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TRANSPORTATION LABORATORY

A REPORT ON

The Problems & Possible Solutions to Disposing of or Recycling Used Tires

REQUESTED BY
HOUSE RESOLUTION NO. 37
1973 SESSION OF CALIFORNIA LEGISLATURE

JANUARY 1975

DO NOT DESTROY

CALIFORNIA DEPARTMENT OF TRANSPORTATION

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STATE OF CALIFORNIA—BUSINESS AND TRANSPORTATION AGENCY RONALD REAGAN, Governor

DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
1120 N STREET
SACRAMENTO, CALIFORNIA 95814

January 6, 1975

Honorable James D. Driscoll
Chief Clerk of the Assembly
State Capitol
Sacramento, California

Dear Mr. Driscoll:

It is a pleasure to present the attached report on the problems associated with Abandoned Tires in California and possible solutions as requested by House Resolution 37 of the 1973 Legislative Session.

Caltrans, through the Transportation Laboratory, is experimenting with the usage of used tires and other waste products in embankments for transportation facilities. Other possible uses, being explored by others, are oriented towards utilizing the "energy" potential within the tire. The report discusses each of these in detail. Information from other state, federal and local agencies and firms was solicited and is included as part of the report.

Caltrans appreciates the opportunity to participate in examining these problems confronting Californians and their possible solutions.

Sincerely,

HOWARD C. ULLRICH
Director of Transportation

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State of California
Department of Transportation
Division of Highways
Transportation Laboratory

A REPORT ON

THE PROBLEMS AND POSSIBLE SOLUTIONS TO DISPOSING OF OR RECYCLING USED TIRES

AS REQUESTED BY
HOUSE RESOLUTION NO. 37
IN THE
1973 SESSION OF THE LEGISLATURE

January 1975

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1973 Session of the Legislature

HOUSE RESOLUTION NO. 37

Relative to tires

WHEREAS, Abandoned tires constitute a health hazard, often serve as a breeding place for mosquitoes, and constitute a fire hazard as well as an eyesore; and

WHEREAS, The disposal of abandoned tires is becoming increasingly more expensive; now, therefore, be it

Resolved by the Assembly of the State of California, That the Department of Public Works* is hereby requested to study the problems of, and possible solutions to, disposing of used tires, giving consideration to the possibilities of recycling such tires; and be it further

Resolved, That the Department of Public Works* submit the conclusions of its study to the Assembly by January 6, 1975; and be it further

Resolved, That the Chief Clerk of the Assembly transmit a copy of this resolution to the Department of Public Works*.

Resolution read, and referred by the Speaker Pro Tempore to the Committee on Rules.

*Department of Public Works officially became Department of Transportation on July 1, 1973.

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INTRODUCTION

In 1973 the Assembly of the State of California passed House Resolution No. 37 requesting the Department of Transportation (formerly Public Works) to "study the problems of, and possible solutions to, disposing of used tires, giving consideration to the possibilities of recycling such tires, and to submit the conclusions of its study to the Assembly". In the language of the resolution, this request was in response to the fact that the disposal of abandoned tires is becoming increasingly more expensive, constitutes a mosquito breeding health hazard, a fire hazard and an eyesore.

The Department of Transportation, Transportation Laboratory initiated investigations into the used tire problem in four major areas:

1) Literature review of various aspects of the used tire problems and solutions.

2) Correspondence and discussions with interested public agencies.

3) Correspondence and discussions with interested private organizations.

4) Ongoing physical laboratory and field research experiments.

This report presents the results of these investigations and tests. The report summarizes some of the problems involved with tire disposal as determined from contacts with tire dealers and disposal site operators throughout the State. An evaluation of the status and trend of the problem is also presented.

California is one of the largest sources of used tires in the country. The ultimate major receiver of this waste material is the disposal industry, mainly dumps and sanitary landfills. About 30% of used tires are recycled by retreading, reclaiming, or splitting, while minor quantities are used in miscellaneous applications.

Possible solutions to the used tire problem are discussed under four major categories: sources and consumers, disposal, recycling, and miscellaneous applications. These are evaluated in terms of their technical and economic feasibility.

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PROBLEM

Abandonment of tires along roadways, bay shores, vacant fields, and other areas has presented a problem for maintenance personnel of public agencies, local health and fire officials, and private landowners. In most instances, these problems are quite localized and have not caused areawide concern as has used tire disposal at dump sites or accumulation at the handling yards. The average car owner trades the used tires for "new" ones; consequently, the tire dealer ends up with the used carcasses. In cases where the automobile owner has retained the used tire and later discards it in an unapproved manner, the result has largely been one of a nuisance more than anything else. Thus, the overwhelming problem appears to be in the disposal of used tires by tire handlers.

Historically, used tires have been very difficult to reuse or recycle because of the handling and energy involved to convert a tire to some convenient reusable form. Since the tire cords are bonded with the rubber, a great deal of energy is required to shred the carcasses. Consequently, products made from recycled rubber are frequently more expensive than if they were made with new rubber.

For many years, one method of tire disposal has been by open burning. However, under the State Health and Safety Code, open burning is not permissible in many areas with the net effect of precluding this former method of tire disposal. The disposal of tires in sanitary landfills has created problems in several areas as tires are difficult to handle and compact, and have a tendency to "float" to the surface of the fill. A survey of 63 disposal site operations throughout the State revealed problems with tire disposal at about 30% of the sites. Many disposal sites have refused to accept tires unless shredded or chopped, while others have increased the disposal fees substantially either to cover the handling difficulties or discourage their disposal.

California generated about 22,000,000 used tires in 1973. This figure is based on a tire sale potential estimate and is illustrated geographically by county on Figure 1. The California 1973 motor vehicle registration distribution illustrated on Figure 2 corresponds closely with the distribution on Figure 1. Figure 2 indicates that the number of used tires may be increasing in some areas while decreasing in others as the vehicle registration in the counties varies. Figure 3 illustrates the statewide vehicle registration over the past 8 years and indicates that total vehicle registration has been increasing by an average of about 4% per year. Thus, statewide, the number of used tires is probably increasing. The effect of the recent "energy crisis" on this trend is unknown and difficult to predict.

