

ALTERNATIVE USES FOR POST-CONSUMER GLASS

Options for Wisconsin Recycling Programs

Traditionally, glass collected by recycling programs in Wisconsin has been marketed as cullet and shipped to bottle manufacturers to be recycled into new bottles and jars. Glass collected in commingled collection systems must be sorted by color prior to being sent to cullet users. Sorting glass is typically performed manually by workers at Material Recycling Facilities (MRF). After glass has been sorted, it is shipped to an intermediate processor who removes additional contaminants (labels and caps) and crushes the glass to meet the needs of the bottle manufacturers.

Increased labor and transportation costs have decreased the revenues recyclers receive for glass that has been recovered from the waste stream. Reduced revenue may cause a recycling program or MRF operator to reevaluate how the glass products produced are marketed. The sorting process also may produce a mixed color glass product that is not suitable to be used as a feedstock for bottles or jars. This fact sheet aims to provide some alternative uses for recovered glass.

USE AS AN AGGREGATE IN ROADBASE OR ASPHALT

Products from a MRF or recycling programs must meet the specification of the user of that particular material. Glass used as an aggregate is no exception. Suppliers of the glass for road building projects must take note of the specifications that are being used in the road construction industry. Standards from various sources are often referenced. [Table 1](#) lists the most common sources of specifications and test methods used to characterize materials for the construction industry. When working with new markets for glass aggregate products one must “speak the language” of the market.

Wisconsin Administrative Code exempts glass from solid waste requirements when “glass is processed or used as an aggregate replacement in asphalt pavement and subbase material under roadway” (s. NR 500.08 (2)(f)). The code states additional conditions that must be met in order to comply with the exemption requirements.

- Glass may not be used where it will be exposed and may pose a safety threat.
- Contaminants such as labels, caps, and metal rings shall be kept to a minimum.
- The glass shall have sufficient properties to perform the function of the aggregate it replaces.
- The use of glass particles greater than ½ inch in size requires written DNR approval.
- Glass shall be stockpiled and stored in a nuisance-free manner with controlled access to the storage area.
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Note: For specific requirements see Wisconsin State Code s. NR 500.08 (2).

Information Sources for Road Construction Standards

AASHTO – American Association of State Highway and Transportation Officials
www.aashto.org

WiDOT – Wisconsin Department of Transportation
www.dot.wisconsin.gov/

ASTM – American Society for Testing and Materials
www.astm.org

FHWA- Federal Highway Administration
www.fhwa.dot.gov/index.html

Table 1

Simply stated, the previous paragraph provides the basis for using recovered glass as an aggregate replacement in asphalt (glasphalt) or in combination with other aggregate materials as base course material in road building. The Wisconsin Department of Transportation has provided construction specifications for the use of glass mixed with “crushed gravel, crushed concrete, or crushed stone up to 12% by weight. (Ref. Wisconsin DOT “Standard Specifications for Highway and Structure Construction, Annotated 2004 Edition” Section 301.2.3.4 By Product Materials.) Additional standards that may be used to characterize glass as an aggregate material can be found at the end of this fact sheet.

An additional consideration when using glass in aggregate applications is to gain an awareness of the volume of materials that are being used. Road construction projects often require thousands of cubic yards of material to be put in place. In general one ton of crushed glass is equivalent to approximately one cubic yard. In relative terms, most recycling programs produce a small volume of material compared to the amount of material used for most road construction projects.

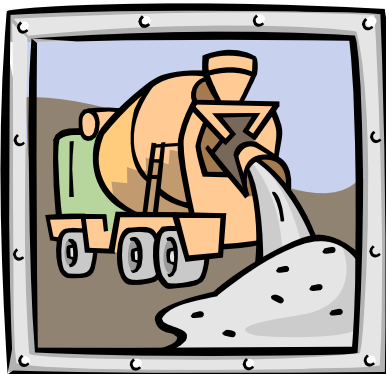
ALTERNATIVE USES REQUIRING A “BENEFICIAL REUSE EXEMPTION”

⇒ Alternatives that have already received a beneficial reuse exemption in Wisconsin

Any alternative use of recovered glass not specifically listed in state code typically will require a “Beneficial Reuse Exemption” from the Wisconsin Department of Natural Resources (DNR). Use of the material must be consistent with s.289.43.8, Stats., and s. NR 500.08 (5)(a), Wisconsin Administrative Code. In this case, recycling is a process in which solid waste is returned to productive use as material. This exemption will permit glass to be recycled or used in various applications approved by the DNR. Many recycling programs have received beneficial reuse exemptions for various applications as highlighted below.

