrastructure and Recycling Funding (Infrastructure Investment and Jobs Act):

- Some grant programs are open to states and municipalities improving recycling or circular economy initiatives.
- Foundry sand reuse aligns with goals of waste reduction and sustainable construction.

FHWA / DOT Support:

- Federal Highway Administration promotes the use of recycled materials (including foundry sand) in road construction.
- Some research grants and technical support available for projects demonstrating new uses of industrial byproducts in infrastructure.

Local Opportunities

Local Government Partnerships:

- Counties and cities sometimes offer mini-grants or project cost-sharing for green construction and waste diversion projects.
- Example: County public works departments may help subsidize trucking costs if foundry sand is used in local road construction.

Public-Private Collaborations:

- Landfills may waive tipping fees for sand.
- Construction contractors may provide free transport in exchange for discounted material.
- Informal partnerships often unlock major savings without formal grant applications.

Summary Table: Key Funding and Incentive Programs

Program/Incentive	Type	Key Details	Impact for Foundry Sand Reuse
SWAP	State Grants/Loans	Competitive funding for projects that divert landfill waste. Requires 25% cash match.	Can fund equipment, logistics, pilot projects.
IWE	Technical Assistance	Free matchmaking service connecting foundries with reuse partners.	Reduces disposal costs, builds markets.
Landfill Fee Exemption	Cost Savings	No $4.25/ton surcharge for foundry sand used as landfill daily cover.	Immediate cost savings for both landfills and foundries.
Property Tax Exemption	Tax Incentive	Property tax exemption for recycling/pollution control machinery certified by DNR.	Reduces cost of capital investments like sand reclaimer units.
EPA/Federal Grants	Research/Demonstration	Funding for innovative reuse pilots, especially under Sustainable Materials Management programs.	Can supplement state funding for large projects.

8. Active Participants in Iowa

Foundries (Generators of Spent Sand)

Clow Valve Company (Oskaloosa, IA)

- Ductile iron and brass foundry.
- Reclaims sand internally and supplies excess sand for landfill daily cover.
- Participated in Iowa DNR waste diversion studies.

John Deere Foundry (Waterloo, IA)

- One of the largest iron foundries in Iowa.
- Supplies sand for road construction projects and industrial fill.
- Works with contractors and regulatory agencies to support beneficial reuse.

A.Y. McDonald Manufacturing & Morrison Bros. (Dubuque, IA)

- Foundries that diverted all their spent sand to the Dubuque Metro Landfill for daily cover use.
- Provided critical case studies showing environmental safety.

Weaver's Iron Foundry (Atlantic, IA)

- Smaller regional foundry interested in local reuse partnerships.

Grede Foundries (regional, including Iowa suppliers)

- Ships 500+ tons/month to Holcim Mason City cement plant for use in Portland cement manufacturing.

End Users (Consumers of Foundry Sand)

Holcim (Geocycle) Cement Plant (Mason City, IA)

- Major consumer of spent foundry sand (~75,000 tons/year).
- Incorporates sand as silica feedstock in cement production.

Dubuque Metro Area Solid Waste Agency

- Accepted foundry sand from local manufacturers for daily landfill cover.
- Demonstrated safe long-term use with no groundwater issues.

Scott County Waste Commission

- Used dredged sand (analogous to foundry sand) successfully in underdrains for new landfill cells, saving $50,000.
- A model for future foundry sand reuse in landfill construction.

Metro Park East Landfill (Des Moines metro)

- Large regional landfill that has expressed interest in industrial byproduct reuse programs.

Construction Contractors

- Various roadbuilders, industrial park developers, and trenching contractors use foundry sand as economical fill material.
- County engineers and public works departments (through Iowa County Engineers Association) are open to foundry sand for road subgrades and culvert bedding.

Supporting Programs and Agencies

Iowa DNR Waste Management Section

- Oversees Beneficial Use Determinations (BUDs).
- Provides grant funding (SWAP program) and technical assistance.

Iowa Waste Exchange (IWE)

- Connects foundries to local end-users.
- Offers free technical matchmaking, regulatory advice, and assistance finding reuse markets.

Iowa Waste Reduction Center (IWRC)

- Based at the University of Northern Iowa.
- Provides pollution prevention research, technical consulting, and pilot project support to small and medium-sized foundries.

American Foundry Society (AFS) – Midwest Chapter

- Provides technical manuals, best practice guides, and case studies.
- Iowa members actively promote foundry sand recycling.

USDA Agricultural Research Service (ARS) – Ames, IA

- Contributed to national EPA risk assessment studies on foundry sand reuse.
- Source of soil science expertise relevant to sand/soil blending applications.

Key Collaboration Insights

- Foundries provide consistent, tested sand streams.

- Landfills and Cement Plants offer large-volume end-use outlets.
- Contractors and Cities create project-specific demand.
- DNR, IWRC, IWE ensure regulatory compliance, funding access, and technical support.
- AFS and Iowa Recycling Networks spread success stories, standards, and new technology ideas.

The synergy between all these participants has made Iowa a national leader in foundry sand beneficial reuse.

9. Success Story Highlights

Success Story 1: Holcim Cement Plant, Mason City, Iowa

- Accepts ~75,000 tons/year of spent foundry sand.
- Saves virgin sand mining and reduces environmental impact.
- Works with multiple foundries including Grede and John Deere.

