Applications of TDA in Civil Engineering

By
Dr. DingXin Cheng, Director

California Pavement Preservation Center
California State University, Chico

For

2011 Arizona Pavement/Materials Conference
Nov 15-16, 2011

Presentation Oultine

- Background
- Benefits of Using TDA
- Civil Engineering Applications
  - Lightweight Fill
  - Retaining Wall Backfill
  - Drainage Filter Material
  - Rubberized Asphalt Paving Materials
  - Others
- Challenges and Barriers

Problems

Millions of used tires are already piled up in huge stockpiles:
both legally …

Problems

… and illegally

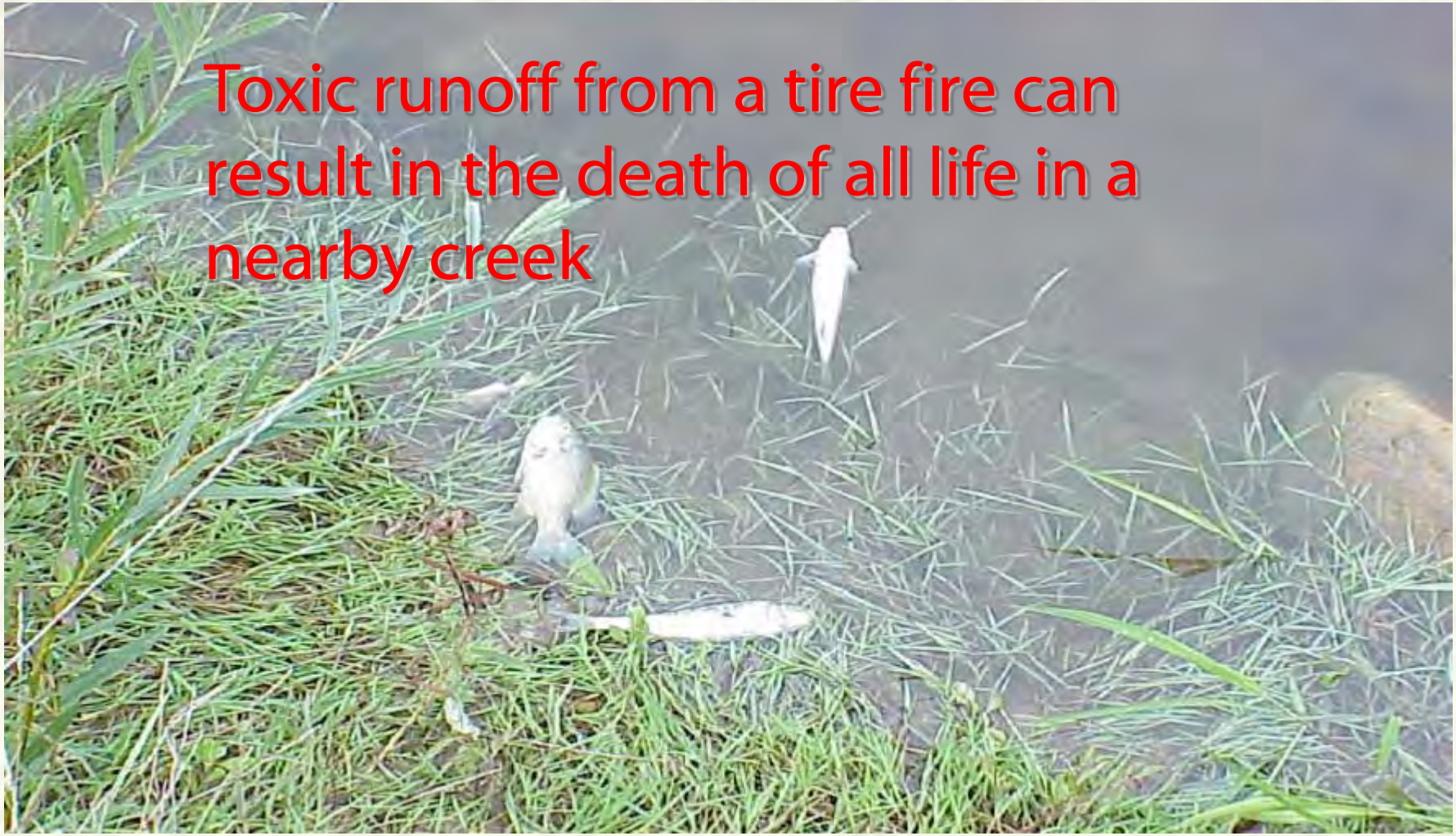
Environmental Issues

Environmental Issues

Tire fires release heavy metals and other hazardous compounds that run into streams and seep into shallow wells