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Figure 1

CALIFORNIA 1973 TIRE SALES POTENTIAL

STATE TOTAL = 22,547,605 TIRES

FIGURE NOTED BY COUNTY IS PERCENT OF STATE TOTAL

SOURCE: UNIROYAL, INC

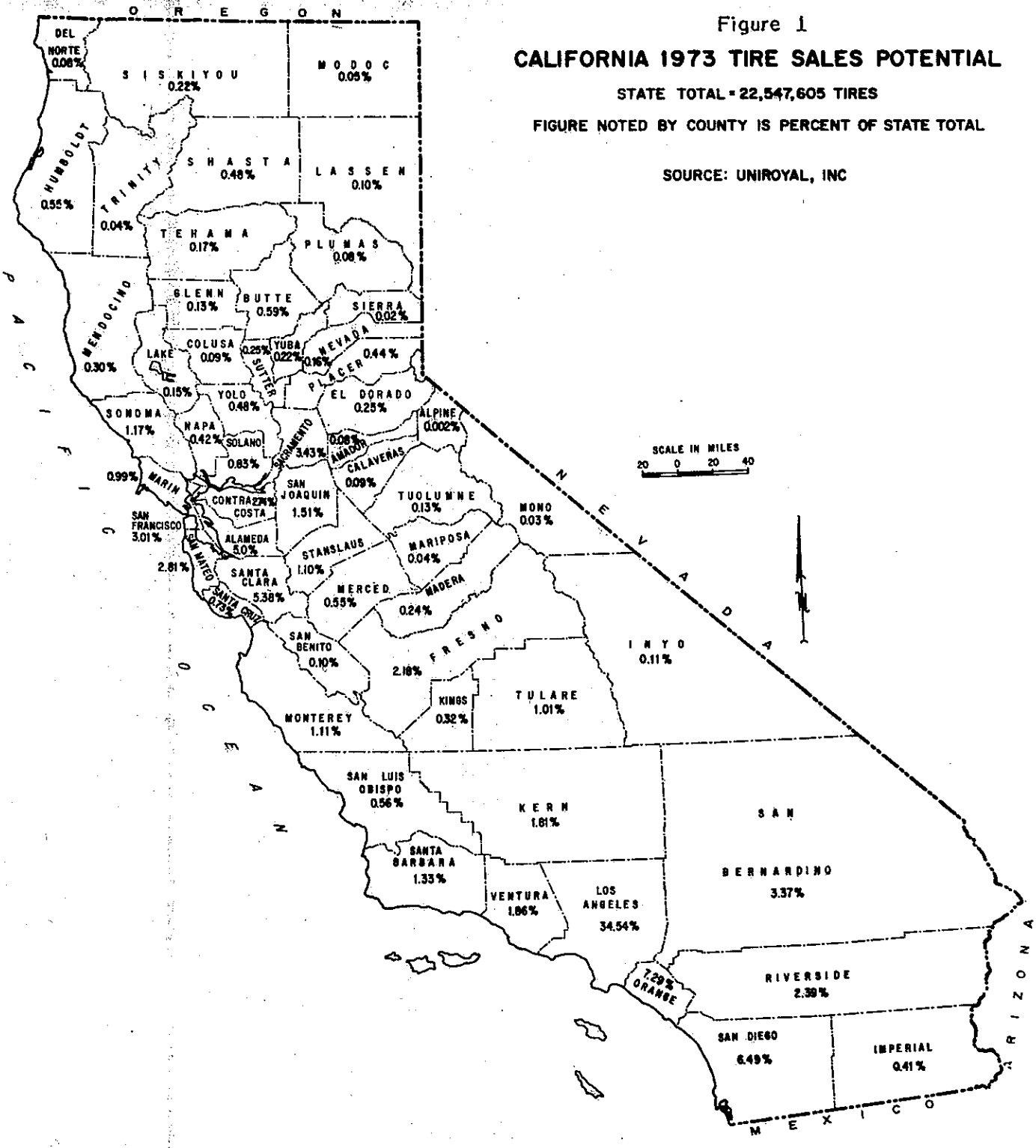

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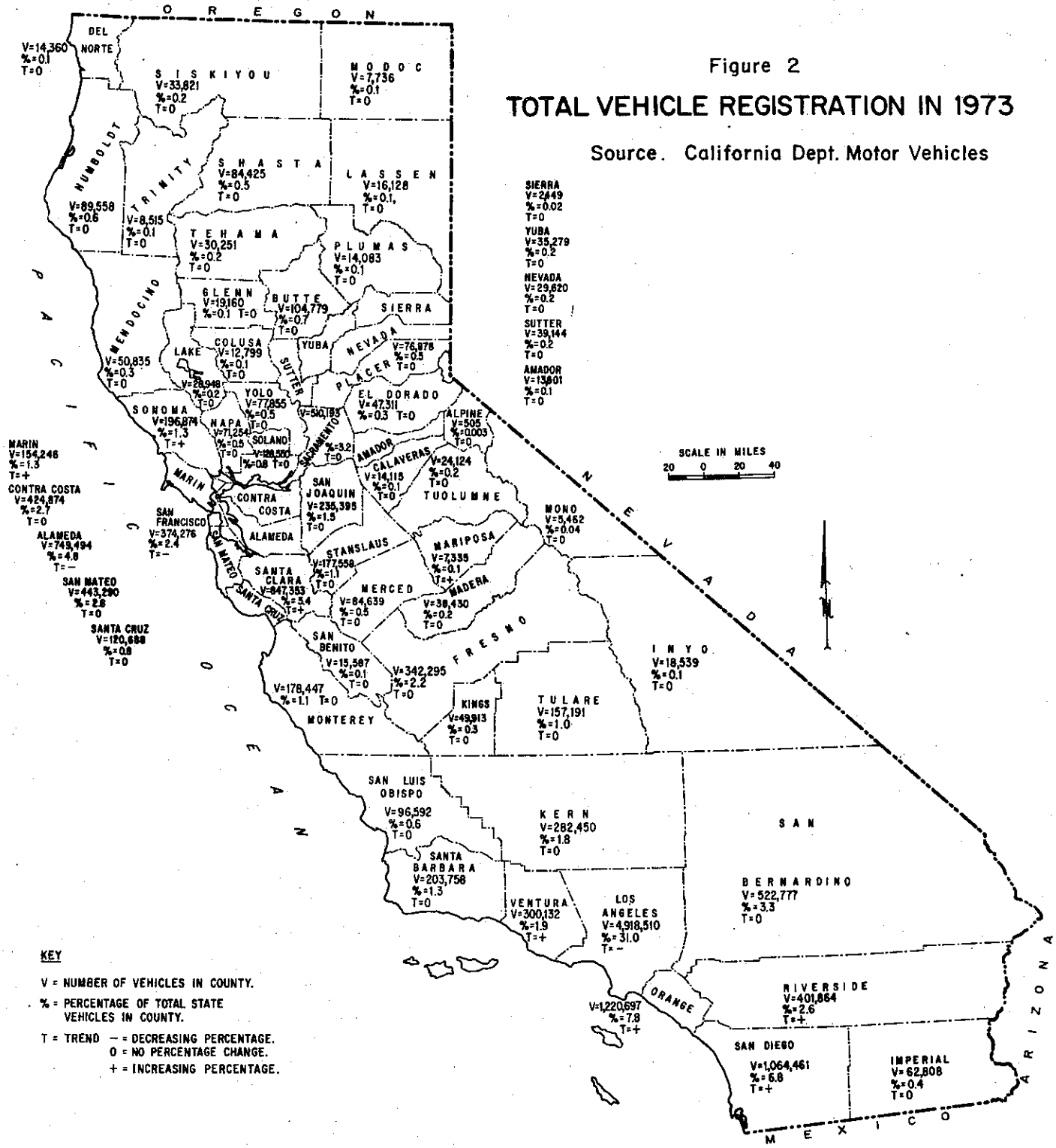
Figure 2

TOTAL VEHICLE REGISTRATION IN 1973

Source. California Dept. Motor Vehicles



KEY

V = NUMBER OF VEHICLES IN COUNTY.

% = PERCENTAGE OF TOTAL STATE VEHICLES IN COUNTY.

T = TREND − = DECREASING PERCENTAGE.
0 = NO PERCENTAGE CHANGE.
+ = INCREASING PERCENTAGE.

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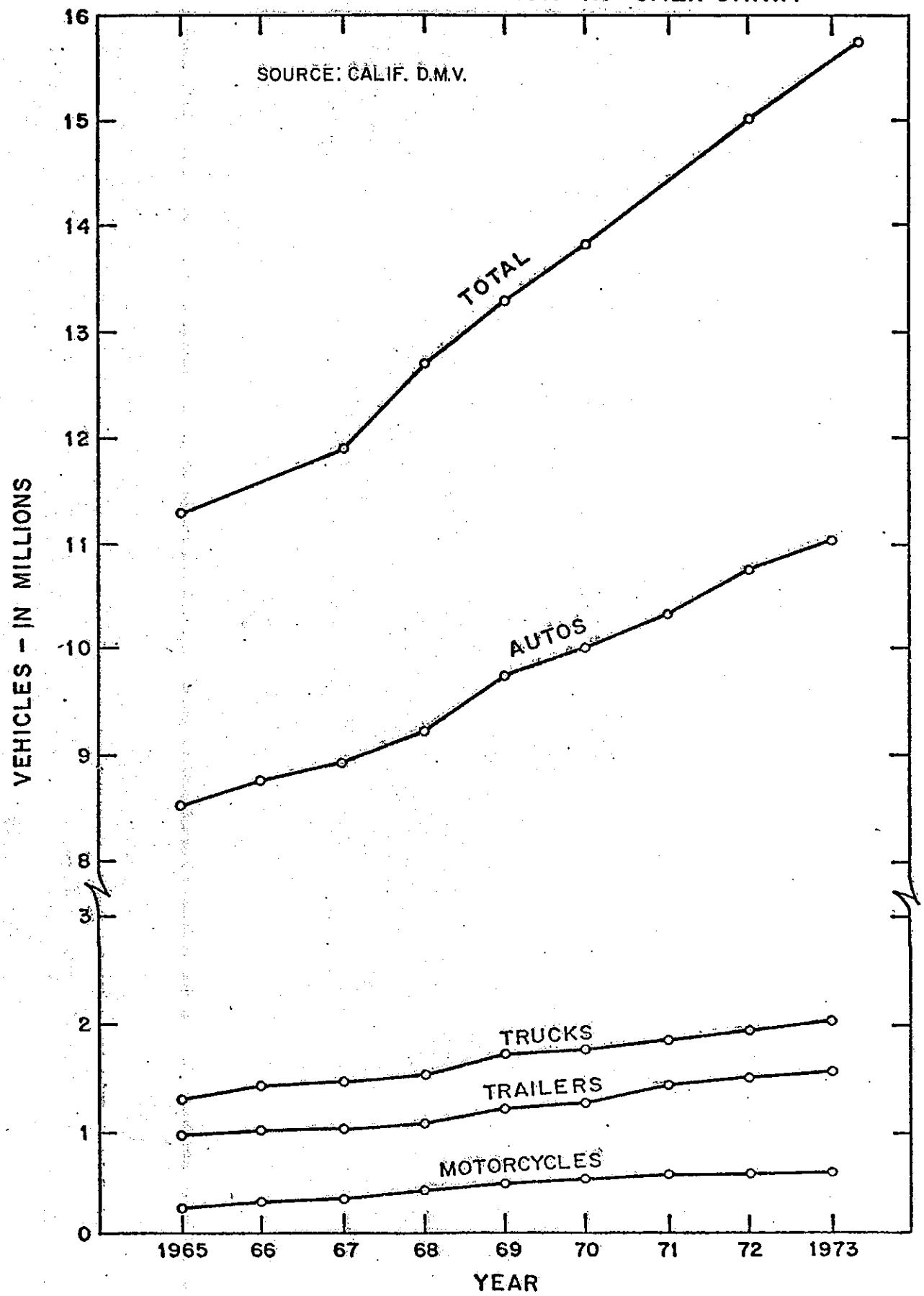
Figure 3

VEHICLE REGISTRATION IN CALIFORNIA



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Investigation by Sacramento County revealed that tires were hauled to the County dump from as far away as Salt Lake City and Seattle. About 30 tons of tires per day were entering the dump and creating a disposal problem. However, after raising the disposal fee from $5 to $20 per ton, the quantity of tires was reduced by 75% and the disposal problem alleviated.

Other disposal site operators noted similar problems, involving the importing of tires from another county. Again, the problem was alleviated by raising the disposal fees. Although raising the disposal fees initially alleviates the problem, it also creates other problems such as the dumping of tires along roadsides or in vacant lots.

While rubber companies are looking for various ways to recycle tires, one of the critical problems is the economics of collecting and transporting the tires. Typical collection costs run from $9.00 to $26.00 per ton(1).

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FINDINGS

The problem with disposing of whole used tire carcasses in dumps or land-fills stems from their tendency to float to the surface. Compaction is very difficult to obtain as air voids are created within the tire after it is buried. Chopped or split tires do not have this problem.

Abandonment of used tires along local roads or highways is very localized and at present, is not a serious problem. A non-refundable return tax on used tires, excessive dump fees, or other charges to consumers for disposing of used tires will probably result in a substantial problem of tire abandonment along roadways, fields, or rural areas.

Fire hazards associated with stacked used tires is a localized problem. Surveillance by local fire officials has kept this problem well in hand. Tire burning normally requires intense heat which generally means that the burning of tires must begin with some other burning mechanism before combustion of the tire takes place.

Mosquito breeding in water trapped by tire carcasses stored outside is a problem during certain times of the year. Control of this problem could be handled through insecticides or requirements for covering stacked tires.

