Roadway Use of Reclaimed Materials

Woody Raine, P.E.
TxDOT Recycling Program Coordinator
Recovery & Reuse

lots of recycling opportunities at TxDOT

- 12,000 employees
- 525 TxDOT facilities
- 92 Rest Areas & TICs
- 16,000 fleet equipment
- 80,067 centerline miles of roads
- 2,750 structures with 8.6 million square feet
- 1.1 million acres of right of way (0.6% of Texas)
Each year, TxDOT uses:

Millions of tons of materials reclaimed from:

- Industry
- Roadways
- Municipalities
- Demolition sources
# Roadway Reclaimed Materials & Products Placed, FY10

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reclaimed Asphalt Pavement</td>
<td>&gt;2 million tons</td>
</tr>
<tr>
<td>Recycled Concrete Aggregate</td>
<td>&gt;700,000 tons</td>
</tr>
<tr>
<td>Compost</td>
<td>200,000 cu yd</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>143,000 tons</td>
</tr>
<tr>
<td>Crumb Rubber</td>
<td>5,500 tons</td>
</tr>
<tr>
<td>Oil &amp; Gas Well Drill Cuttings</td>
<td>2,200 tons</td>
</tr>
<tr>
<td>Glass Traffic Beads</td>
<td>2,200 tons</td>
</tr>
<tr>
<td>Cellulose Fiber Mulch</td>
<td>1,200 tons</td>
</tr>
</tbody>
</table>
Purpose

• **Increase public and private use of reclaimed materials in roadways**

• **Greater use increases supply and competition which reduces costs**
Why Use Reclaimed Materials?

- Environmental
- Economic
- Financial
Why Use Reclaimed Materials?

- Conserve water
- Conserve energy
- Conserve landfill space
- Conserve natural resources
- Reduce air & water pollution
Waste Reduction Model (WARM)

NEW VERSION: Updated August 2010

EPA created the Waste Reduction Model (WARM) to help solid waste planners and organizations track and voluntarily report greenhouse gas (GHG) emissions reductions from several different waste management practices. WARM is available both as a Web-based calculator and as a Microsoft Excel spreadsheet (355K WinZip archive). The Excel-based version of WARM offers more functionality than the Web-based calculator.

WARM calculates and totals GHG emissions of baseline and alternative waste management practices—source reduction, recycling, combustion, composting, and landfilling. The model calculates emissions in metric tons of carbon equivalent (MTCE), metric tons of carbon dioxide equivalent (MTCO2E), and energy units (million BTU) across a wide range of material types commonly found in municipal solid waste (MSW). For information on the data and methodologies behind the calculations, please see the model documentation.

WARM is periodically updated as new information becomes available and new material types are added. Users may refer to the model history to better understand the differences among various versions of WARM. WARM was last updated August, 2010.

WARM now recognizes 40 material types, which are presented in the table below; their emission factors are available for viewing in units of metric tons of carbon dioxide equivalent (MTCO2E) or metric tons of carbon equivalent (MTCE). Note that the emission factors represent the GHG emissions associated with managing 1 short ton of MSW in the manner indicated. GHG savings should be calculated by comparing the emissions associated with the alternative scenario with the emissions associated with the baseline scenario, as opposed to simply multiplying the quantity by an emission factor. For instance, the GHG savings of recycling 1 short ton of aluminum instead of landfilling it would be calculated as follows:

(1 short ton \times -13.61 \text{ MTCO2E/short ton}) - (1 \text{ short ton} \times 0.04 \text{ MTCO2E/short ton}) = -13.65 \text{ MTCO2E}
## Steps 1 and 2. Baseline and Alternative Scenarios

