United States
Environmental Protection
Agency

Industrial Environmental Research
Laboratory
Cincinnati OH 45268

Research and Development

EPA-600/S2-81-193 Oct. 1981

EPA

# Project Summary

# Options for Resource Recovery and Disposal of Scrap Tires: Volume I.

Patricia L. Deese, James F. Hudson, Richard C. Innes, and Douglas Funkhouser

**This report presents a review of the environmental, technological, and economic problems associated with the management of the approximately 200 million tires that are discarded in the United States each year. The report analyzes trends and problems associated with tire retreading, collection, and shredding; rubberized asphalt; and tires as a fuel supplement (tire derived fuel or TDF). The economics of tire collection, rubberized asphalt, and tire derived fuel are analyzed in depth. Various incentive options are examined briefly, from which the authors chose the product charge of 4.4¢/kilo (2¢/pound) as offering several advantages over the others for resolving the scrap tire problem.**

***This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).***

## Introduction

Each year approximately 200 million automobile and 40 million truck tires are removed from service (a total of some 4 million tons), most of which enter landfills for final disposal. Although various new resource recovery options (mainly energy recovery) for the use of these tires have appeared at least superficially attractive, the economics of these processes have permitted only a very slow growth in their utilization. Traditional industries for the reuse of these scrapped tires, rubber reclaiming, tire splitting, and retreading have all experienced zero to negative growth in recent years, with the result that an increasing proportion of these tires are placed in landfills.

A number of impacts associated with this situation tend to make the costs of managing waste tires higher than the minimum necessary. Tires are nearly wholely produced from petroleum derivatives. Since a large percentage of this petroleum is imported, this causes an obvious negative impact on the nation's balance of payments, especially in a world of cartelized oil prices. Further, these tires displace volume in landfills that in many communities is increasingly scarce in supply, raising disposal cost. This is a problem primarily in densely populated areas where the distribution of scrap tires closely parallels the population density. Reducing the size of the tires by splitting or shredding to save landfill volume is costly. Charges imposed to cover the cost of shredding creates an incentive for tires to be illegally dumped or littered, causing negative aesthetic impacts.

There are health impacts also, principally the greater risk of fire and disease from stockpiled and/or littered tires. Tires have been implicated in mosquito borne encephalitis cases in at least one community.

The causes of the scrap tire problem are to be found in the interplay of technological and economic factors. On the technical side, a lack of simple processes to reclaim high quality rubber and/or constituent materials such as carbon black from used tires means that such products, if obtained, are costly and not competitive with virgin materials, although the recent rise in virgin feedstock prices should begin to reduce the cost differential. Technical difficulties that American companies encountered earlier with the construction of steel-belted radial tires have made them virtually unretreadable, probably leading to a higher rate tire scrappage than would have otherwise occurred. This problem now seems to have been resolved.

## Technical Options for Tire Reuse

Currently, there are four technologies in various stages of use and development that lead to reuse of scrap tires in some form and may lead to greater future use. These technologies are shredding, retreading, rubberized asphalt, and energy recovery.

### Shredding

Shredding is a fairly well developed technology and is an intermediate processing step for disposal, rubberized asphalt, and energy recovery.

### Retreading

Currently, approximately 13 million truck and 31 million auto tires are retreaded annually. The figure for passenger auto tires has been declining throughout the decade of the seventies, and stood, for example, at 36 million in 1974. The state of the art is such that well-made retreaded tires are produced with relative ease but the variable performance observed is because of the many small retread shops that do not have the proper equipment for good retreading and/or seek to avoid the cost of producing high quality retreads.

Also, it is true that the shift to radials is having a significant negative impact on the rate of retreading. In 1978, for example, the retread rate for bias-belted tires produced in 1976 was 38%; for radials, 6%. Unless American tire manufacturers can solve the technical problems of construction that have made their radial tires unretreadable, and unless retreaders get the equipment in place to retread these radials, there will be a significant further decline in retread rates, leading to a substantial increase in the number of tires discharged for disposal.

### Rubberized Asphalt

Adding rubber to asphalt is an old concept, although using scrap tires as the source of the rubber component in the mixture has received serious attention in only the last 10 to 15 years. There are two very similar processes in use, both developed in Phoenix, Arizona. Essentially, the process consists of adding crumb rubber (derived from a rubber reclaiming process) to hot asphalt in an asphalt distributor truck, spraying it on the road surface, and covering it with stones ("chips"). The anticipated benefits in road applications (potentially the largest use for the material) are two: (1) prevention or retardation of the rate at which cracks reflect through new asphalt courses overlaid on older and failing pavements, and (2) as a waterproof membrane (for use on bridge decks, for example). The most effective use may be in preventing pavement failure resulting from expansive soils such as clays that stimulate "alligatoring," so named because of the dense and interconnected nature of the cracks.