Several processes for utilizing the potential energy source within the tire are being developed. These processes are primarily combustion oriented whereby the resultant heat is converted to another energy form such as steam to drive a generator for electric power production. The report discusses these processes in greater detail in the following sections.

Retreading is a good way to recycle tires although the trend has been downward in recent years. Various method for increasing the "retread" market are presented in the report.

Other uses for abandoned tires, as well as other potential programs for alleviating the problem, are discussed in the report.

The tire manufacturing industry is expending considerable funds and effort toward solving the used tire problem. The Rubber Manufacturer's Association industry-wide Environment Committee is developing programs, pooling industry knowledge and creating technical information resources to solve the environmental problems involved with used tires(2). It appears that this major effort will soon help to alleviate the problem.

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The solution to the used tire problem which considers the tire as a potential energy source may have considerable merit in view of the current energy crisis. Tires have 50% more BTU content than coal. If all the tires scrapped annually in the United States were converted into energy, the output would take care of the annual electrical needs of a city the size of San Francisco.

Three energy recovery systems that appear to have merit include the Lucas Furnace, the CPU-400 and the Molten Salt Process. Several Lucas Cyclonic Furnaces have been in operation for about five years in Europe, and one has been operating in the United States since May 1974. Since the system will consume whole tires, the expense and energy required to shred the tires is eliminated.

For each of the energy recovery methods, the logistics and energy expense involved in collecting and transporting the tires could be somewhat alleviated by installing the fuel energy conversion plants at tire manufacturing or retreading plants where the existing distribution systems can be utilized. It has been suggested that a refundable deposit in the form of a "tire disposal tax" on each new tire sold would guarantee a supply of tire for fuel at the installations.

At present the largest single recycler of used tires is the tire retreading industry. Representatives of the industry believe that reasonable, workable standards for the industry could lead to increased usage of retreads by improved quality, and better acceptance by the public through improved reliability. However, in terms of percent of new tires recycled, passenger retread tires have dropped from 25% in 1963 to 17% in 1968. Truck tire recycling has dropped from 32% to 28%.

The trend for recycling or reuse of rubber waste products is downward. As a percent of new rubber produced, reclaiming has declined from 19% in 1958 to 10% in 1968, mainly due to cost, quality, or aesthetic reasons. Economic factors forced the shutdown of the Firestone Rubber Co. reclaiming plant in Los Angeles.

Although disposal of used tires in sanitary landfills does not pose a major problem at the present time, this process is a waste of a valuable energy resource. Long-range plans could be developed to discourage the disposal of tires by this method as soon as more desirable, alternate solutions become operational.

The newly developed radial and steel-belted tires have tended to pose problems in recycling and disposal. These tires are difficult to retread, and to shred. However, these difficulties may be counterbalanced by their longer mileage performance.

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The use of tires in the construction of artificial reefs for improvement of fisheries presents a good solution for the use of substantial quantities of tires for a limited duration. The California Department of Fish and Game has successfully constructed tire reefs at various coastal and inland water locations throughout the State since 1968.

In general, the use of tires or tire by-products in the construction of earth embankments also presents a limited duration solution to the used tire problem. With the completion of the interstate highway construction program, the potential use of used tires in highway construction will diminish substantially.

A summary of several major solutions or potential solutions to the used tire problem is presented in Table A. An assessment of the current status, feasibility, percent of market, and energy required of each system is provided.

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TABLE A: Major Solutions to the Used Tire Problem

Disposal or Recycle Method	Assessment: Current Status	Feasibility: Technical	Feasibility: Economic	Probable Percentage of Used Tires Utilized	Energy Required
Fuel Energy					
Lucas Furnace	Operational	Good	Good	100%	Generate
CPU-400	Research & Development	Good	Unknown	100%	Energy
Molten Salt Process	" " "	Good	"	100%	"
Retreading	Operational	Good	Good	(20%) but ultimately all these tires will require disposal.	Saves Energy
Reclaiming	Operational	Good	Borderline	10%	Major
Sanitary Landfill	Operational	Good	Good in most areas of the State.	100%-whole or shredded	Minor
Artificial Reefs	Operational	Good	Good	Substantial, but only for a limited duration.	Minor
Destructive Distillation	Research & Development	Good	Poor	100%	Major
Construction					
Joint Sealers	Operational	Good	Good	Minor	Major
Seal Coast	"	"	"	"	"
Asphaltic Concretes	Research & Development	Borderline	Poor	60%	"
Stress Relieving Interlayer	" " "	Good	Good	Minor	"
Embankment Stabilization	Research	"	Unknown	Minor & for limited duration.	Minor
Vehicle Impact Attenuators	"	"	"	" " "	"

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SUGGESTED SOLUTIONS

Solutions to the abandoned tire problem can be divided into three parts: (1) Collection, and then either (2) Disposal, or (3) Recycling.

(1) The collection of abandoned tires and the development of a dependable centralized source of supply of used tires is one of the major problems facing the economic utilization of the product. One suggested solution to this problem is to provide a "tire disposal tax". The tax can act as an incentive to guarantee the delivery of the tires to a central location where a refund would be paid to the individual delivering the tires. This central agency would have to classify the used tire according to its most benficial future use. This system would be best on a nationwide basis.

(2) Tires to be disposed could be handled in at least two ways:

(a) Disposed in sanitary landfills.

(b) Utilized in an energy producing system. Some systems are now in existence but further research and development is needed in this field.

(3) Recycling - Used tires may be recycled by retreading, manufacture of by-products, used in construction or reclaimed. Various methods are described in the text.

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DISCUSSION

A review of literature pertaining to various aspects of the used tire problem and solutions was performed. Sources of information included: Highway Research Information Service (HRIS); National Technical Information Service (NTIS); and the University of California and California State University System libraries which utilizes the resources of the California State Library.

Discussions with interested public agencies for input to possible solutions and problems were conducted. A summary of the responses from these agencies is included in Appendix B, while correspondence from public agencies is attached in Appendix D.

Information derived from the literature search and public agencies was used in discussions with members of the private sector such as waste disposal companies, sanitary landfill operators, and companies that had developed, or were in the process of developing, new methods for recycling used tires. A summary of the responses from private organizations is included in Appendix A, while correspondence from private firms is attached in Appendix C. Input from disposal site operators is summarized in Appendix E.

Information derived from all sources is discussed below under five major categories: Sources and Consumers, Disposal, Recycling, Miscellaneous Applications and other potential programs.

A. Sources and Consumers

In 1971 an extensive report on the solid wastes, generated by the operations of the fabricated rubber products industry, was prepared by Uniroyal Chemical under contract PH 86-68-208 with the U. S. Environmental Protection Agency(3). The distribution of consumer rubber products by States is tabulated in Table B and indicates that California generates almost 10% of the rubber wastes (and used tires) in the United States. The area distribution is illustrated on Figure 4.

Three major industries consume significant quantities of waste rubber products. Retreaders, the largest of the three, extend the useful life of worn tires by placing new tread on the old carcass. The second largest, the Reclaimers, convert the rubber into a reusable form. The third, the tire splitters, cut out rubber parts from the carcass and tread areas of used tires. The destination of used rubber tires in the United States is illustrated on Figure 5 and indicates that about 70% of used tires end up at disposal sites.

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TABLE B

DISTRIBUTION OF CONSUMER RUBBER PRODUCT WASTE BY STATES

STATE	TIRES*	OTHER	TOTAL
	(thousand pounds)		
Alabama	98,060	77,790	175,850
Alaska	6,600	5,390	11,990
Arizona	71,960	30,770	102,730
Arkansas	72,850	42,300	115,150
California	598,730	374,410	973,140
Colorado	100,860	41,460	142,320
Connecticut	76,670	60,260	136,930
Delaware	15,210	10,690	25,900
Florida	194,640	118,000	312,640
Georgia	126,020	94,030	220,050
Hawaii	12,760	15,000	27,760
Idaho	29,730	15,810	45,540
Illinois	289,330	240,200	529,530
Indiana	163,220	111,130	274,350
Iowa	130,990	65,820	196,810
Kansas	90,570	51,720	142,290
Kentucky	90,780	72,230	163,010
Louisiana	116,670	77,360	194,030
Maine	30,650	23,080	53,730
Maryland	95,670	73,940	169,610
Massachusetts	123,740	122,670	246,410
Michigan	239,360	186,350	425,710
Minnesota	133,070	81,200	214,270
Mississippi	69,800	51,720	121,520
Missouri	194,830	103,000	297,830
Montana	37,020	16,240	53,260
Nebraska	73,000	33,760	106,760
Nevada	19,650	7,000	26,650
New Hampshire	19,000	14,530	33,530
New Jersey	181,940	114,460	326,400
New Mexico	37,960	22,650	60,610
New York	370,520	400,050	770,570
North Carolina	133,900	108,560	242,460
North Dakota	29,260	15,000	44,260
Ohio	328,370	231,230	559,600
Oklahoma	100,720	55,140	155,860
Oregon	85,430	41,890	127,320
Pennsylvania	330,710	269,700	600,410
Rhode Island	23,350	20,520	43,870
South Carolina	56,650	56,850	113,500
South Dakota	32,390	16,240	48,630
Tennessee	124,000	85,050	209,050
Texas	380,010	228,240	608,250
Utah	42,500	20,940	63,440
Vermont	11,230	9,000	20,230
Virginia	117,470	94,460	211,930
Washington	105,290	68,000	173,290
West Virginia	48,800	44,020	92,820
Wisconsin	111,770	94,030	205,800
Wyoming	16,850	7,700	24,550
Washington, D.C.	28,400	18,380	46,780
Total	6,018,960	4,269,970	10,288,930
Percent	59%	41%	100%

The weight of rubber "lost" through tire wear has been deducted from these figures.

*Passenger, Truck and Large Tractor.