- Arsenic
- Chromium
- Lead
- Manganese
- Nickel
- Mercury
- Cadmium
- Oil

Environmental Issues



Tire Derived Aggregate (TDA)

Benefits of TDA

- TDA has properties that civil engineers need:
  - Lightweight
  - Low lateral earth pressure
  - Good thermal insulation
  - Good drainage/hydraulic conductivity
  - Compressible

Benefits of TDA

Can use lots of tires!!!

- 75 tires per C.Y. of TDA fill
- 100 tires per ton

Arizona SR 87 – Phoenix to Payson

Range of Civil Engineering Applications

- Rubberized Asphalt Paving Materials
- Lightweight fill for highway embankments
- Retaining wall backfill
- Vibration damping layers beneath rail lines
- Insulation layer to limit frost penetration in roadways
- Landfill and environmental application

Lightweight Fill for Highway Embankments

- Tire shreds are viable in this application due to their light weight.
- For most projects, using tire shreds as a lightweight fill material is significantly cheaper than alternatives
- Highway embankment in Virginia used 1.7 million tires!

Retaining Wall Backfill

- The weight of the tire shreds allows construction of thinner, less expensive walls
- TDA can reduce problems with water and frost build up behind the wall, because TDA is free draining and is a good thermal insulator.

Vibration Damping Layers Beneath Rail Lines

TDA is a good way to dampen the annoying vibrations caused by passing trains

Insulation Layer to Limit Frost Penetration in Roadways

- Placing a tire shred layer under the road can prevent the subgrade soils from freezing
- In addition, the high permeability of tire shreds allows water to drain from beneath the roads, preventing damage to road surfaces.

Landfill and Environmental Application

- Daily and Intermediate Alternative Cover
- Landfill Gas Pipe Protection
- Drainage Layers in Landfill Covers
- Leachate Collection and Removal System
- Landfill Gas Extraction Trenches

Barriers to Using Recycled Materials: Civil Engineering Aspects

- Engineering properties not well established
- Lack of long term performance data
- Lack of design standards or manual
- Civil engineers are risk adverse

Barriers in Using Recycled Materials: Environmental Concerns

- Chemical composition is complex
- Long term environmental effects unknown
- Public perception – it is a waste, so it must be bad!
- Convoluted regulatory approval process
- Environmental regulators are risk adverse

Overcoming Barriers

- Lab studies to determine engineering properties
- Lab studies to determine environmental impacts
- Pilot construction projects (full or nearly full scale)
- Monitor long term engineering and environmental performance
- Modify specifications, etc. as needed
- Develop national and/or regional standards
- Education – address concerns head on and focus on the benefits

Guidelines Available

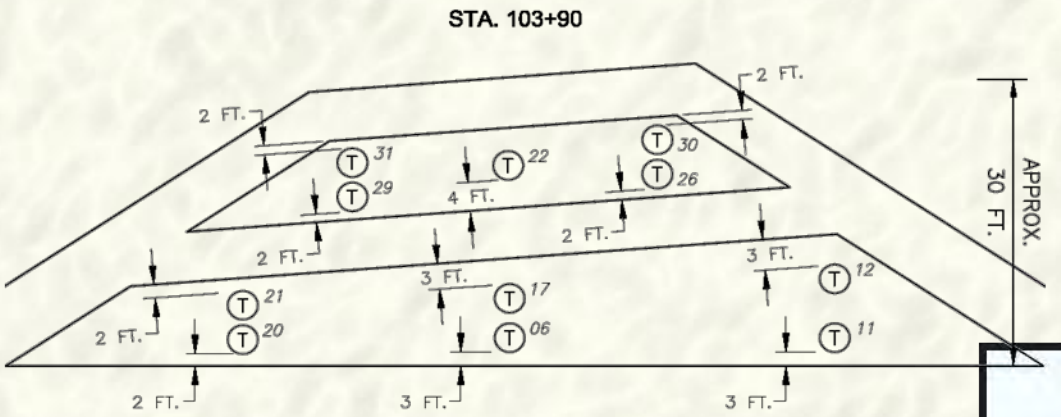
- ASTM D6270 “Civil Engineering Applications of Scrap Tires”
- FHWA guidelines to limit heating in fills
- EPA studies on environmental impacts