Drainage Backfill Material: In this application glass is used to replace all or portions of washed stone/gravel as fill material around pipes or in utility trenches. The glass or final blend of material should meet requirements for the specified use. Project engineers or designers provide specifications for the backfill material.

Aggregate in Concrete: In several demonstration projects, a portion of the aggregate in ready-mix concrete has been replaced with glass aggregate. For example, as part of the DNR’s Waste Reduction and Recycling Demonstration Grant program, Dane County used this material in a sidewalk construction project. A summary of this project can be found on the DNR grant website, under the project summary link; <http://www.dnr.state.wi.us/org/caer/cfa/Ef/recycle/>.



Landscaping applications: In this example the physical properties of glass are utilized in a decorative application. Glass used in this manner is crushed, sized and tumbled to minimize the potential threat to human health. Tumbling of the glass softens the sharp edges on the pieces of glass.

Sandblast Media: Glass is crushed and sized to meet the requirements for the sandblast or abrasive media. This product may need to be dried in order to meet end use requirements. Product specifications in this application typically call for material of a specific uniform size. In addition to the size range of the blast media, it may be necessary to further characterize the material through further testing.

ADDITIONAL USES FOR GLASS NOT YET DOCUMENTED IN WISCONSIN.

⇒ **Alternatives that have not yet received a beneficial reuse exemption in Wisconsin**

Septic Tank Treatment Systems: System components and leach fields for private onsite wastewater treatment systems (POWTS) often utilize aggregate materials of various sizes. The Wisconsin Department of Commerce (DOC) provides the requirements for use in the construction of these systems. These requirements are defined in s. DOC 83 and 84, as well as in component manuals published by the DOC. Additional approvals from the DOC may be required for projects utilizing glass based aggregates.

Flowable Fill: Flowable fill is the name given to backfill materials which, when mixed and deposited, are fluid-like and when in place gain sufficient strength to essentially eliminate later settlement. Materials used in this application have properties that are similar to a soil. Flowable fill is a slurry mixture typically consisting of water, sand or other fine grain aggregate material (glass aggregate in this case), and Portland cement. The Center for By-Products Utilization at UW-Milwaukee has performed some testing with flowable fills using glass aggregates.

Glass Sand: Glass is crushed and sized to the point where it can be a direct replacement of natural sands in various applications. Glass sand has been used on golf courses in sand traps, and for beach sand in New Zealand

Water and Wastewater Filter Media: Water and wastewater treatment systems often utilize aggregate materials in the construction of filter systems. Glass has been used in various locations, alone, as well as in combination, with other materials such as anthracite or sand. Further information about this application and others can be found on the Clean Washington Center's website; www.cwc.org.



STANDARDS AND TEST METHODS FOR ALTERNATIVE USES OF GLASS

The following sections list standards and test methods that may be useful in characterizing recycled glass products for non-container uses. As is the case for most recovered materials, suppliers must speak the language of the market. Most non-container uses for glass require some sort of physical testing to characterize the size and/or shape of the glass as well as other qualities of the material. What follows is a sampling of standards that may be used to help bridge suppliers with potential end users. Work with potential users of the glass product to determine a testing protocol for the product(s) your facility is producing.

Transportation and Roadbase Related Uses

Wisconsin Department of Transportation (WiDOT) – Base Course

WiDOT Gradation (Final Product Blend)

Gradation Table 305.2.2.1 (1) – Ref. WiDOT Standard Specification for Highway and Structure Construction, Annotated 2004 Edition

WiDOT Section 301 General Requirements for Base Aggregates

301.2.2.1 General – Listing of testing requirements – Ref. WiDOT Standard Specification for Highway and Structure Construction, Annotated 2004 Edition

- AASHTO T 2 – Sampling of Aggregates
- AASHTO T 11 – Materials Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
- AASHTO T 27 – Sieve Analysis of Fine and Coarse Aggregates
- AASHTO T 30 – Mechanical Analysis of Extracted Aggregate
- AASHTO T 255 – Total Evaporable Moisture Content of Aggregate by Drying

