

Executive Summary

Arizona's Use of Asphalt-Rubber

I. Overview

Arizona is a leader in the use of asphalt-rubber (A-R).¹ The use of A-R is growing in a number of states, including: California, New Mexico, Florida, South Carolina, Texas, New York, and Nebraska.² A-R, made from recycled tires, “is the largest single market for ground rubber in the United States, consuming an estimated 220 million pounds, or approximately 12 million tires” annually.³ In addition to the mass reduction of waste tires, A-R produces longer lasting road surfaces, lowers road noise, is significantly cost effective over the long-term, reduces road maintenance, and creates shorter breaking distances.⁴ A-R creates a road surface that that will not crack as readily as other surfaces, a desirable feature in a desert setting.

II. Process of Producing A-R



The Arizona Department of Transportation (ADOT) has used over fourteen million scrap tires on paved A-R roadways. Currently, three-fourths of Arizona's five million annually produced scrap tires are recycled in A-R pavement construction.⁵ A-R is a mixture of approximately 20% percent ground tire rubber and 80% paving grade asphalt.⁶ The process consists of grinding waste tires to create crumb rubber particles which are mixed

and heated with paving grade asphalt.⁷ In Arizona, the number of A-R projects has increased from one in 1988 to fifty-four in 2000.⁸

A-R must meet certain requirements set under ADOT's 2008 Standards and Specifications. Certification requires that the rubber used for the manufacturing of A-R must be obtained from

vehicles and other equipment owned and operated in the U.S.⁹ The product design must include the exact specifications of the amounts of cement asphalt in comparison to crumb rubber.¹⁰ During the mixing and handling process, set guidelines must be followed in order to maintain standards set forth to create a proper product.¹¹

III. Significant Cost-Effectiveness

A-R is significantly cost-effective in the long-term.¹² Quantities of asphaltic rubber are paid by the ton.¹³ The initial cost of the A-R material per ton is greater than the initial cost of cement asphalt material per ton. However, the initial cost of A-R material continues to decline as the market for this material grows and competition rises.¹⁴ Moreover, earlier patents on the material have been exhausted and the material is now part of the public domain, further reducing its cost.¹⁵

On roadway projects, overall costs are reduced because less A-R material is required to produce the same results as typical asphalt material, some ratios befall 2:1.¹⁶ Further, roadways composed of A-R last longer, reducing costly road maintenance. For example, on the Arizona highway I-19 repair project, only one inch of A-R was placed at a cost of \$2.45 per square yard.¹⁷ The comparable repair strategy using typical asphalt would have cost \$5.00 dollars per square yard.¹⁸ The results of this repair project using A-R continued to “provide a smooth riding, virtually crack free, good skid resistant, quiet and virtually maintenance free surface for ten years.”¹⁹ Similarly, ADOT found:

[T]he [A-R] project on the I-40 Flagstaff cost about ten dollars per square yard including the cost of the cracking and seating. The adjacent project was reconstructed at a cost of about \$25 per square yard for the paving alone. When all other costs including detours are included the cost for reconstruction is about \$45 per square yard. In addition, the ten mile [A-R] overlay project was built in four months, whereas the adjacent five mile reconstruction project took two years to build. Also, the reconstruction project was overlaid with [A-R] after ten years of service due to excessive cracking and rough ride. The [A-R] overlay project built in 1990 as of today, eight years after construction, still has no cracking. It should be noted that the Flagstaff projects are located at about 7,000 feet elevation. Typical rainfall is about 25 inches per year with an average annual snowfall of about 90 inches per year. The coldest temperature recorded

since construction on this project has been -25°F. The use of [A-R] on this I-40 project alone conservatively saved at least \$18 million dollars and about four years of construction traffic disruption.²⁰

Individual users' vehicle operating costs are also substantially reduced. WesTrack conducted a study comparing typical asphalt with A-R. The study revealed that driving on typical asphalt pavements led to higher costs in fuel, precisely 4.5% more, in comparison to driving on smoother A-R pavements, under identical conditions (i.e. same vehicle geometry, air temperature, and wind speed).²¹ Additionally, the rougher pavement increased the frequency of failures in vehicle components, leading to higher costs in vehicle repair and maintenance.²² Overall costs are significantly reduced with the use of A-R.