Successful TDA Embankment Project

Dixon Landing Interchange

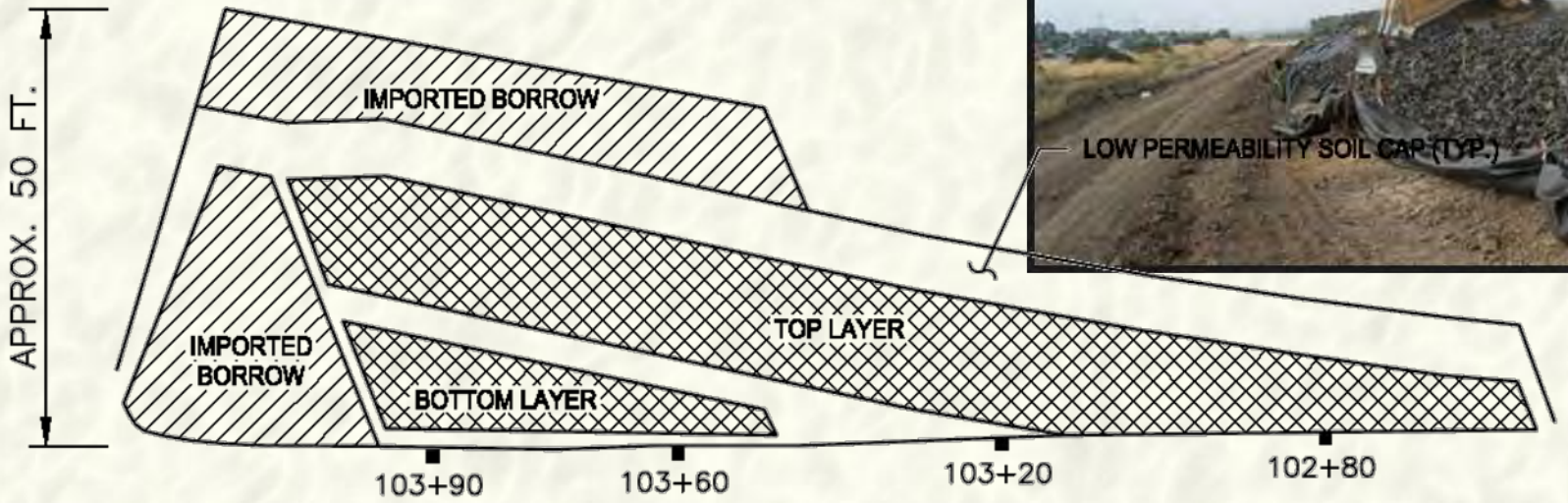
- PROBLEM: Embankment Constructed on Bay Mud
- SOLUTION: Use TDA for the core of the embankment
- CHEAPEST SOLUTION

Embankment Fill Application DIXON LANDING



Lightweight Embankment Fill

Dixon Landing S880 On Ramp



Savings to the State $240,000

Confusion Hill Backfill Project

Confusion Hill Embankment Project

Marina Drive slide repair

133,000 Tires

Wall 119 Riverside, Ca 83,700 Tires

Placement of foundation soil

Compaction of foundation soil

Unloading TDA

Vibration Attenuation

VTA-Vasona Line Extension 2001

Conclusions

- Barriers to using recycled materials can be overcome
- TDA has properties that engineers need
- Civil engineering applications are the fastest growing use for scrap tires in U.S.
- Certain specifications and guidelines are available
- Manageable environmental impact

Acknowledgement

- CalRecycle Tire Management Team:
  - Bob Fujii,
  - Stacey Patenaude
  - Albert Johnson
- Kennec, Inc.
  - Joaquin Wright
- California Pavement Preservation Center
  - Gary Hicks
  - Joel Arthur

THANK YOU