FINDING A HOME FOR YOUR RECYCLED SAND

Three case studies illustrates successful applications for casting sand

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Setting up a sand recycling program in your metal casting facility can improve your environmental performance, reduce operating costs, create a positive image for your facility and reduce the need for virgin materials. However, setting up a program requires operational and financial planning.

Before marketing spent sand and other by products, such as furnace slag and dusts, a metal casting facility should know the materials' properties and composition in order to clear any regulatory hurdles and locate potential end-users. In addition to U.S. Environmental Protection Agency (EPA) regulatory requirements, most state have their own environmental management agency that sets rules and regulations for the use of recycled by products. In Indiana, for example, sands are tested and then categorized for acceptable reuse applications. Typically, these regulations require testing using some type of leachate procedure. Leachable metal content and a variety of organics are typically built into each state's protocol. Metal casting facilities remain responsible for the material, cradle-to-grave, or as Mike Lenahan, president of Resource Recovery Corp., Coopersville, Mich., puts it, cradle-to-cradle.

"Most foundry sand is cleaner than native farm soils," Lenahan said." In most cases, iron, steel or aluminium casting facilities should not have to worry about their material being hazardous. Some brass and bronze casting facilities would have potential concern if they are pouring leaded alloys,"

Once you have determined your spent sand is permitted for use in your state, make an appraisal of the quantities of reusable material routinely available and your current costs for processing and disposing of the material, such as landfill tipping fees, onsite handling costs, cartage, and other waste management fees, such as container rental costs.

Potential users of spent sand often require large volumes of sand that can be delivered as needed. Small metal casting facilities have unique challenges when it comes to recycling their materials. Some may find it best to combine similar by products from other nearby facilities on a single project. If you do combine materials with other metal casters, make sure you know there is oversight relative to regulatory compliance for other facilities.

Forming a beneficial reuse program has its own associated fees beyond the regulatory schematic, such as costs for testing and permitting, handling and hauling, and material preparation, such as screening the sand. If you are combining or commingling your by products, starting a beneficial reuse program will most likely require segregating materials, since end-users typically maintain cleanliness and gradation requirements for each specific end-use.

"The metal caster has to treat and approach its casting sand as a product rather than a by product," Lenahan said. "The customers want clean material, free of core butts and other debris."

Metal casters also will find that very few contractors will pay for the sand.

"Metal casters involved in reuse projects typically are not selling their sand outright; most are paying some fee to have it recycled," Lenahan said." The goal of each metal casting facility should be to reduce costs associated with disposing of the sand. Not every project can be a home run; however, singles and doubles will win you a lot of games."

Finding end-uses close at hand makes a significant impact on the bottom line for the end-user and the metal caster, since a large portion of the cost is associated with transportation. If you are doing your own hauling, utilizing trucking equipment that can legally handle more tonnage will cut down on the number of trips needed.

"Make sure the hauling company is pulling the optimized load weight each time," Lenahan said." The costs associated with inefficient hauling can radically impact your overall cost of recycling or disposal."

Potential applications for casting sands include sub-base for construction, including road sub-base, topsoils, landfill cover, leachate liner cover at landfills, asphalt cement, concrete and polymer composites.

"Look at what other companies have done to use casting sand and suggest it to potential new users," Lenahan said." You don't have to reinvent the wheel. Our business philosophy has been to try not to overreach too fair into the abstract but rather stick with what's been working."

CALCULATING POTENTIAL SAVINGS

When building a business case for disposing of sand to a landfill or building a beneficial reuse program, the below basic formulas can help calculate potential economic savings. The costs can be calculated on a per ton or volume unit basis. If the beneficial reuse cost is not the same as or lower than the present cost by at least 15-20%, the likelihood of a successful beneficial reuse programme is remote.

Beneficial Reuse = (Amortized Capital Investment Costs + Operating Costs + Administrative/ Regulatory Costs) - (By-product Revenue + Raw Material Costs Avoided + Disposal Costs Avoided + Amortized Tax Reduction Benefit)

Present Cost = Current Amortized Equipment Value + Current Operating Costs + Current Disposal Costs + Current Administrative/ Regulatory Costs + /- Current Equipment Asset Tax or Depreciation

CASE STUDY 1: EMBANKMENT AND STRUCTURAL FILL

Rather than dispose of its excess spent nobake sand in a landfill, Rexnord Industries, Milwaukee, provided more than 20,000 tons of it to the Wisconsin Department of Transportation to use as embankment and structural fill material for major work on the College Ave. interchange of Interstate 94 in Milwaukee. The use of the sand was permitted under the authority of Wisconsin's

NR 538 Beneficial Use of Industrial By products, which cover the use of casting sand in geotechnical applications.

Before the sand was accepted for the project, an independent consultant tested for gradation, soil classification, moisture-density relationship and constant head permeability. The sand was classified as poorly graded sand (meaning the material consists mainly of particles of nearly the same size) with some gravel and silts. The unit weight was lower than more well-graded sands, but a lighter unit weight is a benefit around heavy structures, such as bridge foundations. The optimum water content was comparable to other sands, and the permeability coefficient was on the border between sands and fine sands/silts. The permeability was sufficient for embankments and structural fills in the project where storm water controls limit infiltration.

The sand also underwent a water leaching test and an organics test. No organic contaminants beyond regulatory parameters were detected.

The casting sand was delivered in dump trucks and spread with a bulldozer, like any other sand. Accordingly to the contractor, Hoffman Construction Co., Black River Falls, Wis., despite heavy rain, the sand was placed and compacted with no problems. The contractor viewed casting sand preferable to conventional sand in this project because it did not freeze in the winter and arrived with a moderate moisture content, which prevented dust issues and reduced the water needed for compaction.