IV. Benefits Summary



The attractive qualities of R-A verse cement asphalt (Arizona's I-10 Freeway)

A-R pavements provide better roadways in comparison to cement asphalt pavements. For over 30 years, ADOT has routinely monitored A-R road performance.²³ Their findings reveal a

general trend of reduced cracking, improved rutting performance, smoother rideability, reduced traffic noise (by as much as 85%²⁴), reduced maintenance cost, and elevated skid resistance.²⁵

Additionally, A-R creates more attractive road-ways. A-R roads produce long-lasting deep color contrast of road striping and marking (see image). ADOT's study reveals:

[A-R] has reduced the amount of reflective cracking as expected and designed for. A value of ten percent cracking is considered as fatigue cracking, therefore virtually no fatigue cracking has been seen in the [A-R] projects. [T]he average rutting performance [] has been surprisingly better than expected. This could be due to less cracking as well as the use of a very stable stone structure in the [A-

R]. Rut depths below 0.25 inches are considered low and not of any major concern. . . . [A-R] has performed a little better than expected, again perhaps due to less cracking and attendant maintenance. Smoothness values below 93 inches per mile are considered satisfactory and not in need of any correction. . . . [A-R] has performed better as expected due to less cracking and less rutting. A value of \$666 dollars of maintenance cost per lane mile per year is considered high and worthy of attention. [A-R] has a slightly higher skid resistance over time than the conventional [asphalt pavement]. This could be due to less maintenance activities and therefore, less asphalt on the surface. . . . With regard to traffic noise, an Arizona Transportation Research Center study [] printed in 1996, indicated that [A-R] can lower the noise by as much as 5.7 decibels. The report went on to say, "Human hearing can distinguish noise level differences of 3.0 decibels or more. Therefore, the [A-R] overlay appears to be capable of noticeably reducing roadside noise levels in certain situations." In general, objective pavement performance measurements taken over time all indicate that AR is a very good surface wearing course material.²⁶

V. Sustainable Waste Tire Solution

In addition to cost and traffic benefits, A-R projects create a sustainable waste tire solution. Each year more than a quarter billion wasted tires are disposed in the U.S., most often ending in landfills.²⁷ Mass waste tire piles pose substantial health and safety problems including, risks of disastrous tire fires, alleviated pollution, vector, and disease threats.



Finding methods to reuse waste tires is a key factor in eliminating waste tire disposal. According to Han Zhu of Arizona State University, reprocessing waste tires into crumb rubber is an excellent first step in reusing waste tires.²⁸ Crumb rubber may be used to manufacture a variety of products, but the largest user of crumb rubber is the A-R industry. Waste tire piles have been significantly reduced in the state of Arizona due to A-R projects. The over fourteen million scrap tires that have been used in Arizona A-R projects might have otherwise substantially increased land contamination of dumped waste tires.

VI. Conclusion

Asphalt-Rubber has proven to be an exceptional material, especially for driving in the southwest environment. Not only will A-R reduce scrap tire piles, but it will significantly decrease noise pollution, be cost effective in long-term road maintenance, and create better roadways.

Therefore, A-R can provide an excellent durable wearing course while creating a sustainable scrap tire solution.

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 3. Id.
 4. Id.
 5. http://www.azdot.gov/highways/materials/pavement_design/what_is_rubber_asphalt.asp (Accessed July 7, 2009).
 6. Id.
 7. Id.
 8. Id.
 9. ADOT's Standards and Specifications (2008).
 10. Id.
 11. Id.
 12. <http://www.epa.gov/osw/conservation/materials/tires/ground.htm> (Accessed July 8, 2009).
 13. ADOT Standard Specification § 413-9 (2008).
 14. G.Way, OGFC Meets CRM: Where the Rubber Meets the Rubber 15 Years of Durable Success, AR2003, Brasilia, Brazil, Dec. 2003.
 15. Carlson D. D., et al., Asphalt-Rubber An Anchor to Crumb Rubber Markets, 14 (1999).
 16. G.Way, OGFC Meets CRM: Where the Rubber Meets the Rubber 15 Years of Durable Success, AR2003, Brasilia, Brazil, Dec. 2003.
 17. Id.
 18. Id.
 19. Id.
 20. Id.
 21. http://www.rubberpavements.org/Library_Information/AR_Benefit_Analysis_sheets/ARUserCostBenefits.pdf (Accessed July 9, 2009)
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