CIVIL ENGINEERING APPLICATION USING TIRE DERIVED AGGREGATE (TDA)

• PRESENTED BY:
  • Stacey M. Patenaude

• Joaquin Wright - KENNEC Inc.
CalRecycle’s Main Objective is to get TDA Accepted by the Civil Engineering Community

- Educate Local public works, CALTRANS, Private Consulting Civil Engineers and State and Local Environmental Agencies on the benefits of TDA

- Research – Develop Sustainable, Environmental Beneficial and Cost Effective Civil Engineering Reuses for Waste Tires

- Coordinate and Assist Waste Tire Processors to assure there is adequate TDA to meet future demand.
Services Available from CalRecycle to Promote TDA

TDA Technical Expertise –
- Provide TDA project design Assistance
- Provide education and training on the technical aspects and benefits of using TDA

TDA Project Management
- Provide construction management assistance
- Provide procurement and staging for TDA projects
- Provide performance and environmental monitoring for TDA projects
California TDA Projects

- 2001 - First TDA Project, Dixon Landing Interchange Project
- 2003-2007 - Hwy 215 and Route 91 Retaining Wall research projects. Joint project with Caltrans
- 2004 - Valley Transit Authority - Vibration Mitigation Project
- 2007 – Marina Dr, Mendocino Co. Landslide Repair
- 2008 - Riverside County Landfill Gas Collection system, Pilot projects
- 2008 - Caltrans Confusion Hill, Lightweight fill Embankment
- 2008 - Sonoma Co. Geysers Rd. Landslide Repair Project
- 2009 - Sonoma Mtn. Road, Landslide Repair Project
- 2009 - Sacramento County Keifer Landfill, Landfill Leachate recirculation project
- 2010 - Santa Barbara County, Palomino Rd Slide Repair
Future TDA Projects in California

- BART Extension, TDA for Vibration Mitigation 5300 ft. of track, Warm Springs - San Jose
- MTA Goldline Extension TDA for Vibration Mitigation 9900 ft. of track, Pasadena-Azusa,
- Construction of Type 1T Retaining Wall Pilot project, Caltrans
- Septic system leach field research
- TDA in MSE applications
Beneficial Properties of Tire Derived Aggregate (TDA) in Civil Engineering Applications

Tire Derived Aggregate (TDA) has properties that civil engineers, public works directors & contractors need

- Lightweight
- Free Draining/High Permeability
- Low earth pressure
- Good thermal insulation
- Durable
- Compressible
- May be cheapest solution

Help solve significant environmental problems
Conserve natural aggregate resources
Type “B” TDA
Uses for Tire Derived Aggregate

- Lightweight fill for Embankments
- Lightweight fill for slide Repair
- Lightweight backfill for Retaining Walls
- TDA in Landfill Applications, replacement for conventional aggregate
- TDA used in Vibration Mitigation Applications
Dixon Landing/HWY 880 Interchange Project

Dixon Landing Road
7/27/2001

CalRecycle
660,000 Tires
Savings to the State $240,000

Dixon Landing/HWY 880 Interchange Project
Confusion Hill - Lightweight TDA Embankment Project 2008

270,000 Tires
Confusion Hill Lightweight Embankment Project
Confusion Hill - Lightweight Embankment
Confusion Hill - Lightweight Embankment

LEGEND
- STAGE 1 TDA FILL
- STAGE 2 TDA FILL
- STAGE 3 TDA FILL

LOWER COURSE TDA ELEVATION WITH OVERBUILD
0.45 MIN FILTER FABRIC OVERLAP (TYP)
"W" LINE
2.4 3.6 3.6 2.4
TEMP RAILING (TYPE K)
1.5 TOTAL COVER
1.5 MAX TDA FILL THICKNESS
1.0 COVER
SEE TDA UNDERDRAIN DETAIL
FIGURE 17
150 MM PERFORATED PLASTIC PIPE UNDERDRAIN
VAR 2.0-10.0
150 MM PERFORATED PLASTIC PIPE UNDERDRAIN

CONFUSION HILL TDA EMBANKMENT
HIGHWAY 101 - TIRE DERIVED AGGREGATE LIGHTWEIGHT FILL
Confusion Hill Final Project

Saving to State $320,000
Light Weight TDA Fill for “Slip outs”

Lightweight Fill for “Slip Out” Road Slide Repair Mendocino and Sonoma Counties
General View of TDA Slide Repair

**GENERAL TDA SLIDE REPAIR SECTION**

- **REGION III** (HIGH DRIVING FORCE)
- **REGION II** (MEDIUM DRIVING FORCE)
- **REGION I** (LOW DRIVING FORCE)

**LEGEND:**
- $F_S$ = FACTOR OF SAFETY
- $\delta$ = WEIGHT (DRIVING FORCE)
- $\phi$ = SHEAR STRENGTH OF MATERIAL

**TDA CONDITIONS**

<table>
<thead>
<tr>
<th>$\phi_n$</th>
<th>$\delta_n$</th>
<th>$\phi_h$</th>
<th>$\delta_h$</th>
<th>$\phi_L$</th>
<th>$\delta_L$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_S$</td>
<td>$F_S$</td>
<td>$F_S$</td>
<td>$F_S$</td>
<td>$F_S$</td>
<td>$F_S$</td>
</tr>
</tbody>
</table>

