

TIRE RECYCLING GAINS TRACTION

Rubberized asphalt concrete and tire-derived aggregate are just two of the ways that used tires are paving the way in recycling, green reuse and essential infrastructure projects.

BY EDITORIAL STAFF

In an effort to boost the number of scrap tires the Golden State recycles, the California Department of Resources Recycling and Recovery (CalRecycle) recently launched “Green Roads,” an aggressive outreach program to help recycle and reuse the approximately 40 million reusable and waste tires that are generated in the state annually. Behind the initiative is a sound reasoning: using recycled scrap tires is cost-effective, reduces the need for natural resources and diminishes health and safety risks associated with illegal tire piles.

California recovers 70 percent of its waste tires every year. Nearly 42 million waste tires were generated in California in 2010 and around three-quarters were converted into new, higher-value products that help boost the state’s economy. Unfortunately, the remaining 25 percent – about 11 million waste tires last year alone – ended up in landfills or being stored illegally. To try and keep the those tires out of the waste heap, CalRecycle offers local governments millions of dollars in grants and technical advice on how to put recycled tires to use as cost-effective and green alternatives to traditional paving and construction-fill materials.

Where the rubber meets the road

Tire-derived aggregate (TDA) is one of the products made from

shredded waste tires that the Green Roads program is promoting via the grant program. The material – the second largest use of scrap tires in the U.S. behind tire-derived fuel – is employed in a variety of public works projects to replace naturally-mined materials such as gravel.

Cheaper and lighter than gravel, TDA has superior drainage properties, and reduces noise and vibration when used in light-rail projects. When used in place of mined aggregates, it preserves natural resources and landscapes. In addition, twice as much TDA can be transported in a single truckload, when compared to gravel, requiring fewer trucks, less fuel and lower emissions.

TDA is used in a wide range of civil engineering applications. It’s been employed for lightweight embankment fills, landscape repair and slope stabilization, as well as landfill applications such as drainage material for landfill gas and leachate collection. Additionally, it has served as retaining wall backfill and vibration mitigation material.

CalRecycle offers engineering and technical assistance to local jurisdictions and municipalities for education, design and construction oversight on projects involving the material in the Golden West.

One of the specific applications for TDA is its use as an alternative in roadslide repair. TDA decreases the forces on existing, overburdened sub-surface materials. Using it in the place of soil fill

reduces excavation needed to reach hill-side stability levels, resulting in a more stable repair design. TDA is also less expensive than other lightweight fills such as geo-foam. Additionally, the material has a permeability of approximately one centimeter per second and does not substantially absorb water, minimizing the chances the backfill would become saturated. Used properly, TDA can significantly reduce the potential for future failure due to saturated conditions.

Another application that has been tested and is now being promoted in the state is TDA being used as a vibration mitigation material for rail projects. Reducing ground-borne vibration for rapid transit tracks usually takes the form of a special track fastener, or a type of isolation system built under, or incorporated as part of, the track structure, which can be prohibitively expensive. In the last decade, field tests were performed to determine the vibration reduction and damping properties of TDA for potential use beneath rail lines and other applications. These tests confirmed that the use of a one-foot thick layer of tire shreds located beneath the light rail track was an effective vibration alleviation measure. Based on the successful testing, a transit authority in San Jose used the material underneath over 3,000 feet of light rail track.

More recently, the Federal Transportation Authority gave the green light for TDA to be used in a planned extension of the Bay Area Rapid Transit rail system. The 15-mile expansion will begin in 2012 and keep an estimated 250,000 tires out of landfill, while saving taxpayers approximately \$1.5 million on the total cost of the project. Additionally, the California High Speed Rail Authority is considering TDA's use in the state's high speed rail line, a segment of which is currently under construction.

RAC 'em, don't stack 'em

Rubberized asphalt concrete (RAC) consists of crumb rubber from waste tires that is then mixed with asphalt and other aggregate. This mixture forms a durable alternative to traditional asphalt. Research shows that RAC requires fewer repairs than regular pavement, is skid resistant, reduces noise and is a more environmentally-friendly

Table 1 | Cost comparison between rubberized asphalt concrete (RAC) and conventional asphalt concrete (AC)

Cost per lane mile using conventional asphalt concrete	
Materials/preparation	Cost
1,584 tons @ \$100.00 per ton	\$158,400
Pavement preparation	\$12,000
Total	\$170,400
Cost per lane mile using 2-inch rubberized asphalt concrete	
Materials/preparation	Cost
754 tons @125.00 per ton	\$94,250
Note: RAC weighs 5% less than AC	
Total	\$94,250
Savings per lane mile using RAC	\$170,400 - \$94,250 = \$76,150
Source: CalRecycle, 2010	

alternative because it uses 2,000 waste tires for every paved lane-mile.