Source: Reference No. 3

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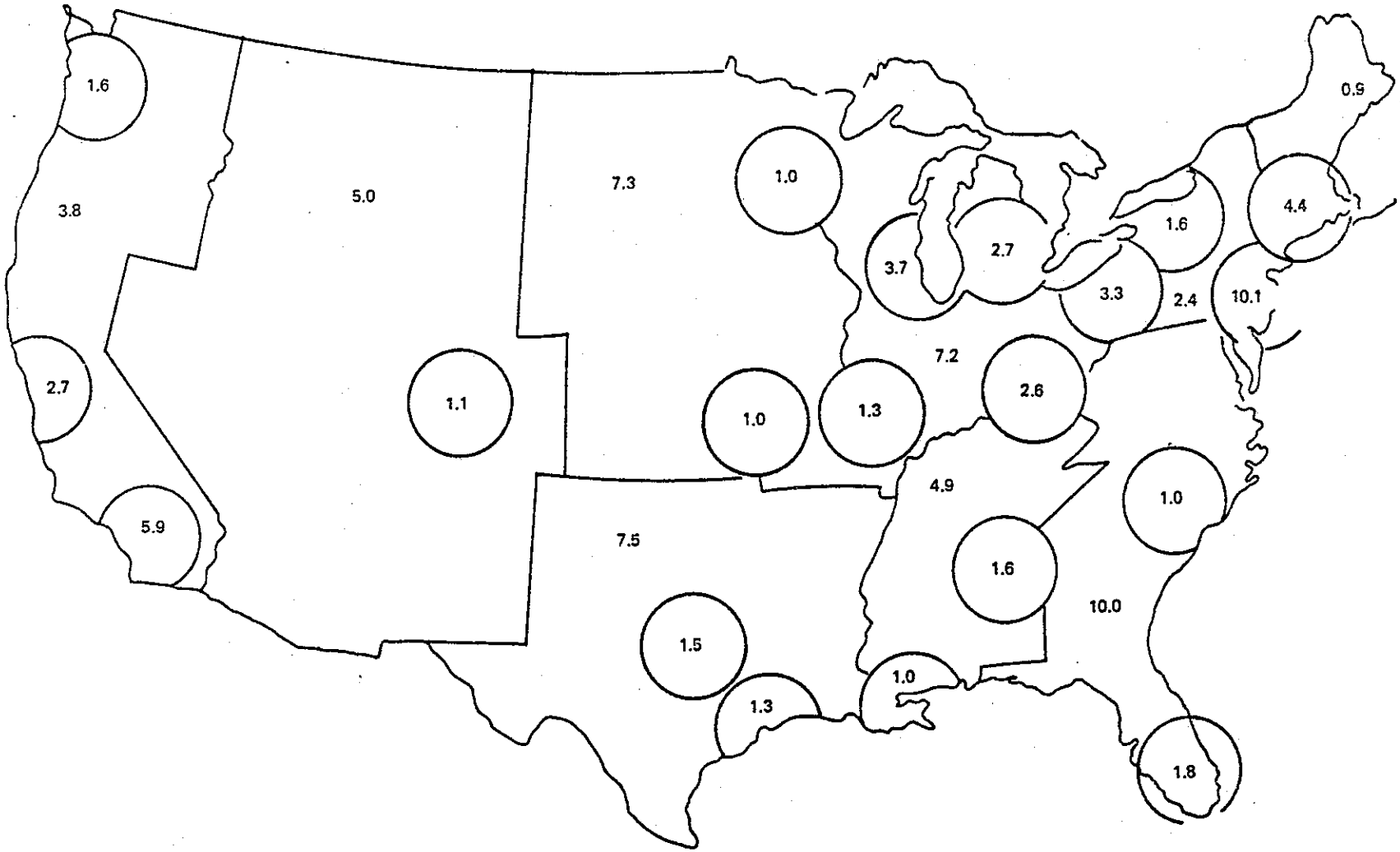

FIGURE 4: GEOGRAPHICAL PERCENT DISTRIBUTION OF WASTE RUBBER

The number indicates the percent of the nation's waste rubber located within the circle. The remaining numbers indicate the percent waste rubber located outside the circles but within the bordered areas.

Source: Reference No. 3

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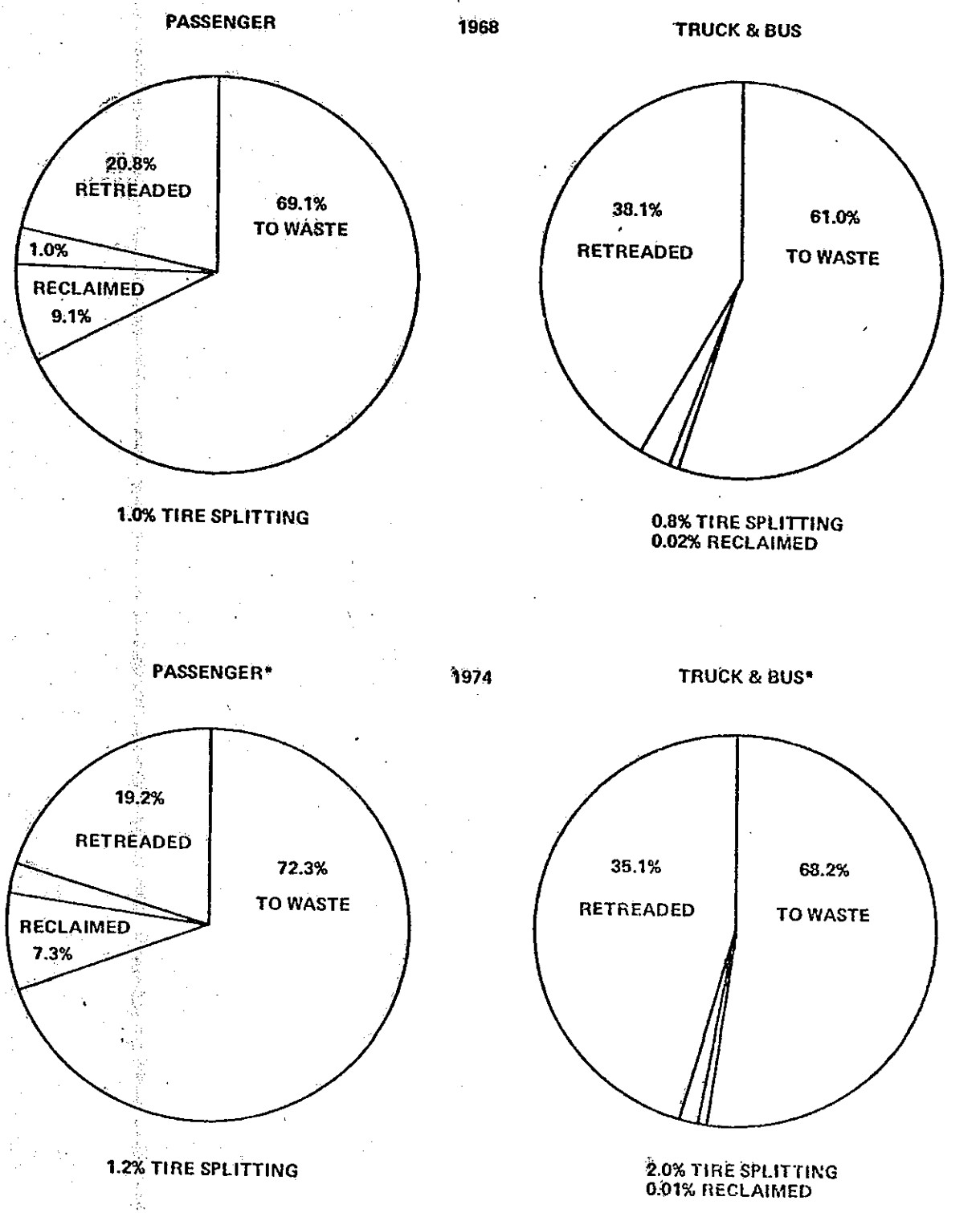
FIGURE 5: DISCARDED TIRE DESTINATION



*Based on the production of 220 million passenger tires

*Based on the production of 32.5 million truck tires.

Source: Reference No. 3

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A study by the Rubber Manufacturers Association revealed that Los Angeles is the second largest regional source of used tires while San Francisco is the third largest source in the United States(4). The scrap tire regional source distribution is tabulated below:

SCRAP TIRE REGIONAL SOURCE DISTRIBUTION

REGION 1 (W)		REGION 2 (NC)		REGION 3 (NE)		REGION 4 (SE)		REGION 5 (SC)	
RAILHEAD	TONS PER YR	RAILHEAD	TONS PER YR.	RAILHEAD	TONS PER YR.	RAILHEAD	TONS PER YR.	RAILHEAD	TONS PER YR
LOS ANGELES	115,000	BILLINGS	13,000	BOSTON	75,000	ATLANTA	44,000	ALBUQUERQUE	12,500
PORTLAND	26,000	CHICAGO	87,500	BUFFALO	46,500	BALTIMORE	34,000	AMARILLO	5,000
SAN FRANCISCO	90,000	DES MOINES	38,000	CINCINNATI	62,500	BIRMINGHAM	16,000	DALLAS	35,500
SEATTLE	31,000	DULUTH	22,500	CLEVELAND	58,500	COLUMBIA	40,500	DENVER	35,500
SPOKANE	10,000	FARGO	13,500	DETROIT	77,000	JACKSONVILLE	34,500	EL PASO	11,000
		INDIANAPOLIS	52,500	NEW YORK	162,500	KNOXVILLE	9,500	HOUSTON	48,000
		OMAHA	27,000	PHILADELPHIA	88,000	LOUISVILLE	28,000	KANSAS CITY	38,000
		ST. PAUL	39,000	PITTSBURGH	48,000	MEMPHIS	39,000	NEW ORLEANS	57,000
						MIAMI	17,000	OKLAHOMA CITY	31,500
						MOBILE	33,000	ST. LOUIS	50,000
						NASHVILLE	12,000	SALT LAKE CITY	17,500
						RICHMOND	46,000	SAN ANTONIO	23,500
						WASHINGTON	33,500	TUCSON	27,500
								WICHITA	14,500
TOTAL	272,000	-	293,000		618,000		387,000		406,500

Source: Reference No. 4

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B. Disposal

A survey of disposal site operators throughout the State was conducted and is summarized in Appendix E. Responses indicated a wide range of policies and disposal fees for tire disposal.