Success Story 2: Dubuque Metro Landfill

- Diverts all local foundry sand for daily landfill cover.
- Saves $4.25/ton landfill fee per load.
- No groundwater contamination after more than 5 years of monitoring.

Success Story 3: Scott County Landfill

- Used alternative sands (dredged and foundry) in landfill underdrains.
- Saved over $50,000 on material costs.
- Helped showcase the environmental safety of sand reuse in Iowa public sector projects.

10. Clear Business Case Summary

Why Foundries Should Reuse Sand:

- Save $30–$50 per ton vs. landfill disposal costs.
- Avoid environmental liability.
- Improve sustainability reporting for customers and regulators.

Why Contractors Should Reuse Sand:

- Get free or discounted sand for construction fill.
- Improve project bids by lowering material costs.

Why Landfills Should Accept Foundry Sand:

- Secure free cover material.
- Reduce operating costs.
- Increase daily cover efficiency.

11. Risk Management Overview

Beneficial reuse of foundry sand carries significant economic and environmental benefits, but participants must manage risk carefully to ensure compliance and protect their businesses.

Best Practices

- Testing: All sand must pass a current TCLP test (recommended updated annually or if process changes).
- Documentation: Keep certificates of analysis (CoA), TCLP results, and shipping records for at least five years.
- Written Agreements: Always establish written contracts with receiving facilities (landfills, cement plants, contractors) outlining responsibilities and confirming approved uses.
- Site-Specific Approvals: For new or unusual uses not covered under Iowa's universal approvals, seek DNR Beneficial Use Determination (BUD) or documented exemption.
- Insurance: Verify liability coverage, and ensure your insurer understands your beneficial reuse activities.

ARS Support: ARS can assist participants in setting up compliance systems, testing protocols, and document templates to minimize legal risk.

12. Step-by-Step Workflow for Foundries

Simple Process to Start Foundry Sand Reuse:

- Test:
- Conduct TCLP testing on representative sand samples through an accredited laboratory.
- Confirm results meet Iowa DNR non-hazardous thresholds.
- Document:

- Save all lab results, including full reports and summary sheets.
- Partner:
- Contact ARS to match your material to a reuse project (landfill, cement, construction).
- Agreement:
- Sign a beneficial reuse agreement or memo of understanding.
- Ship:
- Begin shipping sand as needed.
- Label loads clearly and maintain load-out logs.
- Monitor:
- If your production process changes (e.g., alloy change, new binder), re-test your sand.
- Maintain communication with ARS and receiving partners.

Result: Compliance, savings, and sustainability without added operational headaches.

13. Real Cost Savings Example

Why Reuse Makes Financial Sense:

- Landfill Disposal Costs:
- Disposal fee: ~$70-$150/ton
- Landfill surcharge: +$4.25/ton
- Total = ~$74.25-$154.25/ton to landfill
- Beneficial Reuse Costs:
- Transportation only: ~$10-$75/ton (varies by distance)

Savings Calculation:

If your foundry produces 1,000 tons/year:

Landfill cost: 1,000 tons x $49.25 = $49,250

Reuse transport cost (avg $15/ton): 1,000 tons x $15 = $15,000

Total annual savings = ~$34,250

Multiply this by 5–10 years and the impact becomes massive.

15. General FAQ & Landfill-Specific FAQ

Q: Is reused foundry sand safe for public use projects like roads or parks?
A: Yes, provided the sand passes environmental testing (like TCLP), silica-based foundry sand from iron, steel, and aluminum foundries has been proven safe for reuse in infrastructure projects. Iowa DNR and U.S. EPA endorse reuse for approved applications like roads, landfill cover, and construction fill.

Q: How often does foundry sand need to be tested?
A: Sand must be tested initially to prove non-hazardous status. After that, testing frequency depends on process consistency. Most foundries re-test yearly or if they change raw materials or binder systems.

Q: Can reused foundry sand be used near homes, gardens, or drinking water supplies?
A: Applications like road base and landfill cover are common and safe. For use in soils near gardens or homes, additional case-by-case approvals and environmental assurances may be needed (especially for soil amendments).

Q: What happens if a reused sand load fails testing after reuse starts?
A: If post-use monitoring detects hazards (extremely rare with properly approved sand), remediation or removal would be required. This is why initial proper testing and documentation are critical.

Q: Who is responsible for proving the sand is safe - the foundry or the user?
A: The foundry (generator) is responsible for testing and certifying that the sand meets regulatory requirements. The end user must ensure they use the sand only in approved ways.

Landfill-Specific FAQ

Q: Does foundry sand affect landfill leachate or groundwater?
A: No. Studies by EPA, USDA, and Iowa DNR confirm that properly tested ferrous foundry sand does not contribute hazardous leachate or groundwater issues.

Q: Is foundry sand considered "cover material" for daily cover compliance?

A: Yes. Iowa DNR regulations approve foundry sand (mixed up to 50% with soil) as daily cover.

Q: Do we need special equipment to handle foundry sand?

A: No. Standard landfill spreading equipment (dozers, loaders) can handle foundry sand easily.

Q: How do we document use to maintain surcharge exemption?

A: Maintain simple load logs and daily cover documentation. ARS can provide templates.

Q: What if sand chemistry changes?

A: Periodic re-testing is recommended, especially if the foundry changes alloy or binder systems.

16. References

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- Scott County Waste Commission - Infrastructure and Cost-Saving Reports ➔ Documented under Iowa DNR reuse summaries.