The effectiveness of rubberized interlayers in two other major types of pavement failure, lateral and transversal cracking, is more problematical. Lateral cracking stems from weather caused expansion and shrinking of concrete pavements. Transversal cracking comes from pavement and/or base failure, often caused or exacerbated by excessive weights of vehicles.

Rubberized seal costs are about 70% ($0.45/yd²) more costly than the conventional nonrubberized treatments. Table 1 shows the discounted payback periods implied by various combinations of discount rates and cost savings on a square yard basis. As yet, no good information exists on what the savings are. For example, the stress-relieving interlayer (placed between the old pavement surface and a new, thicker overlay or finish course), some preliminary evidence indicates an annual maintenance cost savings of $0.26/yd². These savings suggest a discounted payback of 4 to 5 years at rates of discount of 6 to 10 percent.

Another important use of rubberized asphalt is in crack and joint sealing compounds. Preliminary evidence suggests that the rubberized sealer is technically superior to conventional sealers (which often fail in less than a year) and the cost premium is only 30%. Thus, the likelihood of the cost effectiveness of the material is high, although again, the answer to this question of cost effectiveness is not known with precision.

### Energy Recovery

Essentially, two basic technologies are being considered by a number of firms as methods of recovering the energy content of tires—direct combustion and pyrolysis. Both normally require shredded tires as feedstock. Neither of these technologies, in the various forms in which they appear, are much beyond experimental or pilot stages, and many have not reached the pilot stage. For the most part, the processes are not yet profitable.

Direct combustion techniques take tires (whole or shredded) and burned them singly or mixed with other fuels (especially coal) typically for steam production. There is no comprehensive information on the air pollution impacts of burning tires, but past experiences suggest that proper feed rates and standard emissions control equipment will be able to deal with tire related residuals.

Large scale combustion of tires depends on an adequate supply of tires for the process. As such, the supply is sensitive to the cost of collection, especially transportation costs, and to prices to be paid (positive or negative)

***Table 1.*** *Discounted Payback Periods for an Asphalt-Rubber Seal Coat (years)*

| Discount Rate (%) | Annual Maintenance Savings (¢/yd²) | | | | | |
|---|---|---|---|---|---|---|
| | .10 | .15 | .20 | .25 | .30 | .40 |
| 6 | 6 | 4 | 3 | 2 | 2 | 2 |
| 10 | 7 | 4 | 3 | 2 | 2 | 2 |
| 15 | 8 | 5 | 3 | 3 | 2 | 2 |
| 20 | 13 | 5 | 4 | 3 | 2 | 2 |
| 25 | >50 | 7 | 4 | 3 | 3 | 2 |

for delivery of tires to a facility. Processing costs do not seem to be an important consideration, at least for plants of 30 tons/day or more. The study of a hypothetical facility in New England suggests that the process would be profitable if as few as 6 percent of tires in New England were collected and delivered to the plant. Currently, there are still no important facilities for shredding or otherwise processing tires for energy recovery. The cost of collection and the insufficiently high prices of alternative fuels do not seem to make energy recovery from tires economical at present.

Pyrolysis of whole or shredded tires has and still attracts the attention of many chemical engineers. Such companies as Firestone*, Goodyear, Tosco, and others have made substantial investments in the past trying to recover fuel oil, carbon black, and gases from pyrolized tires. Typically, carbon black, a major ingredient in tires, is of insufficient quality to make it competitive without further processing. Again, economics is the hurdle that remains to be surmounted before energy recovery from tires becomes profitable.

## Public Policy Options and Recommendations**

The full report briefly reviews the advantages and disadvantages of alternative public policies dealing with the scrap tire problem. These include landfill regulations, tire size standards, tire maintenance, and such economic incentives as disposal charges and product charges. The authors recommend adopting a product charge, with the revenue distributed to qualified disposers to cover the costs of proper disposal.

The full report was submitted in fulfillment of Contract No. 68-03-2735 by Urban Systems Research and Engineering, Inc., under sponsorship of the U.S. Environmental Protection Agency.

*Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

**Although this report has been reviewed by the Municipal Environmental Research Laboratory, and approved for publication, this approval does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency.

*Patricia L. Deese, James F. Hudson, Richard C. Innes, and Douglas Funkhouser are with Urban Systems Research and Engineering, Inc., Cambridge, MA 02138.*

***Haynes C. Goddard** is the EPA Project Officer (see below).*

*The complete report, entitled "Options for Resource Recovery and Disposal of Scrap Tires: Volume I," (Order No. PB 82-107 491; Cost: $14.00, subject to change) will be available only from:*

*National Technical Information Service*
*5285 Port Royal Road*
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*The EPA Project Officer can be contacted at:*

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*U.S. Environmental Protection Agency*
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☆ U S GOVERNMENT PRINTING OFFICE, 1981 — 559-017/7392

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