**MOVEMENT**
- $F_S < 1$

**EQUILIBRIUM**
- $F_S = 1$

**STABLE**
- $F_S > 1$

**FAILURE**
- Static

**STATIC**
- $\phi_n$

**SUBRAIN**

**ROAD PAVING**

**GENERAL ENGINEERED BACKFILL**

**TDA DRAINAGE BLANKET WITH GEOTEXTILE WRAP**

**EXISTING SURFACE**

**CalRecycle**
Mendocino County, Marina Dr.

133,000 Tires

09/04/2007
Marina Drive Slide Repair

Savings to the County $ 90,000
Geysers Road Slide
Geysers Road Slide Repair
Geysers Road Slide Repair

150,000 Tires

01/22/2008
Geysers Road

Saving to County $128,000

Before

After
Sonoma Mtn. Road, Sonoma County
Sonoma Mtn. Road, Sonoma County

Saving to County

$590,000
Palomino Road, Santa Barbara County
Slide Repair
Palomino Road, Santa Barbara County
Slide Repair
Palomino Road, Slide Repair
Palomino Road, Slide Repair
Palomino Road, Slide Repair
Savings to County - $90,000
Light Weight Backfill Behind Retaining Walls
Light Weight Application
Wall 119 and 207

Lightweight Backfill Behind Retaining Walls
Riverside, Ca
Wall 119 and 207
Wall 119 Riverside, Ca

Placement of foundation soil

Compaction of foundation soil

Unloading TDA
Wall 119 Riverside, CA

Installed TDA

Pressure cell installed

Typical Station
Wall 119 Riverside, CA

TDA placed and compacted

TDA placement
Wall 119 Riverside, CA

Final geo-textile wrap
Wall 119 Riverside, CA

Cover soil delivery, placement, and compaction
Wall 119 Riverside, Ca

Completed cover soil installation, 2 feet

Typical gravel/soil section

Road way backfill
Wall 119 Riverside, Ca

86,000 TIRES

2003 9 19

CalRecycle
Wall 207 Riverside, Ca

150,000 Tires

CalRecycle
Type 1 T Retaining Walls

Estimated Savings on Future Walls - $100/ lineal foot
TDA In Light Rail Vibration Mitigation
Vibration Mitigation
Conventional Vibration Mitigation Technology $800+/ft
TDA Vibration Mitigation $150/ft
VTA Vasona Line Light Rail

100,000 TIRES

Saving to VTA $1,000,000
TDA in Landfills Applications

- Landfill Gas Pipe Protection
- Landfill Bio-Reactors System
- Drainage Layers in Landfill Covers
- Landfill Gas Extraction Trenches
- Daily and Intermediate Alternative Cover
Why use TDA in Landfill Systems

- High Permeability/Free Draining
- Compressible
- Lightweight
- Cost savings
- Recycling (100 Tires = 1.5 cy)
Landfill Gas Collection Trenches, Replace Gravel w/Type A TDA

- Type A for Gravel Replacement
- Oversize Auger for Vertical Wells
- Geo-textile separator between TDA and Soil or Fine Material
LFG TDA Trenches Typical Construction

- Typical excavation & relocation of refuse
- Typical equipment, End Dump, Excavator, Skip loader, Air monitor
LFG TDA Trenches
LFG TDA Trenches
Typical Construction

- Geo-textile separator between TDA and Soil or Fine Material
LFG TDA Trenches
Typical Construction
What is Type “A” TDA?

- **Type “A” TDA** – Typical, Three inch minus,
  - 1 Ton = 1.4 cubic yards
  - 1 Ton = 100 tires (PTE)
  - In Place Density = 45-58 lb/ft³
  - Permeability > 1 cm/sec for many applications

- **Uses** – Drainage material, septic leach fields, Vibrations dampening layers under light rail tracks. Gas collection media, Leachate collection material

Dana Humphrey, 2005
What is Type “B” TDA?

- **Type “B” TDA** – Typical, 12 inch minus,
  - 1 Ton = 1.5 cubic yards
  - 1 Ton = 100 tires (PTE)
  - In Place Density = 45-50 lb/ft³
  - Permeability > 1 cm/sec for many applications

- **Uses** – Lightweight fill for embankments, Slide repairs, Lightweight fill behind retaining walls, Gas collection and leachate recirculation media

Dana Humphrey, 2005
CM Aspects for TDA Projects

- Pre–Construction
- Construction
Pre - Construction Activities

- Design and Overall Project Understanding
  - Develop Comprehensive Understanding
    - Communication with team for Design, Construction, and Construction Management expectations.
    - Delivery methods and rates
      - Material quality/verification
      - Stockpile location

- Regulatory Agency Outreach
  - Education and Communication
    - Local Water Board
    - Local Fire Department
    - Interagency Agreements
Construction Activities

- Construction Understanding
  - Communication with team at kick off meeting, TDA Construction, when, where and team expectations.
  - Placement techniques
    - Rates of Delivery, number of suppliers
    - q/a of material
    - Advantageous changes in techniques
    - Documentation of work

- As-buils
  - Documentation of changes
    - Data retrieval methods and verification
    - Drawings of TDA location, sensors etc
The Future of the CalRecycle’s CEA Program

- Continue Assistance with Design and Construction Oversight Assistance
- Continue TDA – Research and Development of new Applications
- Continue TDA Education
- Continue TDA Project Construction Oversight and Material Procurement Assistance
- Develop and TDA Grants and Loans
Questions ?