

*Market Status Report:*  
***Waste Tires***

*October 1996*



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Waste  
Management  
Board

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# Table of Contents

Introduction.....	1
Supply of Waste Tires .....	1
Demand for Waste Tires.....	1
<i>Reuse and Retread</i> .....	2
<i>Tire Derived Fuel</i> .....	2
<i>Crumb Rubber</i> .....	2
<i>Civil Engineering</i> .....	3
<i>Potential Markets</i> .....	3
Market Barriers .....	3
Strategies to Overcome Market Barriers .....	5
Summary .....	6

# Preface

This report is one in a series of reports prepared by the California Integrated Waste Management Board that examine market barriers to recycling of postconsumer materials and strategies to overcome them. The following reports are part of this series:

- *Market Status Report: Buy Recycled Programs* (pub. #422-96-059)
- *Market Status Report: Container and Plate Glass* (pub. #421-96-060)
- *Market Status Report: Ferrous Scrap* (pub. #421-96-061)
- *Market Status Report: Industrial Market Development Programs* (pub. #421-96-062)
- *Market Status Report: Postconsumer Recovered Paper* (pub. #421-96-065)
- *Market Status Report: Postconsumer Plastics* (pub. #421-96-066)
- *Market Status Report: Recycled Inerts* (pub. #431-96-063)
- *Market Status Report: Secondary Material Export Markets* (pub. #421-96-064)
- *Market Status Report: Urban Compost and Mulch* (pub. #421-96-068)
- *Market Status Report: Urban Wood* (pub. #443-96-069)
- *Market Status Report: Waste Tires* (pub. #421-96-067)

In addition, the Board has prepared a market development plan, *Meeting the 50 Percent Challenge: Recycling Market Development Strategies Through the Year 2000* (pub. #400-96-058) that identifies the key actions the Board will implement to promote the recycling of targeted priority materials (paper, compostables and mulches, inerts, plastics, and tires).

To obtain copies of the plan or status reports, please contact the Board's Public Affairs Office or download them from the Publication List on the Board's web site (contact information is on the inside front cover of this report).

## Introduction

In 1995, approximately 30 million waste tires were generated in California. About 18 million of those (60 percent) were diverted from disposal through reuse, retreading, combustion, or recycling. The largest market for waste tires was as a fuel (over 11 million tires: 5 million for electricity production and 6 million for

cement production). The second largest market for used and waste tires was the reuse/retread market (over 4 million tires). Another 2 million tires were recycled into products including rubberized asphalt, rubber mats and playground covers, carpet tile, speed bumps, sound walls, and various stamped or molded products.

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## Supply of Waste Tires

Currently there is no formal system for tracking the generation, reuse/recycling, and disposal of used tires. The generation estimates discussed in this paper are based on population, the number of vehicles registered in the state, vehicle miles traveled, and average fuel consumption. Reuse/recycling numbers

are based on information from businesses involved with scrap tire collection and processing. Based on available information, the supply of waste tires in 1996 is estimated to be 12 million tires, roughly the amount stockpiled (not including tires in existing stockpiles or disposal sites) and disposed of in 1995.

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## Demand for Waste Tires

The amount of waste tires combusted at cement kilns may increase significantly in the next two to three years. Tires are a cheaper fuel source than coal, and may burn cleaner than coal in regard to sulfur dioxide (SO<sub>2</sub>) and oxides of nitrogen (NO<sub>x</sub>). For more information on air quality impacts of tires as a fuel, please refer to the Board's January 1992 report to the Legislature, *Tires as a Fuel Supplement: Feasibility Study*. Since tires are a cheaper fuel alternative to coal, cement kiln operators believe that demand in this market could increase by more than 10 million tires per year. If all existing plants were to utilize tires as a fuel, this market could consume up to 24 million tires annually.

cement kilns may be partially offset due to the possible closure of the Modesto Energy Project, a major market for waste tires. Its purchase agreement with PG&E expires in the spring of 1998, and since the cost of producing electricity at this facility is not currently competitive with other sources of electricity, its contract may not be renewed. The facility, located in Westley, California combusts up to 5 million tires annually.

The increase in combustion of tires in

There are new and existing markets for crumb rubber that may divert more tires in the near future. Rubberized asphalt, in addition to other applications for crumb rubber such as molded rubber products and soil amendment, could divert additional tires. In addition, devulcanized rubber offers the hope that any decline in combustion could be offset by increased diversion through this application. However, it is not possible to accurately predict the degree to which these other end uses can make up for the loss of the electrical generating facility in Westley. An additional 3-4 million tires could be diverted through the above methods within the next 2-3 years.

Based on the above analysis, the overall demand for waste tires in California could potentially increase by up eight or nine million tires during the next few years.

Specific end-use markets are discussed below.

## **Reuse and Retread**

Many tires still have useful tread life after they have been replaced by new tires. In California, an estimated 1.5 million tires were reused in 1995. In addition, another 2.7 million tires were retreaded in California in 1995. There is also a strong export market to Mexico, China, and India for reusable tires. Roughly 1.7 million tires were exported in 1995 for retread/reuse or processing into crumb rubber.