About 30% of the disposal sites indicated problems with tire disposal. The most prevalent problem was the difficulty involved in compacting the tires into the fill. Several of the sites reported that they were stockpiling the tires in anticipation of the development of a recycling method that would allow the tires to be used or sold as a resource.

Several disposal sites do not accept whole tires while others accept them on a limited basis. The process of shredding or cutting the tires in half usually eliminates the disposal problem and disposal sites can accept and handle these "processed" tires in the same manner as general refuse.

Disposal fees varied from no charge for local residents at small rural sites to $25 per ton. Several disposal sites raised their disposal fees to reduce the inflow of tires from other counties or states. Other sites charge substantially higher fees for tire disposal (relative to general refuse fees) to offset the operation costs involved in handling and compacting the tires into the sanitary landfill area.

Most of the disposal sites that were surveyed reported no problems with tire disposal and did not anticipate future problems. One of the rural sites operators noted that tires and general refuse are burned at the present time, although this procedure will be revised in the future and tire disposal may pose a problem at that time.

Two of the largest waste disposal site operators in the State indicated that tire disposal has not presented a problem in their operations mainly because the quantities of tires were small relative to the total waste quantities, and because the tires were usually buried at the bottom of the fills. The Los Angeles County Sanitation District reported that an average of about 65 tons of tires are disposed of each day in Los Angeles County while the total quantity of refuse disposed of is about 30,000 tons per day. In the San Francisco Bay area, Easley and Brassy Corp. reported that they received between 15 to 25 tons of tires a week as compared to 10,000 tons of waste a week. In both cases the tires represented about 0.2% of the total quantity of waste.

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C. Recycling

Information on recycling is summarized under four major categories: Retreading, Fuel-energy, Reclaiming, and Raw Materials.

(1) Retreading

At present the largest single recycler of used tires is the tire retreading industry. Representatives of the industry believe that reasonable, workable standards for the industry could lead to increased usage of retreads by improved quality and better acceptance by the public through improved reliability. However, in terms of percent of new tires recycled, passenger retread tires have dropped from 25% in 1963 to 17% in 1968. Truck tire retreading has dropped from 32% to 28%.

Representatives of the retreading industry acknowledged the fact that minimal effort has been expended in advertising their product. It is anticipated that advertising will be increased to educate the public on the important contribution that the retreading industry can make to the environmental and energy crises.

The following information concerning retreading was taken from a publication published by the Voit Rubber Company and is shown here without comment.

(a) It takes about five gallons of oil to produce one new tire while it takes less than two gallons of oil to recycle a used tire so that its tread is renewed.

(b) If 60% of the spare tires on new cars were retreads in 1974, the nation could save over 24,000,000 gallons of crude oil.

(c) If the nation's retreaders went to three shifts, and could find sufficient retreadable casings, they could produce an additional 25,000,000 passenger retread units which would result in a savings of 125,000,000 gallons of crude oil per year.

(d) If the nation's retreaders could produce and sell 1,000,000 more truck retreads instead of new truck tires, the nation could save 21,000,000 gallons of crude oil per year.

(e) Standardization of tire sizes would increase the number of "retreadable" tires since at the present tires of the same size produced from competitive firms do not all fit the same "tire mold" for retreads.

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Retreading offers a partial solution to reducing tire costs, alleviates the used tire problem by extending the life of a used tire, and makes a major contribution to saving oil.

(2) Fuel-energy

Rubber tires have about 50 percent more BTU content than high-grade coal. If the 200 million tires scrapped annually in the United States were converted into energy, the output would take care of the annual electrical needs of a city the size of San Francisco(5). However the scattered distribution of the tires across the nation would present a problem in accumulating the fuel source at one location. For example, the conversion of the annual discarded tires in New York City would supply the energy needs of a city of 15,000. The utilization of used rubber tires as a fuel energy source, would help to accommodate the Federal "Project Independence" - a drive to make the United States self-sufficient in energy by 1980(6).

The Fluor-Utah Company has installed a Lucas Cyclonic Furnace at a Goodyear Tire Plant in Jackson, Michigan which incinerates about 3,000 tires per day while generating 30,000 pounds of steam per hour for use in curing the manufacture of new tires. Preliminary results suggest that this system may create a revolution in tire disposal and may provide one of the most significant contributions to the used tire disposal problem.

The furnace operates on a rotating hearth principle. The incoming material is fed to the outer edge of the hearth, and from there it travels in a spiral towards the center. The diameter of the hearth plus the speed of input and speed of rotation can all be varied so that by the time the material reaches the center it has been completely incinerated. The solid waste products of combustion (the ash) then fall through a central aperture into a water seal through which they are mechanically removed for final disposal.

The furnace hearth operates at a temperature of 800-1000° C and combustion is complete. The gases from the combustion move above the hearth in a cyclonic pattern which automatically aids complete combustion and eliminates emission of particles from the furnace outlet. From this point, the hot gases may pass through a cooling unit or a boiler or other form of heat exchanger before being emitted from the chimney stack.

The important aspect of the plant, apart from the cleanliness of the gas product, is the fact that there are no moving parts inside the furnace beyond the relatively simple rotating hearth mechanism (the drive for which is outside the furnace itself). Both input and output of the overall control system bring to incineration a high level of technology and sophistication.

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A system presently under development by the Combustion Power Co., under contract with the United States Environmental Protection Agency, appears to have the potential for providing a solution to the overall solid waste disposal problem. Called the "CPU-400 system", it recycles solid waste, including tires, into electrical energy through carefully controlled combustion and use of the gas turbine cycle(7). Waste materials fed into the combustor must be in a form of small particles. Recovery of steel, aluminum, other metals, glass, sand and fly ash is a secondary benefit.

Atomics International (AI) is developing a Molten Salt Combustion Process which appears to be effective in the disposal of rubber products and other solid wastes. Bench scale laboratory tests of this system have been completed, and a large scale pilot plant has been built for further development tests.

In the Atomics International concept, the carbonaceous material and primary air are fed into a molten salt furnace containing sodium carbonate and a dissolved sulfur-containing catalyst at 1800°F. The sodium carbonate serves as a heat transfer medium for the combustion and also as a neutralizing agent for any acidic gaseous combustion products. The shredded waste materials and air are fed below the surface of the salt, so that all the gases formed during combustion are forced to pass through the melt before being emitted into the atmosphere.

A field review of the AI facilities and plant operation was conducted. The Molten Salt Combustion Process appears to offer a potentially viable solution to the abandoned tire problems. The performance results of large scale pilot plant tests should provide valuable data in this respect.

In reference to destruction of tire carcasses by burning processes, all air pollution emissions standards of the county where this operation is to take place would have to be met. This would involve applying for and being granted by the county a "permit to construct" a new stationary source of air pollution. During this "permit to construct" process, the operator must submit a full set of air pollution control plans. The county will then review these plans to ensure their technical feasibility. Once this permit is granted and the plant is constructed, the operator must apply for a "permit to operate" the plant. Before this permit can be granted, an onsite review of the plant will be made to ensure the air pollution control devices were properly constructed and installed. Also, being that this would be a new type of air pollution source, the county may require periodic source testing to make sure all the air pollution standards are being met.

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Currently, there are at least two possible methods of controlling the air pollution emissions from a source of this type. One method would be to eliminate the emissions at the source. This could be accomplished by the installation of a high temperature burning chamber. This chamber would probably need some type of support fuel to maintain the high temperature required to totally consume the tires. The second method would be to remove the emissions after they have formed. To do this, a scrubbing device would have to be placed on the exhaust stack. This would remove the particulate and some of the gaseous emissions. A flare may also be needed to remove the remaining gases and any objectional odors that may pass through the scrubber.

(3) Reclaiming

The trend for reclaiming of rubber waste products is downward. As a percent of new rubber produced, reclaiming has declined from 19% in 1958 to 10% in 1968, mainly due to cost, quality, or aesthetic reasons. Economic factors forced the shutdown of a reclaiming plant in California, which had been operated by Firestone Rubber Co. at Los Angeles. The Atlos Rubber Co. operates a reclaim plant in Los Angeles producing granulated rubber for use in rubberized pavement surfacings. At present, the primary material source for Atlos is tire buffings from retread plants, although future plans project the use of whole tires.

The U.S. Rubber Reclaiming Co. has been engaged in the reclamation of waste rubber since 1883 and is a leader in developing new processes and equipment. Some of the available reclaimed rubber products produced from scrap tires include powdered devulcanized reclaimed rubber for use in sealing pavement cracks and joints, chip seal binder, bridge deck waterproofing, asphaltic concrete additive and athletic facility surfacing. These products are described in Appendix A. Another widely used product, called SRI (Stress Relieving Interface), is an asphaltic composition of approximately equal parts by volume of a vulcanized rubber aggregate (derived from ground scrap tires), mineral aggregate, and an asphalt binder. It is applied as a thin membrane over pavement surfaces prone to cracking, and forms a waterproof strain absorbing interface that is said to prevent base cracks from reflecting through to the surface of an asphalt concrete overlay.

An experimental SRI project was installed by the city of College Station, Texas in 1971(8). A mixture of rubber aggregate, soil or sand, and asphalt was placed in a 1/2 inch thickness or less

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between the roadway base surface and foundation course. On a volume basis, the mix consisted of 35% of finely graded siliceous sand, 35% graded rubber (1/8" top size) and 30% cationic emulsion (Grade CSS - 1h). The application cost was 51 cents per square yard. City Engineer Lloyd L. James noted that the successful results of the application indicated that the SRI might be economically applied on a large scale basis and prompted enthusiasm for continued tests, particularly with respect to concrete streets(9).

The Transportation Laboratory of Caltrans is presently investigating and evaluating the use of the SRI and rubberized chip seals in California. The SRI was placed on an existing roadway near Susanville with a conventional slurry seal machine. It was cold laid prior to placing an asphalt concrete overlay. Jobsite inspection of the project shows that SRI is performing better than an emulsion slurry seal on control areas.

