

## Quick Links—Beneficial Use Resource Page

### 1. METALCASTING INDUSTRY RESOURCES

[This document is an update of Chapter 7 of the AFS 2009 Beneficial Use Manual for Foundries revised 10-05-2020.]

**American Foundry Society (AFS)** is the leading U.S. based metalcasting society that assists member companies (metalcasting facilities, diecasters and industry suppliers) and individuals to effectively manage all production operations, profitably market their products and services and to equitably manage their employees. Beneficial use and recycling of foundry sand is an AFS environmental priority. Among the resources accessible through the AFS website located at: <http://www.afsinc.org> are:

**AFS On-line Library**—the searchable on-line AFS metalcasting library is the world’s largest collection of reference materials for metalcasting. Use the search options to access more than 38,500 AFS articles, publications and research reports. You will be presented with abstracts and the option to purchase papers via automatic download or e-mail. The AFS librarian will assist you on-line in locating articles and will answer questions regarding on-line and open stack collections (Monday-Friday 8:00-4:00 Central time). You can ask for the AFS 2009 Beneficial Use Manual for Foundries or do a general search in the library at <https://afs.softlinkliberty.net/liberty/libraryHome.do>

**AFS Videos**—AFS has developed a series of web-based resources that describe the basic metalcasting processes. Among these is a five-minute documentary that aired on PBS in 2008, the video “Spotlight on Metalcasting” can be viewed at: <https://www.youtube.com/watch?v=1RKtOwv3ulU>

**AFS On-line Directory**—“AFS Metalcaster Directory,” AFS publishes and maintains an on-line capability directory on more than 2,500 North American foundries and diecasters. Data can be sorted by casting alloy and process, alloy data and metalcaster. Once a metalcaster is selected you can request a quote, visit a website, print capabilities & export capabilities. <https://www.castingsource.com/metalcaster-directory>

**Metalcasting On-line Directory**—“AFS Beneficial Reuse Directory,” this tool is intended for foundries to search for ready-mixed concrete, asphalt, and Portland cement facilities that may be able to use foundry sands in their manufactured products. The end-users are available through a listing and Google map views. An advanced search can be done using zip codes or an optimal distance from your plant. Please note: this resource is no longer available. However, similar tools can be found at <https://www.envcap.org/srl/index.php> and <https://rmrc.wisc.edu/tools/recycled-materials-web-map/>.

### 2. U.S. EPA’S INDUSTRIAL MATERIALS RECYCLING PROGRAM

GENERAL INFORMATION ON INDUSTRIAL MATERIALS RECYCLING (IMR)

*As part of the Resource Conservation Challenge (RCC), the U.S. Environmental Protection Agency has recognized that non-hazardous industrial materials such as foundry sands can be valuable resources and do not always need to be thought of or managed as “wastes.” In 2002, U.S. EPA established a program on the beneficial use of industrial materials as one of four RCC priority areas.*

**U.S. EPA Industrial Materials Recycling (IMR) Program**— Although the IMR Program has been discontinued, a detailed summary of their work and guidance is provided in the following document, “Industrial Materials Recycling Tools & Resources (2009)”: <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P1003PNL.TXT>

**Industrial Resources Council (IRC)**—was organized at the urging of both U.S. EPA and the Federal Highway Administration to streamline communications about both agencies' priority materials. The IRC is a collaboration of six manufacturing industry associations working together to promote the appropriate beneficial use of materials generated by the nation's key manufacturing sectors. These industry trade associations represent coal combustion products, foundry sands, iron and steel slag, wood and pulp materials, rubber materials, and construction and demolition materials. The IRC's website provides technical information on utilizing industrial materials in various construction and soils-based applications, including structural fill, embankments, road base, etc.  
<http://www.industrialresourcescouncil.org/>

**“U.S. EPA Comprehensive Procurement Guidelines (CPG)”**—contains information and links to construction and transportation products containing recycled content. Although the CPG is primarily for federal procuring agencies, the information is useful for state and local governments and the private sector. View EPA's recommended recycled-content ranges and access a Supplier Database which includes manufacturers, vendors, and suppliers for each item.  
<https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program>

**Foundry sand** is specifically cited in the CPG relating to flowable fill, a low strength concrete product. For more information, go to: <https://www.epa.gov/smm/guidance-materials-quantities-mixtures-and-specifications-flowable-fill-under-comprehensive>