## **Tire Derived Fuel**

Tires are an attractive alternative to coal at cement kilns because they generate revenue from tipping fees (10-25 cents/tire, where as coal costs approximately \$30.00/ton). In addition, they have a higher Btu content than coal and hence burn cleaner and reduce emissions of "criteria air

pollutants" (pollutants such as SO<sub>2</sub> and NO<sub>x</sub> for which emission standards have been set). Tire incineration at cement kilns also eliminates processing costs associated with recycling or landfilling. Specifically, tires must be processed to produce crumb rubber and by law must be cut or shredded prior to landfilling. Another advantage to combustion at cement kilns is that there is no residue to dispose of since the ash is incorporated into the cement. On the downside, however, cost savings may not be realized if hauling distances are too long.

## **Crumb Rubber**

One area which offers more diversion potential for tires is the crumb rubber market. Approximately 1.8 million tires were diverted from disposal in 1995 through crumb rubber applications. End uses included rubberized asphalt, molded products, mats and playground covers, speed bumps, carpet pads, and soil amendments.

Of the above end uses, rubberized asphalt has the greatest market potential. However, the elimination of the federal requirement that states use rubberized asphalt in federally-funded highway projects has slowed development of this market. Nevertheless, 10 percent of all asphalt placed by CalTrans is rubberized asphalt. The Board estimates that rubberized asphalt could annually divert up to 5 million waste tires generated in California. In addition, existing rubberized asphalt paving projects have shown that the material has better engineering properties and longer life than conventional asphalt.

Recent technological improvements in crumb rubber production allow smaller particle sizes, which have wider applications in molded rubber and composite products. With increases of production capacity, and the consequent increased supply of quality crumb rubber feedstock at a lower cost,

recycled-content rubber products could become more price-competitive with virgin rubber products.

Another important emerging use of crumb rubber is as a soil amendment. When tilled into the soil, crumb rubber improves porosity and the ability of air, water, and fertilizers to penetrate to plant root zones. School athletic playing fields are a large potential market, but it is currently hampered by tight school budgets.

## Civil Engineering

An undetermined amount of waste tires are diverted through civil engineering applications. Demonstration projects have proven that tires cut in half like a bagel and buried under the surface of planted areas (golf courses for example) help trap moisture and fertilizers, thus resulting in significant cost savings since water and fertilizer have to be applied less frequently. Other civil engineering applications for whole or cut tires include sound wall barriers, leachate collection systems, artificial reefs, slope stability/erosion control, and road base. In addition, crumb rubber has been used to manufacture railroad ties and speed bumps.

## Potential Markets

In addition to diverting more tires through incineration and rubberized asphalt, there are three other technologies that are being further developed that have the potential to divert a significant quantity of used tires.

Pyrolysis (heat in the absence of oxygen) is the thermal distillation of waste tires. However, there are currently few markets for the products of pyrolysis (oil, gas, carbon black and steel), principally because the revenue from the sale of the products does not cover the cost of producing them.

Gasification is a thermal process that turns a percentage of the scrap tire into a salable gas. However, once again, because of the high cost of production, there is currently no commercially viable market developed for this product.

Devulcanization is the chemical breakdown of the bonds that provides rubber with its structural integrity. New chemical processes for devulcanizing tires offers the promise of reusing "delinked" polymers in new thermoset products. Previously, thermoset products were not recyclable because chemical bonding of polymer chains prevented their recycling through melting and reforming into new products. The major advantage to devulcanization is the ability to take old tires and break them down chemically into a feedstock which could be used to make new tires and other rubber products. Tire manufacturers believe that new tires may be manufactured with up to 10 percent recycled content within the next two to three years.

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## Market Barriers

The cost advantage of using tires over coal

as a fuel at cement kilns is substantial and

has supported this active market for waste tires. However, this market has been impacted by recent concerns about emissions of toxic air contaminants which may pose a significant cancer risk (which EPA defines as a risk of more than one cancer case per million people) to people living near cement kilns. To help evaluate this risk, the Board will contract for a study to determine the level of emissions from cement kilns of hazardous air pollutants. This study will help identify any necessary pollution control technologies required to reduce emissions to safe levels.

There are four main barriers to crumb rubber markets:

- High cost of collection, sorting, and processing.
- Emerging markets that are underdeveloped.
- Public health concerns over incineration and paving with rubberized asphalt.
- Perception of recycled-content products as inferior.

In order for tire recyclers to operate a profitable business they must charge retailers for the collection of used tires to subsidize the processing of waste tires for reuse or recycling. Typically, tire recyclers receive 65-75 cents per tire to pick them up from a retailer. Often, they are underbid by illegal tire haulers who dispose of the tires at unpermitted storage piles or dumps and avoid paying tipping fees for tire handling and disposal. To combat illegal disposal and put illegal haulers out of business for good, markets for waste tires are needed. If markets could be developed to increase the value of waste tires, then recyclers could be price competitive with illegal haulers for the tires, or at some point maybe even offer money to retailers for the scrap tire.