<table>
<thead>
<tr>
<th>Material</th>
<th>Baseline Scenario</th>
<th>Alternative Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons Recycled</td>
<td>Tons Recycled</td>
</tr>
<tr>
<td></td>
<td>Tons Landfilled</td>
<td>Tons Landfilled</td>
</tr>
<tr>
<td></td>
<td>Tons Composted</td>
<td>Tons Composted</td>
</tr>
<tr>
<td></td>
<td>Tons Combusted</td>
<td>Tons Combusted</td>
</tr>
<tr>
<td></td>
<td>Tons Composted</td>
<td>Tons Composted</td>
</tr>
<tr>
<td>Material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum Cans</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Steel Cans</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Copper Wire</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Glass</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>HDPE</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>LDPE</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>PET</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Corrugated Containers</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Magazines / Third-class mail</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Newspaper</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Office Paper</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Phonebooks</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Textbooks</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Dimensional Lumber</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Medium-density Fiberboard</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Material</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Mixed Plastics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed Recyclables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed Organics</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Mixed MSW</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Carpet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Computers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay Bricks</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Concrete (^{1})</td>
<td></td>
<td>250,000</td>
</tr>
<tr>
<td>Fly Ash (^{2})</td>
<td></td>
<td>130,000</td>
</tr>
<tr>
<td>Tires (^{3})</td>
<td></td>
<td>5,500</td>
</tr>
<tr>
<td>Asphalt Concrete</td>
<td></td>
<td>2,000,000</td>
</tr>
<tr>
<td>Asphalt Shingles</td>
<td></td>
<td>1,000</td>
</tr>
<tr>
<td>Drywall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiberglass Insulation</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Vinyl Flooring</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Wood Flooring</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

Please enter data in short tons (1 short ton = 2,000 lbs.)
Please refer to the User's Guide if you need assistance completing this table.
1 Recycled concrete used as aggregate in the production of new concrete
2 Recycled fly ash is utilized to displace Portland cement in concrete production.
3 Recycling tires is defined in this analysis as using tires for crumb rubber applications and tire-derived aggregate uses in civil engineering applications.
### EPA’s WARM model

<table>
<thead>
<tr>
<th>Material</th>
<th>Tons</th>
<th>Disposal</th>
<th>Recycling or Composting</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organics</td>
<td>100,000</td>
<td>31,400</td>
<td>-19,800</td>
<td>-51,200</td>
</tr>
<tr>
<td>Concrete</td>
<td>250,000</td>
<td>9,700</td>
<td>-1,980</td>
<td>-11,680</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>130,000</td>
<td>5,000</td>
<td>-113,000</td>
<td>-118,000</td>
</tr>
<tr>
<td>Tires</td>
<td>5,500</td>
<td>210</td>
<td>-2,160</td>
<td>-2,370</td>
</tr>
<tr>
<td>RAP</td>
<td>2,000,000</td>
<td>77,700</td>
<td>-164,000</td>
<td>-241,700</td>
</tr>
</tbody>
</table>

* MTCO2E – metric tons of CO₂ equivalents
“TxDOT is a recycling leader, and takes great steps to reduce waste, improve air quality and protect our environment. We’ve made a commitment to improve the environment in Texas and reduce pollution's effect on public health and safety. For conservation efforts to work, however, we all must do our part. Our individual actions make a huge impact. Help us – help Texas. Let’s all be good stewards of our environment.

Happy Earth Day and safe travels!”

Amadeo Saenz, TxDOT Executive Director
Texas Transportation Forum, Earth Day, 2008
"TxDOT adheres to values that have created an entire industry out of resource conservation.

Indeed, it’s good business to be good stewards of the environment.”

Michael Behrens
former TxDOT Executive Director
Transportation News, September 2003
Why Use Reclaimed Materials?

- Reduce construction costs
- Reduce maintenance costs
Why Use Reclaimed Materials?

- Relieve regional material shortages
- Conserve native materials
- Substitute less expensive material
- Reduce hauling costs
Why Use Reclaimed Materials?

- Support markets for scrap materials
  - Concrete
  - Asphalt Pavement
  - Tires
- Reduce disposal costs

Financial
Why Use Reclaimed Materials?

In FY10, TxDOT generated:

- 3.34 million tons of asphalt pavement
- 1.01 million tons of concrete
Why Use Reclaimed Materials?

In FY10, TxDOT generated:

- 2,030 tons of scrap tires & rubber, or
- 203,000 scrap tire equivalents

Financial

In FY10, TxDOT generated:

- 2,030 tons of scrap tires & rubber, or
- 203,000 scrap tire equivalents
Why Use Reclaimed Materials?

- *Meet environmental standards*
  - *Compost* – water quality
- *Improve performance*
  - *tire rubber* - *durability*
  - *fly ash* - *durability*
Recycled Materials Policy

February 7, 2002

"Recycling highway construction materials can be a cost-saving measure, freeing funds for additional highway construction, rehabilitation, preservation or maintenance."
Recycled Materials Policy
February 7, 2002

- Give recycled materials first consideration
- Judge engineering & environmental suitability
- Assess financial benefits
- Remove non-technical restrictions
Recycled Concrete Aggregate