**“Beneficial Reuse of Industrial Byproducts in the Gulf Coast Region”**—this U.S. EPA report examines the beneficial use opportunities for the major industrial byproduct streams generated by 9 sectors that have significant presence in the Gulf coast region. The report summarizes state beneficial material use programs in that region and offers a detailed summary of factors that support or inhibit the creation of market connections to the use of industrial byproducts (i.e., drivers & barriers). The report is intended to provide information to state and federal regulators, trade associations, and other stakeholders to support and promote beneficial material use.  
<https://archive.epa.gov/sectors/web/pdf/beneficial-reuse-report.pdf>

### 3. STATE BENEFICIAL USE REGULATIONS & PROGRAMS

*The use and disposal of most foundry sands and slags are regulated by state environmental agencies because they are non-hazardous materials covered under Subtitle D of the Resource Conservation and Recovery Act (RCRA). It is important, therefore, for foundries, end users, and their marketing partners to know which state environmental rules apply to the circumstances where foundry sands and slags will be recycled or beneficially used in each state.*

**State Profiles**—a database of State information is maintained by the Environmental Compliance Assistance Platform (EnvCAP) that provides information on foundry sand rules and regulations in most of the top foundry states at: <https://www.envcap.org/srl/index.php>

*NOTE: because state rules change, it is important that foundries or foundry sand marketers check directly with their state regulatory agencies to be sure that the beneficial use they are proposing will comply with the state's rules. In many instances, states will grant case-by-case or Research and Development permits for foundry sand projects where it can be shown that similar projects have been conducted in other states.*

**Association of State and Territorial Solid Waste Management Officials (ASTSWMO) Beneficial Use Survey November 2007**—report prepared by the ASTSWMO Beneficial Use Task Force is a compilation of information from a 2006 survey of State (responses from 40 States) and Territorial beneficial use programs/decision-making processes for non-hazardous, industrial solid wastes. The report updates the April 2000 report and provides additional information. Currently not available at:  
<http://astswmo.org/?s=beneficial+use>

**Northeast Waste Management Officials' Association (NEWMOA) Beneficial Use Resources**—NEWMOA established a Beneficial Use Determination (BUD) Workgroup that has produced several resources for state use only: a searchable database of all the BUDs that have been issued by the NEWMOA

states plus five additional other states; and a table comparing the BUD application requirements of the NEWMOA states. In addition, the Workgroup produced fact sheets for the public on selected waste/use combinations. The BUD database includes information on foundry sand permits in 13 states.

<http://www.newmoa.org/solidwaste/bud.cfm>

**EPA State Toolkit for Developing Beneficial Reuse Programs for Foundry Sands**—the EPA Sector Strategies Program developed this document to help address state program barriers. Developed in partnership with the Association of Territorial Solid Waste Management Officials as an assistance tool for states, the guide is designed to help states initiate or revise their beneficial use programs in a way that increases safe beneficial use of foundry sand. The Toolkit provides program options and solid examples of a variety of approaches used to efficiently conduct beneficial use determinations. Although EPA’s Sector Strategies Program has been discontinued, an archived copy of this toolkit is available at this link: <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P10046NJ.txt>

#### **STATE MARKET DEVELOPMENT**

**Recycling Market Development**—this website provides recycling market development information for state and local officials, sources of technical and financial assistance for recycling businesses, and information on the economic benefits of

recycling. <https://archive.epa.gov/wastes/conserves/tools/rmd/web/html/index.html>

#### **4. ENVIRONMENTAL AND ECONOMIC BENEFITS RESOURCES**

**“Waste and Materials-Flow Benchmark Sector Report: Beneficial Use of Secondary Materials-Foundry Sand”**—EPA funded the development of three reports to look at the costs and benefits of recycling the following industrial materials: coal combustion products, foundry sand, and construction and demolition materials. The purpose of these reports is to provide an initial assessment of the market dynamics that affect the generation, disposal, recovery, and beneficial use of these materials; and to provide a preliminary life cycle analysis of the beneficial impact of these materials. A copy of this publication is available in the AFS Library

<https://afs.softlinkliberty.net:443/liberty/OpacLogin?mode=BASIC&openDetail=true&corporation=AFS&action=search&queryTerm=uuid%3D%22430a115e0a0a00f2538653ee01880132%22&operator=OR&url=%2Fopac%2Fsearch.do>

