

The benefit/cost analysis
was performed in 1999



JTRP/INDOT RESEARCH PROGRAM

Research Pays Off

Use of Foundry Sand in Highway Embankment Construction

Over 9 million-Mg of waste foundry sands (WFS) is produced annually in the United States as a by-product of the metal casting industry. The majority of WFS is deposited in restricted or sanitary waste landfills. Considerable savings are available to the metal casting industry through the development of reuse applications for their WFS. Currently, the Indiana foundry industry spends approximately \$15 million per year on depositing of WFS.

Laboratory investigations have

indicated that WFS can provide the necessary engineering properties for a highway embankment and the Microtox™ bioassay test can be used to screen the toxicity of WFS to prevent a negative environmental impact. In 1996, INDOT and Purdue University constructed a demonstration embankment using WFS. WFS and control embankments were instrumented to monitor geotechnical and environmental performance. Stockpile and job site WFS samples were also tested.

Research Findings and Implementation

Geotechnical results indicate that WFS can perform well as a structural fill with strength and deformation characteristics comparable to natural sand, but cannot be considered as freely draining. Environmental testing consisted of Microtox™ and Nitrotox bioassays, ion chromatography, and inductively coupled plasma testing for metals. Bioassay results indicate that the WFS have not resulted in toxicity higher than those expected from natural sands. Ion migration from the WFS into foundry sand lysimeter was found, but at concentrations below reuse regulatory criteria. Metal concentrations were generally below Indiana regulatory reuse Type III criteria and Drinking Water Standards. Where metal concentrations in the wells exceeded regulatory criteria, exceedences appeared in both up- and down-gradient wells suggesting background metal concentrations as opposed to significant leaching from the WFS. The WFS did not result in a negative environmental impact on the site.

State environmental regulatory agencies were the most frequently identified source of barriers to the beneficial reuse of WFS. The resultant liability exposure from state and federal regulations was the prevailing concern expressed by DOTs when considering using a regulated waste such as WFS. Foundries need to make a commitment to the reuse of their WFS and establish both product quality control and a marketing strategy. To facilitate the reuse of WFS by INDOT, an acceptance criteria protocol based on the Microtox™ bioassay test was developed. A proposed "Recurring Special Provision" for the use of WFS in embankment construction and a WFS stockpile random sampling protocol were provided. The necessary decision tools for incorporating WFS into highway construction, primarily embankment construction, were made available to INDOT as products of this research.

Benefits

Benefits created by the study include low-cost construction materials provided to INDOT, significant savings in landfill disposal costs to the Indiana casting industry, and savings in terms of extended life span of Indiana landfills. On the one demonstration project thus far, using WFS as an embankment material in lieu of conventional clay fill, INDOT's savings were

\$283,436. The value of landfill space that was freed up through the reuse of the WFS was estimated by the industry at \$189,656 if current landfill space was considered and at \$956,852 if new landfill space had to be obtained.

*Cost of
Research
\$140,578*

Estimated Economic Value Over 20 Years At 5% Discount Rate

Volume of WFS Used (Cubic Meters)	Net Savings on Landfill per Cubic Meter	Net Savings on Materials per Cubic Meter	Discounted Savings (20 years)	Benefit/Cost Ratio
85,630	\$11.17	\$3.31	\$15500000	110

Note: Assume that one WFS project is constructed a year.

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