973 Materials, Austin
Recycled Concrete Aggregate

- Cement Treated Base
- Flex Base
Recycled Concrete Aggregate

- Rigid Pavement
Recycled Concrete Aggregate

• Gabions
Recycled Concrete Aggregate

- Rock Filter Dam
Recycled Concrete Aggregate

• Dry Rip Rap
Recycled Concrete Aggregate

- Select Backfill for Retaining Walls
  www.reinforcedearth.com
Recycled Concrete Makes Cents

Recycled Concrete Aggregates Make Cents

In today’s environment of skyrocketing material and transportation costs encountered in road construction, recycled concrete aggregates (RCA) provide substantial savings to TxDOT and taxpayers. Natural resources are conserved, waste disposal is reduced, and air quality is improved due to reduced haul distances and reduced energy consumption. In many cases, allowing the use of RCA can be the most cost effective choice for an aggregate source. This is especially true for those districts that do not have good, native aggregate sources. Using RCA can reduce time and expense of importing aggregates from other parts of the state.

TxDOT has researched and used RCA with good success for about 15 years. In just the last two years alone, TxDOT saved approximately 1.8 million tons of virgin aggregates by incorporating RCA in cement treated base, flexible base, continuously reinforced concrete pavement (CRCP), filter dams, gabion walls, concrete traffic barriers, flowable fill and select backfill for mechanically stabilized earth walls. This equates to an estimated savings of $12.6 million from reduced or eliminated landfill and virgin aggregate associated costs. Savings from using RCA has the potential to increase tenfold based on current availability of RCA.

**ENGINEERING PROPERTIES**

Compared to virgin aggregates, RCA typically have a higher percentage of material passing the No. 200 sieve, lower specific gravity, higher water absorption, higher sulfate soundness loss and higher Los Angeles Abrasion loss. The minus No. 4 fraction typically has a low plasticity index and high alkali content. Item 6, “Control of Materials,” of the Department’s 2004 Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges requires that it be certified as a nonhazardous recyclable material (NRM) in order to be used on TxDOT projects. The RCA producer must meet the requirements of departmental material specification DMS-11000, “Evaluating and Using Nonhazardous Recyclable Materials Guidelines.”

**ITEM 247, FLEXIBLE BASE**

RCA can be used on TxDOT projects when specified on the plans as Type D under Item 247, “Flexible Base,” of the Department’s 2004 Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. In addition to the requirements specified in DMS-11000, Item 247 requires contractor-supplied RCA to be free from reinforcing steel and other objectionable material. It can have a maximum of 1.5% deleterious material and 3000 ppm of soluble sulfates. The Engineer may also require separate dedicated stockpiles. RCA typically increases the optimum moisture requirement when used as a flexible base. Because of its high absorption properties, it can potentially lose strength if not protected from moisture. When allowing Type D as an option, it is recommended that strength and wet ball mill requirements be specified (such as in Grade 1). An alternative is to specify Item 276, “Cement Treatment (Plastic Merit),” to reduce or eliminate the potential for loss of strength and water absorption of RCA.

**ITEM 421, HYDRAULIC CEMENT CONCRETE**

RCA can also be used as a coarse aggregate in Item 421, “Hydraulic Cement Concrete,” as long as it meets the specification requirements. CRCP constructed with RCA has a long history of good performance. Positive effects for pavements are higher creep values and lower modulus of elasticity. Although RCA can cause the final concrete to have a higher coefficient of thermal expansion (COTE) due to the addition of old mortar, experience has eliminated this as a concern and COTE requirements are waived when RCA is used.
Recycled Concrete Aggregate

**Benefits**

- **Engineering**
  - Better than native aggregates along coast
- **Financial** – e.g., Houston District:
  - $2/ton less to deliver than limestone
  - $5/ton disposal savings
- **Environmental**
  - Reduced CO$_2$ & NOx emissions

www.hpprecycles.com/RiceAirPollutionStudy.pdf
Reclaimed Asphalt Pavement

Applications

- Flexible Pavement
- Flex Base
- Pavement Edges
Reclaimed Asphalt Pavement

*Fractionating RAP into coarse & fine aggregates allows:*

- More RAP
- Less asphalt binder
- More financial savings
- More environmental benefit
Recycled Asphalt Shingles
Scrap Tires & Rubber, FY10 Use

• 5,500 tons of crumb rubber, or
• 550,000 scrap tire equivalents
Scrap Tires & Rubber

- *Surface Treatments* *(Chip Seals, Seal Coats)*

- 5 to 15% rubber in asphalt binder
- Adds durability
- Holds aggregate
Scrap Tires & Rubber