Once the tires are picked up by recyclers, reusable tires that still have tread life are sorted from the remaining tires, which will be used for manufacture into other products. The sorting and processing costs associated with manufacturing new products, whether its whole or cut tire civil engineering application or for crumb rubber uses, often makes the product more expensive than products made from virgin rubber feedstocks. Once again, better markets could help tire recyclers realize economies of scale to bring down their unit costs and be more price competitive with virgin rubber products.

Public health concerns may also prove to be a barrier in the cement kiln and rubberized asphalt market. Exposure to toxic air pollutants which may be generated when tires are incinerated could limit the amount of tires being diverted to cement kilns. This issue came up during a recent successful lawsuit brought by Greenpeace against a kiln operator. The court ruled that the operator had to revise its local permits in compliance with the requirements of the California Environmental Quality Act (CEQA) prior to burning tires at its facility. The main concern to be addressed in the CEQA review was public exposure to carcinogens such as dioxin in the air emissions from the facility. There have also been worker health and safety problems during rubberized asphalt paving projects. Specifically, exposure to the off-gasses resulting from heating of the rubberized asphalt have made workers ill. This impact must be addressed in order to promote rubberized asphalt on a wide scale.

Another market barrier to waste tire recycling is the perception of products manufactured with recycled content as inferior. Some people believe that recycled content products are not as durable nor as reliable as products made from virgin materials. On the manufacturing side, some product designers prefer to use virgin

rubber with established physical properties, and are hesitant to use recycled rubber because of supply and quality concerns. However, waste tire processors have proven that with improved technologies now available they are able to meet supply and quality specifications.

In addition to the above market barriers, another issue to consider is that the Board's grant program favors urban areas over rural areas, because a primary consideration in awarding grant is the

number of tires that the proposed project will divert. Obviously, urban areas will have significantly more tires to divert than rural areas.

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## Strategies to Overcome Market Barriers

The solution to the waste tire problem is market development. In general, spending available State funding on site clean up and tire hauler enforcement will not address the problem. Market development for waste tires is the only long-term, viable solution to tire disposal, both legal and illegal.

The two primary growth markets for waste tires are as fuel for cement kilns and feedstock for crumb rubber applications. The Board should focus its waste tire market development activities toward these two markets in the short term. However, the Board should also consider medium to long-term market development activities in the area of pyrolysis and devulcanization. If the latter two markets were to become economically competitive, then significant new markets would be opened for waste tires. In conclusion, the Board should pursue the following strategies.

### **Strategy**

Increase waste tire diversion by developing alternative uses including use as a fuel supplement at cement kilns, pyrolysis, and devulcanization.

### **Actions**

- Adopt a Board policy which supports the

use of tires as a fuel supplement.

- Provide financial assistance for emissions testing at long kilns.
- If emission test data show that there is a significant increase in emissions that poses a potential public health risk, contract for a study on how to safely incinerate tires at cement kilns.
- Provide financial assistance for fuel handling equipment at cement kilns to reduce processing costs.
- Provide a point preference to local government tire grant applicants that propose to recycle cleaned up tires at a cement kiln.
- Allow use of grant funding for research and development projects aimed at establishing large-scale pyrolysis and devulcanization facilities in California.

### **Strategy**

Increase the use of recycled crumb rubber by promoting and developing crumb rubber markets through the Board's Tire Grant and RMDZ Loan programs.

### **Actions**

- Include criteria in future waste tire grant regulations establishing a hierarchy of end uses, but giving priority to crumb rubber market development.
- Revise RMDZ loan criteria to increase the priority of manufacturers that utilize crumb rubber in their products, and for local agencies utilizing crumb rubber in civil engineering and other applications.
- Facilitate contacts between end-users and suppliers of crumb rubber through outreach programs, including workshops and conferences, to disseminate information on emerging technologies for using waste tires.
- Encourage industry efforts to establish quality standards for crumb rubber production to address quality concerns on the part of product manufacturers and coordinate meetings to establish an industry group which would develop these standards.
- Encourage industry efforts to establish a "tire advisory council" to promote the waste tire reuse/recycling industry.
- Promote the use of rubberized asphalt by providing information to local governments about production methods, proper application techniques to street surfaces, and potential cost savings through its longer life span over conventional asphalt.

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## **Summary**

Each year California, because of its large population and business community, generates tens of millions of waste tires. There are currently three main markets for these waste tires, as a fuel at cement kilns; reusable and retreadable tires; and as a feedstock for crumb rubber producers. Unfortunately, these and other markets are insufficient to divert all of the waste tires generated. Nevertheless, well over half the waste tires are currently being diverted from landfilling or stockpiling (both legal and illegal).

To promote markets for waste tires, and hence increase diversion from disposal, the Board should assist cement kiln operators in performing emissions testing to address concerns about hazardous air pollutants; and encourage the use of crumb rubber in rubberized asphalt and as a feedstock for a variety of rubber products. In addition to the above, the Board should consider promoting methods for the efficient collection and processing of waste tires. And finally, the Board should encourage public and private buy recycled promotional activities to stimulate consumer demand for recycled-content rubber products.