**Risk Assessment of Spent Foundry Sands in Soil-Related Applications**—U.S. EPA and the U.S. Department of Agriculture conducted a multi-pathway risk assessment for foundry sands, building on research conducted by USDA-Agricultural Research Service (ARS) in its Foundry Sand Initiative (see below). EPA officials have stated that they believe that properly managed iron, steel and aluminum foundry sands are safe for use in manufactured topsoils and roadbases. (Some sand types, including olivine sands and nonferrous sands, may require further assessment.) The risk assessment and associated documents can be found here:

<https://www.epa.gov/smm/risk-assessment-spent-foundry-sands-soil-related-applications>

**U.S. Department of Agriculture-Agricultural Research Service Foundry Sand Initiative**—in 2003, USDA’s Agricultural Research Service (ARS) undertook a five-year research study to assess the safety and suitability of foundry sands in horticultural and agricultural applications. The results were very favorable for properly screened iron, steel and aluminum foundry sands. The soil scientists involved have published several peer-reviewed journal articles; references to these articles can be found in the AFS Library. A full copy of the 2014 ARS risk study can be found here:

<http://afsinc.s3.amazonaws.com/Documents/EHS/EPA%20Risk%20Assessment%20sfs%20in%20Soil%20Apps.pdf>

Data from the ARS study were further refined by U.S.EPA in producing the risk assessment described above. A number of peer-reviewed journal articles resulted from the foundry sand project; a listing of most of them can be found by accessing the publication page of Dr. Robert Dungan, lead ARS scientist for the project, at <http://www.ars.usda.gov/pandp/people/publications.htm?personid=34560>, or by visiting the ARS homepage at <https://www.ars.usda.gov/>.

**Department of Energy-funded Study: Excess Foundry Sand Characterization and Experimental Investigation in Controlled Low Strength Material and Hot-Mixing Asphalt (2004)**—DOE research funding supported a multi-phase research project conducted by the Pennsylvania State University and the University of Wisconsin. As part of the study, nearly 400 foundry sand data sets were analyzed for potential environmental impacts. The report addresses three topics: a statistically sound evaluation of the characterization of foundry sand, a laboratory investigation to qualify excess foundry sand as a major component in controlled low-strength material (CLSM), and the identification of the best methods for using foundry sand as a replacement for natural aggregates for construction purposes, specifically in asphalt paving materials.

<https://afs.softlinkliberty.net:443/liberty/OpacLogin?mode=BASIC&openDetail=true&corporation=AFS&action=search&queryTerm=uuid%3D%227eb8c6f30a0a00f22c5b43fa0210bd69%22&operator=OR&url=%2Fopac%2Fsearch.do>

**Geo Engineering Report No. 05-21: “Metals Leaching from Highway Test Sections Constructed with Industrial Byproducts”**—describes the results of a study by the Department of Civil and Environmental Engineering at the University of Wisconsin-Madison to assess metals leaching from industrial byproducts (foundry sand and foundry slag from a gray-iron foundry; and bottom ash and fly ash from a coal-fired power plant) used in highway construction. This study was funded by the Recycled Materials Research Center through the Wisconsin Department of Transportation, the Wisconsin Department of Natural Resources Waste Reduction and Recycling Demonstration Grant Program, and Alliant Energy.

<https://rmrc.wisc.edu/wp-content/uploads/2012/10/P32Final.pdf>

## **5. INDUSTRIAL MATERIALS RECYCLING APPLICATIONS & SPECIFICATIONS**

### **A. RECYCLING AND REUSE OF INDUSTRIAL MATERIALS IN ROADWAYS**

U.S. EPA, U.S. Dept. of Transportation, Federal Highway Administration (FHWA), & American Association of State Highway & Transportation Officials (AASHTO)

Federal Highway Administration (FHWA)

**FHWA Recycled Materials Policy**—is designed to advance the use of recycled materials in highway applications. The policy outlines the importance of re-using materials previously used in constructing the Nation's highway system and calls upon the FHWA and State transportation departments to explicitly consider recycling as early as possible in the development of every project.

<http://www.fhwa.dot.gov/legregs/directives/policy/recmatmemo.htm>

**Office of Pavement Technology Recycling Homepage**—one focus area is environmental stewardship, which includes material use and recycling. The recycling website includes information on FHWA's current projects and activities to facilitate the use of recycled materials in the highway environment. Foundry sand is one of FHWA's priority materials, although the agency recognizes that there may not be an adequate supply in all states to build large state DOT projects.

<http://www.fhwa.dot.gov/pavement/recycling/index.cfm>

**“Foundry Sand Facts for Civil Engineers,” FHWA-IF-04-004 (May 2004)**—this publication provides technical information on the potential uses of foundry sand in civil engineering applications and is sponsored by the FHWA, and the U.S. EPA.