- Wet-weather performance
- Water quality protection
- Noise abatement

Permeable Friction Course (PFC)
I-35, San Antonio
Scrap Tires & Rubber

Recycled Rubber Products

- Joint fillers
- Crack sealant
- Delineator posts
- Guard rail spacer blocks
Scrap Tires & Rubber
Recycled Rubber Products

Delineator Posts

SHUR-TITE on I 35
Scrap Tires & Rubber

Recycled Rubber Products

Guardrail Spacer Blocks
Scrap Tires & Rubber

*Tire Bales*

2-cubic yard, 1-ton bales stacked like bricks
Scrap Tires & Rubber

Tire Bales

Portable Tire Baler
Scrap Tires & Rubber

Tire Bales

Slope Repair on I-30, Fort Worth
Scrap Tires & Rubber

Tire Bales

Slope Repair on I-30

~60,000 scrap tires in 600 bales
Scrap Tires & Rubber

Tire Bales

Slope Repair on I-30
Scrap Tires & Rubber

*Tire Bales (& compost)*
Compost & Mulch

• **Benefits**
  - Accelerates revegetation
  - Reduces storm water runoff & erosion
  - Protects water quality
Compost & Mulch

FY10 Usage - 200,000 cubic yards
Fly Ash

**FY10 Usage - 143,000 tons**

- Concrete Pavement
- Concrete Structures
- Subgrade & Base Treatment
Fly Ash

- *Subbase and Base Courses – base material, stabilization*
  - Adds strength and durability
  - Adds resistance to sulfates
Fly Ash

- **Rigid Pavement or Structures** *(backfill, rip rap, concrete structures)*
  - Reduces cement up to 35%
  - Yields higher ultimate strengths, although initial strength gain is slower
  - Improves resistance to alkali-silica reactivity (ASR), sulfates, seawater
  - Improves workability, pumpability
Glass Cullet

Applications:

- Reflective Striping Beads
- Pipe bedding, other backfill
- Embankments
- Road base
- Paving
More Municipal & Industrial Byproducts

• Sand blast material
• Foundry sand
• Drill cuttings
• Print toner
• Filter cake
• Toilets
DMS-11000
Guide to Using Nonhazardous Recycled Materials

Eligible materials:

• *Have TxDOT History of Use*
• *Meet Environmental Risk Standards*
• *On Approved Products List*
Recycling Information for Contractors

As our Annual Recycling Summary attests, TxDOT prevents waste through workplace recycling, environmentally preferable purchasing and the use of recycled products and materials in roadway construction. These materials include recycled concrete aggregate, reclaimed asphalt pavement, tire rubber, fly ash from coal-fired power plants and many others.

Roadway Recycled Materials

- Specifications
  - By Roadway Application
  - By Recycled Material
  - Environmental Guidelines
- Materials Information
  - Material Summaries
  - Material Suppliers Map
- Research and Demonstrations
  - Research Summaries
  - Road Base
  - Embankments
  - Vertical Moisture Barriers

Recycled-content Products

- Environmental Purchases
- Recycled Concrete Aggregate
- Roadway Products
- Recycled Glass
- Recycling Education Stop of Texas (REST)

Recycling Service Specifications

- Recycling Asphalt Millings
- Removing Scrap Rubber

Other Resources

- Links

Construction Debris Recycling

- Associated General Contractors
- Construction Materials Recycling Association
Specifications Using Recycled Materials by Application

TxDOT has eliminated unnecessary requirements for virgin materials in its construction and maintenance specifications. Additionally, we have approved specifications that specifically call for or allow for the use of recycled materials. Some specifications require their use, while others allow their use if noted in the plans. Please note, this document is provided for information only and is not to be used for bidding or contract purposes.

Specifications using Recycled Materials can also be viewed by Materials. All use 2004 Standard Specifications unless noted.

Acronyms
- RAP - Reclaimed Asphalt Pavement
- SCM - Supplementary Cementing Material

Earthwork

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>RECYCLED MATERIALS</th>
<th>APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embankment</td>
<td>Granular materials (such as crushed concrete, glass cullet, RAP)</td>
<td>Form a stable embankment</td>
</tr>
<tr>
<td>Compost</td>
<td>Leaves, yard trimmings, biosolids, food scraps, food-processing residuals, manure or other agricultural residuals, forest residues, bark, and paper</td>
<td>Establish vegetation, control erosion (See compost producer list and DMS-6360 Compost)</td>
</tr>
<tr>
<td>Seeding For Erosion Control</td>
<td>Cellulose</td>
<td>Mulch</td>
</tr>
<tr>
<td>Landscape Establishment</td>
<td>Loose organic materials such as wood chips or shredded bark</td>
<td>Mulch</td>
</tr>
</tbody>
</table>