In Ventura County hot-applied rubberized chip seals were placed on several county roads. The hot asphalt-rubber mix is applied through a modified asphalt distributor tank truck with rock chips applied and rolled in place close behind the distributor. Performance to date indicates that considerable raveling has taken place in some of the areas and in some locations the rubber chip seal coat that was placed late last summer has been overlaid with a conventional asphalt concrete dense graded mix.

Since 1968 the New York Department of Transportation has used over one million pounds of reclaimed, devulcanized rubber, the equivalent of 50,000 tires, as a sealer for joints and cracks on the Dewey Thruway(10). Cost savings resulted when the rubber sealer lasted up to three times as long as conventional asphalt sealers. The N.Y. D.O.T. Transportation Commissioner Raymond T. Schuler stated that the D.O.T. was very pleased to be able, in one stroke, to help rid the landscape of used tires, save public funds on highway maintenance, and utilize an improved product(11).

The City of Phoenix, Arizona began experimenting with reclaimed hot rubber-asphalt seal coats to cure cracking streets in 1963 and has since implemented the procedure on a large scale(12). The process involves the mixing of ground tire tread rubber, #16 to #25 mesh, produced by Atlos Rubber Company of Los Angeles, with 120-150 penetration grade asphalt heated to a temperature of between 350°F and 400°F(13). The mixture consists of 75% asphalt and 25% rubber and is applied to the pavement surface under pressure with an asphalt distributor modified with mixing devices to blend the asphalt, rubber and kerosene. A large contract in the summer of 1971, which included some 208,000 square yards of major streets and airport apron work, was accomplished at a cost of about 52 cents per square yard, excluding preparatory work and cleanup work.

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Caltrans conducted an experiment in the field using reclaimed powdered rubber in bituminous plant-mix surfacing in 1951(14). The powdered rubber, furnished by the Firestone Rubber Company, was added at the rate of 5% to 7% by weight of the asphalt. The report concluded that it was doubtful if the extra cost of adding the rubber could be justified by the beneficial effects of the treatment.

In December 1971, Douglas Bynum, Jr. reported that new test techniques indicate that low-cost, high-grade road pavements can be developed using reclaimed solid waste generated from rubber tires and added to asphaltic concretes(15). He noted that although controversy continues over how, or to what extent, rubber additives improve asphaltic concrete, some new types of tests show very positive improvements. A part of the problem in evaluating rubberized roads has been that many variables must be considered and funds to evaluate all variables are seldom available.

In March 1973, it was reported that both laboratory and field testing of asphalt-rubber mixtures have yielded favorable results(16). All major tire manufacturers were experimenting with rubber in road pavement, and the University of Connecticut received a grant from the Rubber Reclaimers Association (RRA) to further test this use. It was noted that if 1 to 2% reclaimed rubber in roadbeds became common practice, 60% of the nation's waste tires could be utilized each year. The Rubber Reclaimers Association is seeking Federal Environmental Protection Agency and Federal Highway Administration approval for the use of reclaimed rubber in asphalt concrete surfacing on federally financed projects.

(4) Raw Materials

There are several processes under research and development to convert used tires into usable raw materials. Although the technical feasibility of some of the techniques has been demonstrated, it may take many years to make them commercially feasible in this country. However, in view of today's energy crisis and the skyrocketing prices of raw materials, this situation may change.

In 1962 the Palma Rubber Factory of Hungary developed a process to break down tires and sort them into rubber granulate and usable textile material(17). The system proved so successful in its yields of industrial raw material that in 1964, the Hungarian industry set up in full production. The process involves several operations: 1. debeading, 2. chopping, 3. grinding and textile separation.

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Due to the fineness and special structure, the granulate lends itself well to the production of high-grade rubber bitumens which have, in Hungary, found an outlet in the rubber and oil industries. The textile threads are used as loose felting, sound and insulation board.

Firestone Rubber Co. has been active in research and development on the Destructive Distillation Process since 1968. The process has been demonstrated to be technically feasible but the cost is high and the products need further refinement. The destructive distillation of scrap tires gives three primary crude products: char, oil, and hydrocarbon gas rich in hydrogen. The major product is solid carbonaceous residue which could be used in applications such as filter char, particulate in concrete or asphalt, or as smokeless fuels. The liquid (oils) and gaseous products can be used as fuels. Firestone is continuing to work on this process but it may take years to perfect it and make it commercially feasible.

The approach of producing carbon black from used tires comes closest to true recycling since carbon black is an essential ingredient in the production of new tires. Again, however, economic problems must be overcome before this process is practical.

D. Miscellaneous Applications

There are a multitude of miscellaneous applications for used tires that are in various stages of development. The applications fall into two basic categories: those that utilize whole tires, and those that require processing of the tires.

(1) Whole Tires

(a) Artificial Reefs

During the last 15 years, biologists have conducted studies of various materials and techniques that can be used to build artificial reefs and the resulting effects of the reefs on fish populations. The utilization of used tires for this purpose has proven effective and successful in many cases. The Coastal Plains Center for Marine Development Services published a bibliography of literature and studies related to artificial reefs which provided an excellent starting point to obtain information in this area(18).

The first attempt to build an artificial reef from used tires on the West Coast was initiated by the Eureka Kiwanis Club and the California Department of Fish and Game in the South Humboldt

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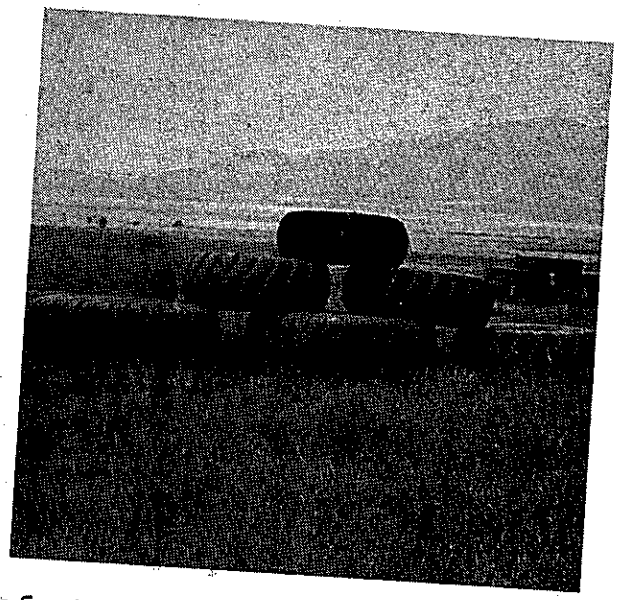
Bay(19). The reef consisted of 800 used truck tires. The first use of an artificial reef underneath a pier on the West Coast was at Santa Cruz. If this use proves successful, it could represent a new method to improve pier fishing in California and also help to alleviate the used tire problem.

To enhance Lake Perris fishing, the Wildlife Conservation Board, Riverside Fish and Game Commission, Department of Fish and Game and Perris Dam Constructors cooperated in building a large artificial reef with 350 used heavy construction equipment tires(20). The Department of Fish and Game will plant fish in Perris Lake and designate the tire reef area as a wildlife enhancement area.



Tire reef at Perris Lake before completion of the Dam (in background) and inundation of the area.

As a result of the recent development in reef construction and an increasing awareness of the need for habitat improvement, most coastal states have at least one artificial reef in their offshore waters. There are more than 100 artificial reefs on the east coast of the United States(21). Goodyear Tire Co. is studying the use of 1.5 billion used tires to turn offshore sand flats in the Atlantic Ocean into highly desirable fishing reefs(22). At one reef site off New Jersey as many as 72 million tires could be utilized.

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Conflicts between sport and commercial fishing groups have developed over the construction of artificial reefs in some areas(23). A few commercial shrimp trawlers have damaged their nets and protests have halted plans for construction of one artificial reef by the Georgia Game and Fish Commission. Investigations indicated that in some cases the problems with commercial net damage was due to improperly constructed reef units involving tires connected together with steel rods. Modifications and recent developments in artificial reef technology should serve to overcome these problems.

The U. S. Environmental Protection Agency is conducting an extensive investigation on the utilization of used tires as artificial reefs(24). The study will determine:

1. where and how many used tires may be used for artificial reefs

2. the costs of building such reefs

3. the number of reefs that may be established

4. suitable designs

5. the geophysical environs and depths of water most adaptable to establishing artificial reefs.

It has been determined that the average cost per tire installed in reefs has been 44¢ but it is expected to drop.

(b) Erosion Control

The utilization of used tires by the Department of Parks and Recreation for erosion control in the San Diego area was investigated. Tires were used to control localized erosion along the slope facing the Pacific Ocean at San Elijo Beach south of Encinitas. The installation consisted of notching steps into the slope starting from the bottom of the eroded area. Rows of tires were then laid flat, tied together with wire, and anchored with stakes and by filling in the voids in and between the tires. This process was repeated up the slope, with each row overlapping the other. Vegetation was then planted to obscure the tires from view. The tires were effective in controlling erosion at this location. However, the vegetation was sparse and did not cover the tires, leaving a negative visual impact.

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Tires for Slope erosion control at San Elijo Beach.

The usage of tires to control bank erosion along a section of beach at the Salton Sea proved to be totally ineffective, mainly due to the negative visual impact. The tires will be removed at this location and replaced with riprap.

(c) Vehicle Impact Attenuators

The concept of used tires as safety buffers originated in 1970 and a series of field tests have been carried out(25). In one test an assembly of vertically positioned tires, 7-1/2 feet wide and 4-1/2 feet high, were secured together and anchored to the ground by two steel cables tautly strung through the bottom rows. An automobile sustained only slight fender and grill damage when it hit the barrier at 40 mph and at 50 mph. Cars hurtling at speeds close to 60 mph have collided into these cushioning devices head-on and have been absorbed much like a finger being jabbed into a stale marshmallow. A report by the Texas Transportation Institute concluded that it was both technically and economically feasible to use scrap tires as vehicle impact attenuators(26).