- AASHTO T 89 - Determining the Liquid Limit of Soils
- AASHTO T 90 – Determining the Plastic Limit and Plasticity Index of Soils
- AASHTO T 96 – Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- AASHTO T 104 – Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- AASHTO T 103 – Soundness of Aggregates by Freezing and Thawing
- AASHTO T 113 – Lightweight Pieces in Aggregate
- AASHTO T 99 – Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
- AASHTO T 191 – Density of Soil In-Place by the Sand-Cone Method

ASTM D2940 Graded Aggregate Material for Bases or Subbases

ASTM D4791 – Flat and Elongated Particles in Coarse Aggregate

ASTM C-33 – Standard Specifications for Concrete Aggregates

Glass Sand Applications (includes POWTS as well as water and wastewater filters)

ASTM C-33 has several aggregate categories that are used in the construction of various types and components of Privately Owned Wastewater Treatment Systems (POWTS). Wisconsin Administrative Code (Comm 83) lists nine types of POWTS that may require the use of aggregates for construction. The Department of Commerce provides component manuals with specifications for the design requirements of these systems. The following standards are referenced within the component manuals.

- ASTM C – 33 Standard Specifications for Concrete Aggregates
 - ◆ Coarse Aggregate
 - ◆ Size 4 Coarse Aggregate
 - ◆ Size 7 Coarse Aggregate
 - ◆ Fine Aggregate
- Comm 84.30 (6)(i) – Stone aggregate
- Comm 84.30 (6)(k) – Synthetic aggregate

Note: The use of glass aggregate in the construction of POWTS may require approvals beyond what is normally required. Consult with local officials during the design/planning phase of any project.

Sand Blast Media/Abrasive

Glass can be used as a replacement for traditional blast media. Blast media are typically characterized by the physical properties of the material. Media are often classified on the basis of size and hardness. Sieve analysis can be used to determine the size of the material. Most commercially available media contain material that is uniform in size, typically within two sieve sizes. Below are test methods that can be used to characterize blast media.

- ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- ASTM E384 - Standard Test Method for Microindentation Hardness of Materials
- ASTM D4940 - Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives

Drainage/Utility Trench Backfill Material

Backfill material specifications may vary based upon project specifications. Use of glass in this application again requires the supplier to characterize the properties of the material. The WiDOT Standard Specification for Highway and Structure Construction, Annotated 2004 Edition, Section 209 provides for the specifications of Granular Backfill.

- Section 209.2.2 Gradation of Material Passing the No. 4 Sieve
- Section 209.2.3 Sampling and Testing

- ◆ AASHTO T 2 – Sampling
- ◆ AASHTO T 11 – Percent Passing the 200 (75um) sieve
- ◆ AASHTO T 27 – Gradation
- ◆ AASHTO T 89 – Liquid limit
- ◆ AASHTO T 90 – Plasticity index and plastic limit

The applications listed above are all examples of glass replacing traditional materials. In addition to being able to describe the product your facility is producing, it will take some efforts to change the ideals and attitudes of the end users. Glass products will often be viewed with some skepticism, or treated as an inferior product. For example, a contractor or highway department is constructing a road that is designed to last for 20 years or longer. There may be some hesitation to using new materials. Be prepared to “sell” the benefits of using your product over the traditional materials. By creating a specification sheet for the glass product, you can be prepared to speak the language of the market you are entering.

Obtaining a Beneficial Reuse Exemption from the DNR (s. NR 500.08 (5)(a))

All alternative uses for glass that do not fall under the road subbase or asphalt use categories will require a beneficial reuse exemption from the DNR. An exemption can be obtained through your local DNR office by working with regional solid waste staff. It is important to talk to DNR staff when you begin exploring alternative uses. Receiving a grant of exemption is not a sure proposition. The DNR may request additional requirements for the project before granting an exemption, so involving DNR staff early in the planning process can improve the chances for a successful outcome. Regional staff may also be able to help guide you through the beneficial reuse exemption application process. A listing of regional DNR contacts can be found on the DNR Waste Management website, www.dnr.state.wi.us/org/aw/wm/, look for the “**who to call?**” link.



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