Sub-base and Base Courses

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>RECYCLED MATERIALS</th>
<th>APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible Base</td>
<td>Crushed concrete, RAP, or other (such as glass cullet)</td>
<td>Coarse aggregate</td>
</tr>
<tr>
<td>Lime Treatment (Road-Mixed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lime Treatment (Plant-Mixed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fly Ash Or Lime-Fly Ash Treatment (Road-Mixed)</td>
<td>Fly ash</td>
<td>Subgrade or base stabilizer</td>
</tr>
<tr>
<td>Cement Treatment (Road-Mixed)</td>
<td>Crushed concrete, RAP, or other (such as glass cullet)</td>
<td>Coarse aggregate</td>
</tr>
<tr>
<td>Cement Treatment (Plant-Mixed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asphalt Treatment (Plant-Mixed)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Roadway Recycled Materials Summaries

As part of our Road to Recycling initiative, a road construction industry panel identified 12 materials with great potential in road construction that are readily available in Texas in potentially large volumes, offer engineering benefits, cost-effective pricing and no increased environmental risks.

We have assembled packets of information for each of these materials. The packets include a material overview, research summaries, case studies, a list of current specifications, a list of material sources and a summary of experiences with the material.

Material Summaries

<table>
<thead>
<tr>
<th>Title</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Shingles</td>
<td>HTML</td>
</tr>
<tr>
<td>Coal combustion by-products, including fly ash, bottom ash, and hydrated fly ash</td>
<td>HTML</td>
</tr>
<tr>
<td>Compost and Mulch</td>
<td>HTML</td>
</tr>
<tr>
<td>Glass</td>
<td>HTML</td>
</tr>
<tr>
<td>Industrial sands</td>
<td>HTML</td>
</tr>
<tr>
<td>Metals, primarily steel and aluminum</td>
<td>HTML</td>
</tr>
<tr>
<td>Plastics</td>
<td>HTML</td>
</tr>
<tr>
<td>Reclaimed Asphalt Pavement (RAP)</td>
<td>HTML</td>
</tr>
<tr>
<td>Recycled Concrete Aggregate</td>
<td>HTML</td>
</tr>
<tr>
<td>Slags, including ground granulated blast furnace slag</td>
<td>HTML</td>
</tr>
<tr>
<td>Soils, including petroleum-containing soils</td>
<td>HTML</td>
</tr>
<tr>
<td>Tires and tire rubber</td>
<td>HTML</td>
</tr>
</tbody>
</table>
Compost and Mulch

Texas generates about 4 million tons of yard trimmings (leaves, grass, weeds, and tree limbs) each year. Rather than dispose of these materials in landfills, many cities and private enterprises turn these materials into compost or mulch.

Compost is an effective soil amendment and erosion-control material. It retains water in sandy soil, maintains even moisture in clay soils, and adds nutrients to soil to be passed though plants. Similarly, shredded brush mulch is useful in controlling erosion. It retains moisture, reduces soil temperature, and prevents erosion during heavy rains.

Roadway Construction

TxDOT uses several hundred cubic yards of compost and mulch each year to establish vegetation and control erosion on highway roadsides. Using project-generated shredded brush mulch increases the benefits.

During the final phase of most roadway construction projects, the contractor blades topsoil over subgrade material, hydroseeds the area with grass seed, applies a mulch or erosion-control blanket over the seedbed, and irrigates the area to re-establish vegetation.

Importance

Establishing vegetation after roadway construction is completed is extremely critical. If grass fails to grow, soil washes away and erosion begins to threaten the paved surface of the roadway. The Environmental Protection Agency (EPA) mandates stiff penalties for noncompliance. Delays are expensive to the contractor and inconvenient for the traveling public.

Quality topsoil is essential to adequate grass cover. Unfortunately, soil is often void of the organic matter needed for proper grass establishment, whether stockpiled on site or obtained from other sources. Research found that adding compost improves topsoil quality.
Consequently, TxDOT worked with the Texas Commission on Environmental Quality (TCEQ), the Texas Transportation Institute (TTI) and the compost industry to develop a specification for compost. This specification has enabled TxDOT to enhance the environmental sensitivity of its transportation system while providing a much-needed market for organic materials.

