Technology Brief

BENEFICIAL REUSE OF SPENT FOUNDRY SAND

The foundry industry generates a number of byproducts, of which the largest volume is a “spent sand” that consists of silica or olivine sand with residuals of phenolic resin, clay or no-bake binders. The Clean Washington Center's Recycling Technology Assistance Partnership is working with the Washington State Chapter of the American Foundrymen's Society (AFS) toward the implementation of beneficial re-use applications for spent foundry sand. This fact sheet describes common uses of foundry sand, provides an overview of several beneficial reuse options, and discusses issues for future development of a viable market for the recycled sand.

Key Words	
Materials:	Spent foundry sand.
Technologies:	Fine aggregate substitution; stabilization.
Applications:	Asphalt concrete, bricks & pavers, compost additive, concrete, flowable fill, mineral wool products, portland cement.
Market Goals:	Establish variety of regional markets throughout Washington State.
Abstract:	Summary of beneficial re-use options for spent foundry sand.

Background

All foundries produce castings by pouring molten metal into molds. The characteristics of the residuals vary from foundry to foundry, and depend on the type of metal being poured (iron, steel, aluminum, brass/bronze), the type of casting process (sand casting, investment casting), and the technology employed, particularly the type of furnace (induction, electric arc, cupola) and the type of finishing process (grinding, blast cleaning, coating).

Sand Casting

The most common type of casting process is known as sand casting. There are two basic types of mixtures for sand casting: "green" sand and "no-bake" sand. Green sand uses a mixture of clay and water to achieve bond strength, while no-bake sand uses synthetic resins. Sand casting involves making a pattern of the component to be cast, and packing sand around the pattern to produce a hollow mold. Molds are typically made in two halves to facilitate removal of the pattern, and then the molds are assembled to form a "hollow" that matches the pattern's shape. Cores, made of packed sand with special binders, may be inserted into a mold, prior to assembly, to form interior surfaces for complex shapes. Molten metal is poured into the mold cavity and allowed to solidify and cool. The casting is shaken out of the sand mold using vibratory machines, mechanically cleaned of extraneous metal by cutting or grinding, and blast cleaned to remove casting sand and other surface contaminants.

Sand casting generates residuals from metal melting and pouring, and molding processes. Residuals consist of "spent sand" from molding and core-making, slags, and wastes from cleaning rooms, dust collectors or scrubbers. Depending upon the process, some foundry wastes, including spent sand, slags, and dust collector/scrubber wastes, may be hazardous.

Spent Foundry Sand

It is standard foundry practice to reuse molding and core-making sands. Residual sand is routinely screened and returned to the system for reuse. As the sands are repeatedly used, the particles eventually become too fine for the molding process; and, combined with heat degradation from repeated pourings, requires periodic

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replacement of "spent" foundry sand with fresh sand.

This "spent sand" is typically non-hazardous, black in color, and contains a large amount of fines (particles of 100 sieve size or less). Olivine and silica sands are most common in Washington State foundries.

Quantity

An informal survey places the amount of spent sand generated by Washington State foundries at a conservative estimate of 22,000 tons per year.

Some Beneficial Reuse Options

Non-hazardous and non-dangerous spent sand has traditionally been used as "clean fill" in many parts of Washington State. However, "clean fill" opportunities have declined in recent years, making exploration and implementation of other applications essential. Spent foundry sand has been successfully used throughout the United States in various applications. Below are some recycling options for spent sand:

- **Asphalt Concrete:** Substitution of up to 15% spent sand for conventional asphalt concrete fine aggregate.
- **Compost Additive:** Bulking agent for composted yard waste, to produce topsoil or topsoil additive.
- **Concrete:** Substitution for regular sand in structural grade concrete, at low percentages.
- **Bricks and Pavers:** Encapsulation in a proprietary, high pressure, pozzolanic process that can encapsulate and chemically bind various waste materials in C-grade flyash (a fine particulate ash produced by coal-burning electrical power plants). The ambient-temperature process results in bricks that are cost effective and can be shaped to meet end-user requirements
- **Portland Cement:** Cement kiln feed for portland cement. A study by the American Foundrymen's Society indicates that portland cement manufactured with up to 13% of spent foundry sand exhibited slightly higher compressive strengths than conventionally produced portland cement, without any degradation of key characteristics such as set time.
- **Mineral Wool Products**: Potential silica source.
- **Flowable Fill:** Substitution for regular sand in flowable fill, a mixture of sand, flyash, and water that is mixed into a slurry and poured. Flowable fill is a self-leveling and self-compacting mix that hardens and develops strength over time, similar to concrete, and is commonly used as backfill for trenches (sewer, conduit, utility).

Future Development

Recycling of spent foundry sand in Washington State must overcome many challenges, including:

- Relatively low total volume of material. *(Estimated at 22K tons/year.)*
- Non-uniformity. *(Characteristics depend on type of metal poured & type of sand/binders used.)*
- Transportation costs and logistics. *(Weight of material implies that the most promising situations involve close proximity of end-user to generator.)*
- Consolidation logistics. *(May require collection & storage to acquire volume for some applications.)*
- Understanding of regulatory requirements and concerns. *(Due to increased public awareness about industrial byproducts in general, a more thorough understanding of specific situations & applications is essential for implementation of spent foundry sand recycling strategies.)*
- Identification of regional end-user manufacturers and product markets. *(The CWC and the AFS are working together to locate and support beneficial reuse applications in Washington.)*

As is true for any recycling opportunity, the success of recycling spent foundry sand is dependent upon economics - the bottom line issues will be cost, availability of supply, and consistent quality of the feedstock. Successful resolution of these issues will enable the State of Washington not only to keep spent foundry sand out of the landfill, but also to increase the competitiveness of both the foundries and the end-users of the spent foundry sand.

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For More Information

For a copy of the report, *Beneficial Reuse of Spent Foundry Sand (IBP-95-1),* use the CWC Publication Order Form. For more information call CWC at (206) 443-7746, email info@cwc.org, or visit the CWC Internet Website at www.cwc.org.

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