

CASE STUDY: Foundry Sand as Sub-base Fill for an Airport Runway

Aarrowcast, Inc. Shawano, Wisconsin

Aarrowcast, Inc. in Shawano, Wisconsin, has been producing high precision gray and ductile iron castings since 1978. Foundry sand from the facility is usually stored at a site adjacent to the Shawano Landfill, specifically for later use in various beneficial reuse projects.



Photo 1: An aerial shot of the runway in construction.

material was screened before being placed. This extra material processing ended up costing about \$43,000, bringing the total cost of using the foundry sand up to about \$113,000 or approximately \$5 per cubic yard.



Photo 2: Some of the fragments that did not break up as expected.

This particular beneficial reuse project used approximately 23,000 cubic yards of foundry sand as sub-base fill for a new cross-wind runway at the Shawano Municipal Airport. Aarrowcast paid Zimmerman Aggregate of Shawano approximately \$67,000 to transport the sand one mile from the storage facility to the work site at the airport. Once there, Musson Brothers, Inc. applied the sand according to specifications (Table 1) and watered it down to ensure that it compacted correctly. Watering cost about \$5,000 and application cost about \$65,000. During application, it was discovered that casts and large metal fragments left in the sand by the foundry were not breaking down as expected. This caused significant concern regarding potential heaving because the sand was being used above the frost line. As a result, it became necessary to screen the sand. The material that had already been applied was pulverized in place, while the remaining

Compaction	Depth Required
100%	0-8"
95%	8-18"
90%	18-32"
85%	32-44"

Table 1: Compaction Requirements



Photo 3: Foundry sand in place and compacted.

The primary reason foundry sand was used in this project was because it made the overall cost of building the runway much lower for the airport than borrow, which can run up to about \$8 per cubic yard, had been used as fill. This cost savings occurred because Arrowcast both supplied the sand free of charge and assumed the transportation expenses for it. Additionally, foundry sand is environmentally friendly and approved by the Wisconsin DNR for uses such as this one, making its incorporation into the project relatively easy. Note that even though Arrowcast paid a significant sum for transportation, it was still less than the amount it would have cost to landfill the sand. Furthermore, use of the sand saved on limited landfill space for the Shawano landfill, and the sand itself provided good compaction qualities due to its clay content and met the grade requirements (Table 2).

Sieve Designation (square openings)	% by weight passing sieves
3 in. (75.0 mm)	100
No. 10 (2.0 mm)	20 - 100
No. 40 (0.450 mm)	5 - 60
No. 200 (0.075 mm)	0 - 15

Table 2: Gradation Requirements

Despite these benefits, two main disadvantages were experienced with using Arrowcast's foundry sand. The first is the screening issue referred to earlier. Although the sand still ended up being more affordable than other options, screening the sand added significant and unexpected costs to the project. In retrospect, screening should have been done at the foundry from the start.

Doing so would have provided additional economic resources (approximately \$2 per cubic yard) to cover transportation costs.

The second disadvantage is that the sand required significant amounts of watering to achieve the desired compaction requirements. Although this is generally necessary for all types of sand fill, the watering must be done correctly and generally only works once. If the sand has to be worked a second time after application, it does not behave like the virgin material.



Photo 2: The runway in construction. Note the watering truck to the right.

In the end, using foundry sand worked extremely well for this project. It offered cost savings that made the project affordable and, once screened, was a very consistent and manageable material. Through its first winter, the runway showed no signs of differential heaving or excessive joint openings. Arrowcast's foundry sand may continue to be used for projects like this one in the future.



Case Study: Arrowcast, Inc.: Foundry Sand as Sub-base Fill for an Airport Runway

<p style="text-align: center;">Personnel</p>	<p>Foundry: Arrowcast, Inc. Engineers: Omni Associates Contractor: Zimmerman Aggregate (sand hauler) Musson Brothers, Inc. (applicator) End User: Shawano Municipal Airport Regulatory Agency: Wisconsin DNR</p>
<p style="text-align: center;">Site</p>	<p>Location: Shawano, Wisconsin</p> <p>Site Description: Foundry sand from Arrowcast, Inc. is stored at a facility adjacent to the Shawano Landfill until it is needed for various beneficial reuse projects. For this particular project, Arrowcast provided transport for the sand from the storage facility to the project site – about one mile away – at the Shawano Airport. It was then used as sub-base fill for a new runway and covered with asphalt.</p>
<p style="text-align: center;">Materials Utilized</p>	<p>23,000 cubic yards of spent foundry sand.</p>
<p style="text-align: center;">Project Costs and Benefits</p>	<p>Costs Include:</p> <ul style="list-style-type: none"> • \$67,000 in transportation costs assumed by Arrowcast, Inc. • \$113,000 for screening, placing, and watering the sand (about \$5 per cubic yard). <p>Benefits Include:</p> <ul style="list-style-type: none"> • Arrowcast avoided landfill disposal costs. • Using foundry sand made the project much more affordable for the Shawano Municipal Airport. • Shawano Landfill saved on landfill space. • Foundry sand is environmentally safe and approved for this type of use by the Wisconsin DNR. • Foundry sand has good compaction characteristics due to its clay content and met the project’s technical requirements.