(d) Segmented Circle Airport Marker System

The Department of Aeronautics has developed a new use for used tires in the operation of small airports. The tires are used

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to construct segmented circle airport marker systems. Each system requires about 200 tires and provides a small contribution to the solution of the abandoned tire problem.

(e) Toys

Many enterprising companies and individuals are developing uses for used tires as toys. One group has developed the bouncer, tire climber, donut tunnel, swings and other unique play equipment.

(2) Processed Tires

(a) Fill Stabilization

A recent laboratory investigation by Caltrans concluded that chopped rubber tire inclusions were beneficial to moderately plastic, silty clay embankment soils with a low angle of internal friction but were detrimental to better quality embankment soils(27). Additional research encompassing a field study with actual highway embankments is planned to provide more meaningful results. Split rubber tires in applications similar to mechanically stabilized construction are also proposed. Tentative plans include the construction of a short section of instrumented embankment in the San Francisco Bay area. The embankment will have variable side slopes and will be reinforced with used automobile tire sidewalls placed in strips at given intervals throughout the embankment. Any soil strength gain could reduce construction costs by allowing steeper side slopes and reduced right of way requirements. A finite element analysis of a theoretical embankment indicated that a significant increase in resistance to earthquake-induced embankment distress is possible using rubber tire reinforcement.

(b) Freezing and Fragmenting

The process of freezing used tires in liquid nitrogen and fragmenting them to effect a size reduction of 80% is being researched. The University of Wisconsin has constructed a pilot plant for this operation. The tires are frozen to -80°F with liquid nitrogen and then fragmented by passing them through a hammermill. The high cost of the equipment and liquid nitrogen is a serious drawback to this process.

(c) Tire Splitting

A small portion of used tires is consumed by the tire splitting industry. Tire splitting involves the cutting of the tire carcass into three sections, the crown or tread and the two sides. These sections are then manufactured into products such as gaskets, shims, automotive tail pipe insulators, door mats, bumpers for docks and loading platforms, etc.

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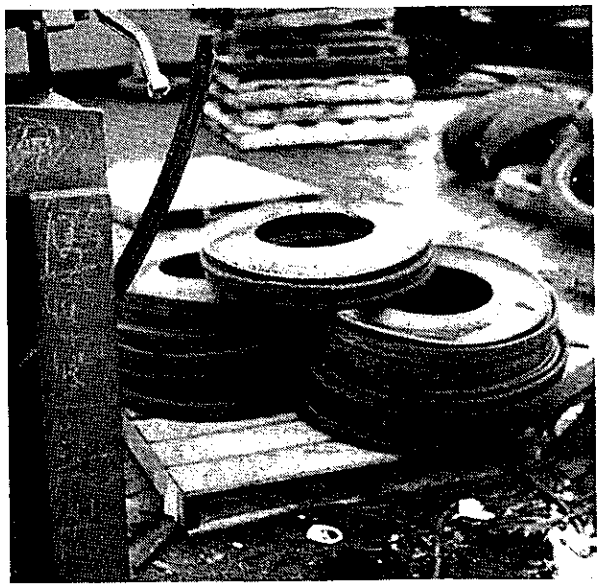
The Lutz Tire Co. in Benicia consumed about 20,000 tires in 1973 by splitting the carcasses and selling the treads and sidewalls to a steel company for use in packing pipe. However, it was noted that the demand for this product was extremely variable and that the operation was conducted on a part time basis to meet the demand.



Tires split into treads and sidewalls, and sold to steel companies for packing pipe.

E. Other Potential Programs

A review of a draft of this report by other State agencies has resulted in a number of suggestions as to possible programs that could be implemented to help alleviate specific problems or assist in the overall used-tire disposal situation. These proposals are summarized below and the agency response letter is included in Appendix D.

1. Economic incentives to increase use of retreads such as: a) increasing the excise tax on new tires, b) education of drivers to maintain proper tire pressure and change tires while still retreadable, c) inspection of automobiles to see that tires are removed while still retreadable, and d) renting of tires as done by some bus companies.

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2. Alleviate problem of tires "floating" to the surface in landfills or dumps by requiring tires to be split prior to disposal.

3. Export potential of surplus tires, such as to Mexico, should be explored further. Other uses for the spent tire in these emerging nations might include housing materials, shoes, etc.

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APPENDICES

A. Input From Private Organizations

B. Input From Public Agencies

C. Correspondence From Private Organizations

D. Correspondence From Public Agencies

E. Input From Disposal Site Operators

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A. Input From Private Organizations

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Input From Private Organizations

Several private organizations involved with tire manufacturing or disposal were contacted by letter, telephone, and by personal visit. Correspondence relating to private organizations appears in Appendix C. Letters of acknowledgment were mailed to all firms providing input to this study. The information received from the various organizations is summarized below:

1. Firestone Tire & Rubber Co.

Firestone has had active meaningful programs in progress on recycling used tires for many years. Three major tire reclaiming plants had been operating for years utilizing the devulcanization process to yield a product with about 50% inert material and 50% revulcanizable rubber. Competition from new rubber and substitute materials forced the shutdown of two of these plants, including one in Los Angeles, California.

Firestone has been active in research and development on the Destructive Distillation Process since 1968. The process has been demonstrated to be technically feasible but the cost is extremely high and the products need further refinement. The major product is solid carbonaceous residue which could be used in applications such as filter char, particulate in concrete or asphalt, or as smokeless fuels. The liquid (oils) and gaseous products can be used as fuels. Firestone is continuing to work on this process but it may take years to perfect it and make it commercially feasible.

Firestone commented that the viable technologies available presently for the pollution-free disposal of used tires include:

(1) Fuel energy in an incinerator/boiler or as a fuel additive in selected boiler equipment.

(2) Tire shredding followed by burial in a sanitary landfill.

2. Branich Manufacturing Company

Branich presented information and literature pertaining to the Branich Tire Cutting Machine. This machine is designed to cut passenger and truck tires in half to reduce handling expenses and make the casings more suitable for burial in sanitary landfills. The unit costs about $4,000.

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3. Atomics International

Atomics International (AI) was very interested in this research project and forwarded information on their Molten Salt Process which is discussed more thoroughly under "Section Discussion".

A field review of the AI facilities and plant operation was conducted. The Molten Salt Combustion Process appears to offer a potentially viable solution to the used tire problems. The performance results of large scale pilot plant tests should provide valuable data in this respect.

4. Gates Rubber Co.

Gates Rubber Co. referred our inquiry to the Rubber Manufacturers' Association (RMA) and a meeting with Mr. Dan Pennington of the RMA was arranged.

5. Rubber Manufacturers' Association (RMA)

A meeting was held with Mr. Dan Pennington of the RMA to review the used tire problem. It was noted that the development of practical and economically feasible methods of disposing of used tires without adversely affecting the environment is one of the major concerns of the tire industry.

The following comments were presented by Mr. Pennington:

(1) The numbers of recycled tires are expected to decline because of decreasing demand for retreaded tires and tighter government regulations on retreads.

(2) The use of reclaimed rubber is down some 40% in the last 12 years and many reclaiming plants have shut down because of competition from cheaper synthetic rubber compounds.

(3) Tires are difficult to dispose of in landfills due to their low bulk density and tendency to "float".

(4) One of the most promising methods for disposing of used tires lies in their use as a source of fuel energy.

(5) The problem of acceptability of tires in landfills is overcome by shredding, and several commercial shredders are available.

(6) An increasing number of areas around the country are using finely chopped up rubber in asphalt roads and for other highway uses.

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(7) The technology of using rubber chips as a fuel additive is being explored.

(8) The process of freezing used tires in liquid nitrogen and fragmenting them to reduce their size is being researched. However, the high cost of the equipment and liquid nitrogen makes this method undesirable.

(9) The approach of producing carbon black from used tires comes closest to true recycling since carbon black is an essential ingredient in the production of new tires. However, economic problems must be overcome before this process is practical.

(10) Destructive distillation is a technically feasible process, but its cost is extremely high and the products need further refinement.

(11) The utilization of used tires as impact barriers appears to have great promise as a future safety device.

(12) The United States Interior Department's Bureau of Sport Fisheries and Wildlife estimate that well over a billion tires can be disposed of in artificial reefs on the East Coast alone.

(13) With the growing fuel shortage and the development of tire-fired incinerators the concept of storing used tires could become a significant energy asset.

(14) Many other methods of utilizing used tires include fabrication into artificial turf, weed control, buoys, channel markers, traffic lane markers, boat dock bumpers, erosion control, high protein food production, soil conditioning and water purification.

6. U. S. Rubber Reclaiming Co.

This company has been engaged in the reclamation of waste rubber since 1883 and is a leader in developing new processes and equipment. A summary of the several products (listed by trade name) available for the mass utilization of used tires was forwarded and is presented below:

(A) Rubber Recovered From Scrap Tires For Use in Roads:

"Flo-Mix" is a powdered devulcanized Reclaimed Rubber produced from used automobile tires. When dissolved in a compatible asphalt cement at approximately 20% by weight, it produces a rubberized asphalt with improved flexibility, temperature susceptibility, resilience, adhesion and resistance to flow and

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brittleness. This rubberized asphalt can be utilized in the following ways to improve performance and durability of roads.

1. To seal cracks and joints
2. Binder in chip sealing
3. Binder in hot mix concrete
4. Binder in plant mix friction seal
5. To patch and waterproof bridge decks

"Ramflex" is a powdered devulcanized Reclaimed Rubber produced from used automobile tires. When added to a dense graded hot mix in the proper amounts, it will effectively desensitize the mix with regards to binder content and improve post compaction properties of the mix. The end result is an asphalt concrete surface that shows considerable resistance to bleeding, rutting and shoving.

"SRI (Strain Relieving Interface)" is an elastic asphaltic composition of approximately equal parts by volume of a vulcanized rubber aggregate (derived from ground used tires), mineral aggregate and an asphalt binder. When applied in a thin layered membrane over surfaces prone to cracking, it forms a waterproof strain absorbing interface that is said to prevent base cracks from reflecting through to the surface of an asphalt concrete overlay.