<https://www.fhwa.dot.gov/pavement/pubs/013791.pdf>

**Recycled Materials Resource Center (RMRC)**—is a national center that promotes the appropriate use of recycled materials in the highway environment. Their mission includes systematically testing, evaluating, developing appropriate guidelines for and demonstrating environmentally acceptable increased use of recycled materials in transportation infrastructure construction and maintenance. The RMRC website provides information on recycling and reusing industrial materials in roadways. RMRC is funded by the FHWA and the U.S. EPA.

<https://rmrc.wisc.edu/>

### **RMRC Foundry Sand**

Detailed information on the management of foundry sand is available from the RMRC here:  
<https://rmrc.wisc.edu/foundry-sand/>

**User Guidelines for Industrial Byproduct Materials in Pavement Construction**—is an FHWA-developed information resource for 20 different byproduct materials in road construction. The Guidelines were recently updated to include current information about the U.S. EPA’s Resource Conservation Challenge priority materials, coal ash, foundry sands and construction and demolition materials, along with current information about environmental considerations in the use of byproduct materials.  
<https://www.fhwa.dot.gov/publications/research/infrastructure/structures/97148/intro.cfm>

**“Study on Increasing the Usage of Recovered Mineral Components in Federally Funded Projects Involving Procurement of Cement or Concrete” EPA 530-R-08-007 (June 2008)**—this Congressionally-mandated study looked at the use of recovered mineral components in cement and concrete.  
<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P1003EUM.txt>

**Using Recycled Industrial Materials in Roadways**—U.S. EPA is developing this fact sheet to provide information on the use of industrial materials in roadways as an alternative to virgin materials and conventional construction products. This fact sheet is not yet available, but will be posted on EPA’s Industrial Materials Recycling (IMR) homepage at:  
<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100518X.txt>

### **Case Studies**

**Report on Use of Recycled Foundry Sand in the Cleveland Area**—a published FHWA report that reviews the use of foundry sand in roadway construction around the Cleveland, Ohio area. This report and other similar reports are available here:  
<https://www.fhwa.dot.gov/pavement/recycling/currentproj.cfm>

**Roadway Case Studies**—the AFS website contains case study examples using foundry sand. The initial case studies were developed under a grant from U.S. EPA Region 5. Foundries with additional case studies are encouraged to contact AFS for information about how to post their success stories. A partial list of foundry sand case studies is listed below.  
<https://www.afsinc.org/case-studies>

- “Foundry Sand as an Asphalt Pavement Ingredient,”** a case study on the use of foundry sand in asphalt pavement for a high-performance test track.
- “Foundry Sand as Structural Fill and Road Base,”** a case study on the use of aluminum foundry sand for local construction projects.
- “Foundry Sand as Sub Base for an Airport Runway,”** a case study using foundry green sand as a subbase for a commercial airport runway.
- “Foundry Sand for Roadbase and Manufactured Soil,”** a case study on the reclamation of a Pennsylvania coal mine using foundry sand.
- “A Resource Recovery Cooperative,”** a case study of a foundry-owned cooperative in Michigan that processes sand from multiple foundries for use in asphalt paving, landfill liners, and soils.

**AASHTO Center for Environmental Excellence Waste Management & Recycling Page**—the American Association of State Highway Transportation Officials (AASHTO) represents the state Departments of Transportation. The AASHTO Center for Excellence is an evolving web-based tool to help local best environmental practices and other sustainability practices.

[http://environment.transportation.org/environmental\\_issues/waste\\_manage\\_recyc/#bookmarkRecycling](http://environment.transportation.org/environmental_issues/waste_manage_recyc/#bookmarkRecycling)

## B. RECYCLING AND REUSE OF INDUSTRIAL MATERIALS IN BUILDINGS

**“Federal Green Construction Guide for Specifiers,”**—EPA collaborated with the Federal Environmental Executive and the National Inst. of Building Sciences & the Whole Building Design Guide (WBDG) to develop this green guide which provides comprehensive information for procuring green building products and construction services within the Federal government.

<https://www.wbdg.org/ffc/epa/federal-green-construction-guide-specifiers>

**EPA Green Building Resources**—compiles a collection of EPA programs that relate to green building.

<http://www.epa.gov/greenbuilding/> and further information available at <https://www.epa.gov/land-revitalization/green-buildings>.