Because rubberized pavement lasts longer, RAC roads also result in lower greenhouse gas emissions due to fewer repairs needed with more conventional materials. These claims are backed by the Arizona Department of Transportation, which conducted numerous tests on RAC roads to prove that roads paved with the material are quieter and more durable than those that use more traditional asphalt. ADOT's tests also show that RAC roads can result in fewer accidents caused by wet conditions. The material reduces water spray during rain and provides more friction when wet when compared to traditional roads.

Research from multiple sources has found that the material reduces noise considerably – by 50-to-80 percent – both for the neighborhoods surrounding the re-paved roadways and inside the cars themselves.

According to the Rubber Pavements Association, the cost of RAC has decreased substantially since several related patents have expired – roughly half of what it was in 1985. Figure 1 illustrates one project design example, showing cost savings over conventional asphalt concrete (AC).

Using RAC chip seal as a stress-absorbing interlayer – in place of a thicker layer of AC – is where much of the material cost savings comes from, as well as from the benefits of speeding construction.

Table 2 | Cost comparison chart

Product	Project description	Conventional materials quote	Recycled materials quote	Cost savings
Rubberized asphalt concrete	Southern California project requiring 4-inch overlay of conventional asphalt	\$126,720 1,584 tons	\$90,480 754 tons	\$36,240
Tire-derived aggregate	Highway 880 interchange at Dixon Landing	\$491,820 7,026 tons	\$251,826 6,627 tons	\$239,994
Source: CalRecycle, 2010				

While some features cost twice as much as similar conventional treatments, they are typically cheaper than the equivalent amount of conventional AC.

Granting tires a new life

One of the ways CalRecycle is boosting usage of TDA and RAC is through millions of dollars in grants, funded by a fee levied on tires sold in the state, for tire-related projects in the California that promote the use of state-source scrap tires. Since the 2003-2004 grant cycle, CalRecycle has awarded 444 rubberized asphalt concrete and chip seal grants totaling \$39.4 million. As of June 30, 2010, 220 of the grants totaling \$15 million have been completed, resulting in 4.4 million tires being recycled and diverted from California's landfills. And more financial support is still available – the most recent 2010-2011 grant cycle offered \$5 million to applicants.

Some projects stemming from tire recycling grants include:

- In Mendocino County, an equivalent of 270,000 waste tires were used in the Confusion Hill landslide repair project.
- In Mendocino County, Marina Drive

landslide repair project used approximately 133,000 waste tires and resulted in an overall cost savings to the county of \$740,000.

- In Mendocino County, Sonoma Mountain road landslide repair used approximately 330,000 waste tires and saved the county of \$300,000.
- For the Dixon Landing embankment fill project 6,627 tons or 662,700 passenger tire equivalents (PTE) of TDA was used.
- In Sonoma County, Geyser Road landslide repair used approximately 150,000 waste tires and resulted in an overall cost savings to the county of \$370,000.
- In Riverside County, tire-derived aggregate (TDA) was used as retaining wall backfill, using 837 tons of TDA (equivalent to 83,700 waste tires) was installed behind approximately 300 lineal feet of Wall 119 and 1,410 tons of TDA (equivalent to 141,000 waste tires) was installed behind approximately 300 lineal feet of Wall 207.

To further boost usage of TDA and RAC, CalRecycle is also reaching out to engineers and elected officials to inform them about these products, so they might

be considered as an option for a municipality's next civil engineering project. Workshops are currently being created to detail the steps of implementing projects using the materials.

Rolling on

Tire recycling may not receive the same attention that other forms of recycling and green businesses do, but given both the frequency with which waste tires are generated and the proven demand for end-uses, scrap tires are a valuable recycling commodity. In California – parts of which have become synonymous with car-culture – efforts to repurpose or recycle waste tires not only represent a way to successfully manage a growing waste stream, but also a way to invest in the transportation infrastructure of the nation's most populous state. Tire recycling reduces waste, provides green jobs and helps keep people moving. 

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