Promoting Sustainability through Educating Undergraduate Students on Applications of Waste Tire Products in Civil Engineering and Transportation

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At 2009 TRB
Outline

- Introduction
- Objectives
- Background
- Challenges and Barriers
- Civil Engineering Applications
- Curricula Development
- Sample Work
- Conclusions and Recommendations
Waste tires occupy valuable landfill space. Waste tires in stockpiles may produce tire fires that are very hard to put out, and cause significant public health and environmental concerns. There are approximately 300 million waste tires generated each year in the United States.
Objectives

- Synthesize the knowledge of utilizing waste tires in civil and transportation engineering
- Develop effective teaching materials to educate university students
- Promote sustainability of using waste tires through university education
Overview of the Project

- Started in July 2007
- Conducted extensive literature review
- Developed training materials for both professionals and university students
- Gave lectures at CSU Chico
- Gave guest presentations at MSA conference, CAAPA meeting, etc.
- Conducted two professor training workshops
Problems

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

... and illegally
Environmental Issues

Tire fires are an environmental nightmare!
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
Toxic runoff from a tire fire can result in the death of all life in a nearby creek.
Use of Waste Tires in California

- 40.2 million reusable and waste tires are generated each year and an estimated 1.5 million waste tires have been illegally dumped or stockpiled
- CE applications of waste tires in California include:
  - Tire Derived Aggregate (TDA)
  - Rubberized Hot Mix Asphalt (RHMA)
  - Others
Challenges and Barriers for Using Waste Tires

Using recycled materials in real applications faces many challenges and barriers, especially, if the knowledge of how to use the recycled materials such as waste tires has not been well disseminated.

The challenges can involve many different people including the public, engineers, contractors, and educators.
Approach to Overcome Barriers

- Disseminate the information through education
- Research results and real applications
- Guideline and standards
- Educate university students – future engineers
Benefits of Rubberized Asphalt Concrete

- Improves traction
- Improves durability
- Reduces noise
- Reduces vibration
- Lowers maintenance needs
- Reduces the spray/splash when raining
- Uses waste tire chips (2000 waste tires per lane mile)
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 other 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
Student Sample Works

![Graph and Diagram]

CENTER AT (122.5, 149.0)  RADIUS = 73.891  S.C. = 0.00  P.R. = 0.00
FACTOR OF SAFETY (2D) = 3.505 BY SIMPLIFIED BISHOP METHOD
Ability to design and analyze data, as well as to interpret results for waste tire CE applications.

Knowledge of the engineering properties of waste tire derived aggregate, and application of the properties in their engineering analyses.

Understanding the importance and benefits of utilizing recycled materials such as waste tires in civil engineering applications.
Websites

http://www.ecst.csuchico.edu/cp2c/dxcheng/Curricula/CIWMBEducation.php

Tire Derived Aggregate and Rubberized Hot Mix Asphalt Concrete Education

If you would like to review course teaching material for applications of waste tire derived aggregate or rubberized asphalt pavement in civil engineering, please obtain an account by contacting Dr. Ding Cheng of CSU Chico via email

System Login

Username:  
Password:  
Log In

Forgot your password?
# Websites

**NOTE:** [User: "dcheng" logged in.]

![Image of a website interface with a login button](http://www.ecst.csuchico.edu/cp2c/dxcheng/curricula/CIWMBEducation.php)

## Continue Education and Curricula of RAC and CE Application of Waste Tires

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Websites

Teaching Waste Tire Derived Aggregate Applications and Rubberized Hot Mix Asphalt Paving in Civil Engineering Curricula

Click Here To Register

Date and Location:
December 19, 2008
Sacramento, Ca

Hotel:

Agenda
Professor Training Workshop
Registration starts at 7:30 AM

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<td>- Albert Johnson-CIWMB</td>
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<td>- Ding Cheng- CSU Chico, CP2 Center</td>
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<tr>
<td>8:45 - 9:00 AM</td>
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Conclusions

- Waste tire applications cover a wide range of civil engineering applications;
- The teaching modules or lecturing materials were developed to cover freshman level to senior level classes;
- The outcomes show that it is an effective way to teach waste tire applications and can reach more students; and
- You can help.
Not About This But It Is Fun
The authors would like to thank the California Integrated Waste Management Board (CIWMB) for funding this project. The authors also appreciate Dr. Dana Humphrey, Joaquin Wright of Kennec, Inc., and Andrew Brigg of MACTEC for providing valuable training materials.