**“Planning for a Sustainable Future - A Guide for Local Governments,” EPA902-K-08-001 (Nov. 2008)**—this EPA publication provides information and resources to help local governments integrate sustainable planning into their communities. Areas of opportunity include: green building and procurement; land use; solid waste generation; and recycling.

<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P1009XUN.txt>

### Standard Specifications

**“Beneficial Use of Industrial By-Products: Identification and Review of Materials Specifications, Performance Standards, and Technical Guidance” (Dec 2003 – updated 2020)**— this document was developed for the National Council for Air and Stream Improvement (NCASI) under a grant from U.S. EPA Region 5. The document identifies and summarizes existing performance standards, material specifications, and technical guidance for the beneficial use of byproducts from four industries: cement, foundry, pulp and paper, and coal-fired utility.

<https://aashtojournal.org/2020/08/07/aashto-issues-final-2020-material-standards-update/>

**American Society for Testing and Materials (ASTM) International**—ASTM is a voluntary standards development organization with over 130 technical committees covering diverse industry areas ranging from metals to the environment. The technical committees are made up of professionals from around the world who develop ASTM standards. The “Standard/Annual Book of ASTM Standards” is composed of over 80 volumes and contains ASTM’s 12,000 plus standards.

<http://www.astm.org>

**American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Materials**—this Subcommittee focuses on developing specifications for materials used in the construction and maintenance of all transportation facilities including highways, bridges and structures, and standard methods of sampling and testing these materials; and serves as a conduit to exchange information on the performance of special products evaluated by AASHTO Member Departments. The Subcommittee on Materials also maintains and updates the “Standard Specifications for Transportation and Methods of Sampling and Testing, and Provisional Standards” materials reference which contains 418 materials specifications and test methods commonly used in the construction of highway facilities.

<https://materials.transportation.org/>

**FHWA National Highway Specifications Website**—developed and maintained by the Federal Highway Administration, this website consists of a searchable library of highway specifications from across the nation.

<https://highways.dot.gov/federal-lands/specs>

**State Specifications/Provisions on Recycling Technology  
State Transportation Websites**

Links to state transportation websites from the Federal Highway Administration website  
<http://www.fhwa.dot.gov/webstate.htm>

### C. RECYCLING AND REUSING INDUSTRIAL MATERIALS IN AGRICULTURAL & HORTICULTURAL APPLICATIONS

**U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS)**—conducts research to develop and transfer solutions to agricultural problems of high national priority and provide information access and dissemination. The ARS research is organized into National Programs categorized by four areas. The Natural Resources and Sustainable Agricultural Systems National Programs develops technologies and strategies needed to help farmers, ranchers, and other managers effectively steward the diverse agricultural mosaic spread across the nation. The Manure and Byproduct Utilization National Program under the Natural Resources area develops cost-effective management practices, technologies and decision aids that will allow producers to capture the value of manure and other byproducts without degrading environmental quality or posing a threat to human and animal health.

#### **ARS Homepage**

<https://www.ars.usda.gov/>

#### **Manure and Byproduct Utilization Website**

<https://www.ars.usda.gov/ARSEUserFiles/np206/WholeNP206AssessmentDocument.pdf>

ARS projects focused on foundry sand utilization can be found by searching the ARS website at  
<https://www.ars.usda.gov/research/>.

#### **Other References -Agricultural and Horticultural Use**

**AFS website Technical Library**—abstracts and references to other reports concerning the use of foundry sand in horticulture and agriculture can be found on the AFS website and on-line library, searching under keyword “agriculture.”

<https://afs.softlinkliberty.net/liberty/libraryHome.do>

**National Agricultural Library, Beltsville, MD**—this library is part of the U.S. Dept. of Agriculture and has instituted a global search for documents relating to the use of foundry sands in agriculture and horticulture.

<https://www.nal.usda.gov/main/>

#### **Case Studies – Agricultural and Horticultural Uses**

**AFS Website Agricultural Case Studies**—the AFS website provides several case studies on the beneficial use applications for foundry sand. The initial case studies were developed with a grant from U.S. EPA Region 5.

<https://www.afsinc.org/case-studies>

**“Foundry Sand as a Manufactured Potting Soil”**

Case study on how a potting soil facility blends local peat moss with foundry sand.

**“Foundry Sand for Manufactured Soil and Roadbase”**

Case study on reclamation of a Pennsylvania coal mine using foundry sand.

**“Resource Recovery Cooperative”**

Case study of a foundry-owned cooperative in Michigan that processes sand from multiple foundries for use in soils, asphalt paving, and landfill liners.

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