Research and Reports

<table>
<thead>
<tr>
<th>Title</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics of Composts: Moisture Holding and Water Quality Improvement</td>
<td>HTML</td>
</tr>
<tr>
<td>Comparison of Alternative Seed Mixes to Standard TxDOT Specifications</td>
<td>HTML</td>
</tr>
<tr>
<td>Effects of Using Compost as a Preventive Measure to Mitigate Shoulder Cracking: Laboratory and Field Studies</td>
<td>HTML</td>
</tr>
<tr>
<td>Evaluation of Highway Runoff Filtration Systems</td>
<td>HTML</td>
</tr>
<tr>
<td>Research Summary: Use of Compost and Shredded Wood on ROWs</td>
<td>HTML</td>
</tr>
<tr>
<td>Use of Compost and Shredded Brush on Rights-of-Way for Erosion Control: Final Report</td>
<td>HTML</td>
</tr>
<tr>
<td>Water Quality Characteristics and Performance of Compost Filter Berms</td>
<td>HTML</td>
</tr>
</tbody>
</table>

Specifications

<table>
<thead>
<tr>
<th>Title</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 161 Compost</td>
<td>HTML</td>
</tr>
<tr>
<td>Item 161 Special Provisions</td>
<td>HTML</td>
</tr>
<tr>
<td>Special Specification 5049 Biodegradable Erosion Control Logs</td>
<td>HTML</td>
</tr>
<tr>
<td>Erosion Control Log</td>
<td>HTML</td>
</tr>
<tr>
<td>Sediment Traps</td>
<td>HTML</td>
</tr>
</tbody>
</table>

Material Use and Availability

<table>
<thead>
<tr>
<th>Title</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compost Fact Sheet</td>
<td>HTML</td>
</tr>
<tr>
<td>Material Supplier Mapping System</td>
<td>HTML</td>
</tr>
<tr>
<td>Seal of Testing Assurance, Texas Participants</td>
<td>HTML</td>
</tr>
</tbody>
</table>

More Information

- Links
Public Education

Colorado County Safety Rest Area

RECYCLING ROADS TO MAKE NEW ROADS

Each year 500,000,000,000 tons of asphalt are used in U.S. roadwork. If not recycled, this ends up in landfills. TxDOT has been recycling asphalt since 1967. Here’s how:

Old worn roads are broken up and loaded into a “crusher” at the recycling plant.

Asphalt chunks are ground-up and mixed with recycling agent, new asphalt, and/or aggregate.

This new mix creates a stronger road that is more impervious to water and needs less maintenance.

Old asphalt from the IH-10 access road was recycled in this manner to rebuild the roads here. This reduces use of natural resources, reduces landfill, reduces transportation costs, and preserves the environment.

IH-10 near Columbus
Web References
Highway & Environmental Groups

- Federal Highway Administration
  www.fhwa.dot.gov/pavement/recycling
- Turner-Fairbanks Highway Research Center
  www.tfhrc.gov/hnr20/recycle
- AASHTO Environmental Excellence Center
  environment.transportation.org
- U.S. EPA Conservation Challenge
  www.epa.gov/epaoswer/osw/conserve
- Recycled Materials Resource Center
  www.rmrc.unh.edu
- U.S. Green Bldg Council
  www.usgbc.org
- Association of General Contractors (AGC)
  www.agc.org
- Green Highways Partnership
  greenhighways.org
Web References
Material Related Groups

- American Coal Ash Association – www.acaa-usa.org
- American Foundry Society – www.afsinc.org/Env.htm
- Asphalt Shingles – www.shinglerecycling.org
- Asphalt Recycling & Reclamation Assn (ARRA) – www.arra.org
- Foundry Industry Recycling Starts Today (FIRST) – www.foundryrecycling.org
- Nat’l Council for Air & Stream Improvement (paper & pulp) – www.ncasi.org
- National Slag Association – www.nationalslag.org
- Portland Cement Association
  www.cement.org/tech/cct_aggregates_recycled.asp
- Rubber Manufacturers Association – www.rma.org
- Rubber Pavements Association – www.rubberpavements.org
- Silica Fume Association – www.silicafume.org
- Slag Cement Association – www.slagcement.org
Enjoy *TxDOT Green*, our environmental video, at
www.youtube.com/user/TxDOTpio - TxDOT Green Parts 1 & 2

For more information
http://crossroads/org/gsd/Recycling/
Ready to go?

Woody Raine, P.E.
Recycling Program Coordinator
General Services Division
Texas Department of Transportation

woody.raine@txdot.gov
512-302-2422