Because the sand was already approved for use before the bidding process, the contractor was able to bid a lower price.

CASE STUDY-2: RETAINING WALL BACKFILL

In 2007, Great Lakes Construction used 11,500 tons of foundry sand as reinforced structural fill under the approaches to a bridge over the CSXT Railroad, as well as to raise the grade of two connecting roads in Cuyahoga Country, Ohio. The sand, which was supplied by Kurtz Brothers, Independence, Ohio, came from a Ford casting facility and was narrowly, graded fine sand, with 98% passing the # 30 mesh and 75% larger than the # 70 mesh. Approximately 10% of the sand mixture was bentonite, while the sea coal content was 3%. In addition to meeting the regulatory requirements of Ohio EPA DSW 0400.007, additional engineering and test data showed the sand met Ohio Department of Transportation (ODOT) requirements, specifically under Supplemental Specification 871 “Embankment Construction Using Recycled Materials.” ODOT requirements examined the sand’s Atterberg limits, gradation, moisture- density relationship, pH, chloride and sulphate levels, and contaminant levels.

A virgin material with uniform grain size like the Ford casting sand would be difficult to compact in the field, but the presence of clay and seacoal helps with the compaction and provides additional shear strength. Uniform grains size also helps with drainage, which was important in the project because the sand was backfilled behind a wall and water needs to drain quickly to prevent lateral pressures building on the wall.

Kurtz Brothers used this particular project as a demonstration of casting sand's capabilities to ODOT and the general contractor, so the company was comfortable breaking even on the delivered sand price. ODOT saw a cost saving using the casting sand compared to natural sand.

CONSIDERING THERMAL RECLAMATION

Before relegating its sand to landfills or beneficial reuse, metal casting facilities may also consider thermally reclaiming the sand. According to Gerald Reier, president of GMD Environmental, thermal reclamation systems for resin – bonded sand typically reclaim 90% of true silica sand, which can be used as new sand throughout the metal casting facility.

"If you start with a high purity sand, it could be continually processed for years, " Reier said." Weaker or poorer sand grain will fracture and become a fine particle that is removed in the first pass. If the sand doesn't break away from the system, it will be continually recycled."

As the sand is thermally reclaimed, Reier said it becomes stabilized and cleaner than purchased new sand. While most new sand comes in with a significant amount of fines that requires more binder, the fines are removed during reclamation. Most facilities using thermal reclamation are nobake casting facilities, but according to Reier, equipment exists that will efficiently thermally reclaim green sand, as well.

"Almost every sand casting facility out there except for a very small company could justify buying a thermal reclamation system with savings on new sand and disposal costs, "he said." In a feasibility study, it has been found that metal casters will only need 10% new sand on an annual basis (with thermal reclamation). "

While Reier notes that U.S. Companies' interest in thermal reclamation has stalled, growing numbers of facilities in China, Italy and Mexico are incorporating the sand recycling systems.

12 QUESTIONS FOR POTENTIAL BROKERS

Rather than dedicate personnel to running a beneficial reuse program, metal-casting facilities may choose to have outside contractors manage their program. Below are basic questions to ask potential firms to obtain a general understanding of the contractor and its investment and experience level in the casting industry.

1. **How long have you been in business?**
2. **Who else are you working with in the metal casting industry and beyond?**
3. **What else do you do to generate revenue?**
4. **What is your background relative to metal casting or industrial recycling**
5. **Are you an active member of a state or national metal casting association, and if so, for how long?**

6. **Does anyone in your company sit on industry technical committees or state cast metals boards? And if so, for how long?**
7. **What is your technical expertise?**
8. **What is your annual revenue?**
9. **What type of equipment do you own and operate?**
10. **Where is my sand going after you handle it?**
11. **Who do you know and work with at the U.S. Environmental Protection Agency, the state environmental agency, the local board of health, etc.**
12. **Do you provide analytical testing services?**

CASE STUDY 3: HIGHWAY SUB-BASE LAYER

Wisconsin has areas of soft native soils that cause problems in road construction. Typically, the upper layers of the soft soil are removed and replaced with 12 in, and greater – sized crushed rock in order to provide an adequate working platform for construction traffic. The crushed rock is more expensive than regular fill material and sometimes has to be transported a great distance from the quarry to the rock site.

A working group from the Wisconsin Department of Transportation considered new techniques to deal with soft soils, including using gray iron castings sand from a Wisconsin green sand metal casting facility, for a 0.9 – mile segment of Wisconsin State Highway 60 (STH 60) in 2000.

The sand was placed in bulk along a 166 yard stretch as a 33-in. Sub-base layer. The control section used reclaimed stone from cuts made as part of the highway's modifications. The casting sand used was fine with a narrow range of grain sizes. The dry unit weight was 71% of the gravel, and the optimum water content was twice that of the gravel due to the bentonite content (10%). The sand was placed and compacted using standard construction equipment.

Water leach tests were conducted on the casting sand according to ASTM D 3987 to determine its suitability for use as a sub base material, and it met all requirements in Section NR 538 of the Wisconsin Administrative Code for by products used in confined geotechnical applications.

The physical and environmental properties of the sections have been monitored for more than eight years. During that time period, the payment performance has been the same for both the foundry sand and control sections.

The casting sand for this project was provided at a reduced cost for the demonstration. However, casting sand as a general rule is less expensive than select materials, such as crushed stone.