(B) Rubber Recovered from Used Tires For Use in Athletic Facility Surfaces:

"Perma-Track" is a specially prepared composition of rubber aggregate, mineral filler and asphalt emulsion that cures into a tough resilient layer when applied over a prepared base. It provides an excellent all-weather surface for track and field event areas, as well as tennis courts.

"Saf-Pla-E" is similar to Perma-Track but is supplied in 5-gallon cans or 55-gallon drums for "do-it-yourself" installations or repair of other resilient asphalt surfaces. It is also used for covering play areas around swings, etc.

"Rubberized Asphalt Hot Mix Tracks" - In response to numerous requests by schools with limited budgets, a Rubber/Asphalt Hot Mix track was developed that can be installed with conventional paving equipment at a moderate cost for an all-weather resilient surface.

7. Lucas-American Recyclers

We were referred to Fluor-Utah Corp., the new American distributor for Lucas furnaces.

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8. Fluor-Utah, Inc.

This company had the exclusive license to market, design and construct Lucas Cyclonic Furnace systems in the U.S. (The license was returned to Lucas-American in May 1974.) A furnace of this type is being installed at Jackson, Michigan for Goodyear Tire Co.

The Lucas Furnace installation at Jackson will incinerate 3,000 whole tires per day while generating about 30,000 pounds of steam per hour, for use in the manufacture of new tires.

9. National Tire Dealers and Retreaders Assoc.

Information concerning the utilization of used tires as an energy source was provided. The Lucas Cyclonic Furnace and the Wasteco Controlled Atmosphere Furnace were discussed. The Wasteco system requires testing and development in order to demonstrate its feasibility and the Wasteco Co. is not capable of undertaking this expense alone.

The NTDRA pamphlet entitled "The Problem is Scrap Tire Disposal", covers comments on several possible ways that can be explored to alleviate the used tire problem. These include (1) use as fuel energy, (2) development of artificial reefs, (3) freezing and fragmenting, (4) reuse through reclaimed rubber, (5) highway barriers at bridge abutments, (6) soil conditioners, (destructive distillation), (8) mixture with asphalt for road surfaces, (9) road filler, and (10) use for playground toys.

It was noted that the used tire disposal problem is one that must be tackled at the township, city, county and state levels. In large cities, incineration plants similar to the type built in Jackson, Michigan can be investigated as a possible source of used tire disposal with the resultant energy sold as a power source to industry.

10. Aim Automotive-Industry Marketing Corp.

Information and comments concerning the used tire disposal problem, tire shredders, and the Tire-Gon shredder manufactured by Aim were presented and are summarized below:

(1) Currently there are about ten types of tire shredders available.

(2) Agreements have been reached with some industries for purchase of the chips as a booster fuel to upgrade the BTU output of lower grade fuels such as low grade coal, wood chips and general refuse. These agreements are generating a recovery of 15¢ to 25¢ per tire.

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11. Consumers Union

Reports indicating relative tire tread life of various tire types were presented. The reports (August 1968) revealed that, in general, the higher priced, longer mileage tires were more economical on a cost per mile basis than the lower priced, low-mileage tires.

12. Uniroyal, Inc.

Permission was secured from Uniroyal to utilize the tire sales potentials estimated in their 1973 Tire Sales Opportunity Report. This data is tabulated in Table C and was used in this report to estimate the quantity and geographical location of used tires. It was assumed that each tire sold would generate a used tire.

13. Tire Shredder Operators

There are three tire shredders in operation in California which were investigated during the course of this study.

Fred Taulby Tire Co. in Alviso uses a tire shredder, manufactured by Reitz Mfg. Co. of Santa Rosa, to shred about 25,000 tires per month. The shredded tires are disposed of at a nearby disposal site. The cost of shredding and disposal of these tires is about 15¢ per tire. The shredder has a 25 HP electric motor, costs about $40,000, and consumes about 0.06 KWH of energy per tire shredded.

El Dorado Tire Co. of Roseville and Orange Avenue Disposal Co. of Fresno recently purchased tire shredders manufactured by T.E.B. Ltd. of Addison, Illinois. Operating statistics were not available.

The "Shred-Pax" Tire Shredder at the Orange Avenue Disposal Co. in the midst of a mountain of used tires.

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TABLE C: CALIFORNIA 1973 INDUSTRY SALES POTENTIAL - IN UNITS

SOURCE: UNIROYAL, INC.

COUNTY	PASSENGER TIRES	PASSENGER RETREADS	TRUCK TIRES	TRUCK RETREADS	FARM TIRES	TOTAL	PERCENT OF STATE TOTAL
Alameda Co.	745,689	228,616	95,930	58,487	934	1,129,656	5.00
Alpine Co.	216	66	44	27	-	525	0.002
Amador Co.	11,110	3,406	1,877	1,144	172	17,709	0.08
Butte Co.	83,324	25,546	13,442	8,195	2,797	133,304	0.59
Calaveras Co.	11,848	3,632	2,360	1,439	215	19,764	0.09
Colusa Co.	11,704	3,588	2,522	1,538	1,977	21,329	0.09
Contra Costa Co.	418,952	128,444	42,475	25,897	1,319	617,087	2.74
Del Norte Co.	11,540	3,538	2,413	1,471	165	19,127	0.08
El Dorado Co.	35,187	10,788	6,891	4,201	403	57,470	0.25
Fresno Co.	312,867	95,920	44,509	27,137	11,425	491,858	2.18
Glenn Co.	16,701	5,120	3,321	2,025	2,348	29,515	0.13
Humboldt Co.	76,743	23,528	14,631	8,920	1,059	124,881	0.55
Imperial Co.	55,317	16,959	11,015	6,716	2,591	92,598	0.41
Inyo Co.	13,833	4,241	3,734	2,277	149	24,234	0.11
Kern Co.	252,423	77,389	45,148	27,526	5,285	407,771	1.81
Kings Co.	43,881	13,453	7,095	4,326	2,776	71,531	0.32
Lake Co.	19,983	6,126	3,878	2,364	857	33,208	0.15
Lassen Co.	13,503	4,140	2,643	1,611	677	22,574	0.10
Los Angeles Co.	5,156,378	1,580,859	651,142	396,994	2,242	7,787,615	34.54
Madera Co.	32,599	9,994	5,346	3,259	2,785	53,983	0.24
Marin Co.	156,200	47,888	12,269	7,480	279	224,116	0.99
Mariposa Co.	5,334	1,635	1,229	749	130	9,077	0.04
Mendocino Co.	42,012	12,880	7,146	4,357	1,092	67,487	0.30
Merced Co.	77,450	23,745	10,706	6,527	5,415	123,843	0.55
Modoc Co.	5,946	1,823	1,540	939	1,340	11,588	0.05
Mono Co.	3,082	945	1,075	655	71	5,828	0.03
Monterey Co.	164,077	50,303	19,669	11,992	3,197	249,238	1.11
Napa Co.	61,182	18,757	9,071	5,530	960	95,500	0.42
Nevada Co.	23,074	7,074	4,243	2,587	193	37,171	0.16
Orange Co.	1,100,517	337,400	127,520	77,748	1,141	1,644,326	7.29
Placer Co.	63,558	19,486	9,831	5,994	963	99,832	0.44
Plumas Co.	10,580	3,244	2,086	1,272	160	17,348	0.08

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COUNTY	PASSENGER TIRES	PASSENGER RETREADS	TRUCK TIRES	TRUCK RETREADS	FARM TIRES	TOTAL	PERCENT OF STATE TOTAL
Riverside Co.	343,326	105,258	54,565	33,268	3,236	539,653	2.39
Sacramento Co.	507,534	155,601	67,093	40,906	2,792	773,926	3.43
San Benito Co.	14,332	4,394	2,232	1,361	1,227	23,544	0.10
San Bernardino Co.	480,865	147,425	80,718	49,213	1,793	760,014	3.37
San Diego Co.	957,488	293,550	131,001	79,870	2,346	1,464,255	6.49
San Francisco Co.	423,720	129,905	71,596	43,651	-	677,872	3.01
San Joaquin Co.	217,975	66,827	28,993	17,677	7,888	339,360	1.51
San Luis Obispo	80,316	24,624	12,416	7,570	2,206	127,132	0.56
San Mateo Co.	437,003	133,978	38,822	23,669	385	633,857	2.81
Santa Barbara Co.	197,382	60,514	24,367	14,856	1,729	298,848	1.33
Santa Clara Co.	822,843	252,270	83,861	51,129	2,728	1,212,831	5.38
Santa Cruz Co.	108,055	33,128	13,558	8,266	898	163,905	0.73
Shasta Co.	65,969	20,225	12,864	7,843	805	107,706	0.48
Sierra Co.	2,154	660	471	287	63	3,635	0.02
Siskiyou Co.	29,176	8,945	6,693	4,081	1,537	50,432	0.22
Solano Co.	123,954	38,002	14,141	8,622	1,767	186,468	0.83
Sonoma Co.	169,362	51,924	24,039	14,656	2,859	262,840	1.17
Stanislaus Co.	156,247	47,903	23,273	14,189	6,418	248,030	1.10
Sutter Co.	34,068	10,445	5,395	3,289	3,150	56,347	0.25
Tehama Co.	23,695	7,264	4,157	2,534	1,441	39,091	0.17
Trinity Co.	5,620	1,723	1,554	947	56	9,900	0.04
Tulare Co.	140,859	43,185	21,819	13,303	8,278	277,444	1.01
Tuolumne Co.	19,446	5,962	2,947	1,797	128	30,280	0.13
Ventura Co.	275,181	84,366	36,244	22,098	2,326	420,215	1.86
Yolo Co.	67,050	20,556	10,806	6,588	3,114	108,114	0.48
Yuba Co.	32,377	9,926	4,378	2,669	885	50,235	0.22
TOTALS	14,772,807	4,529,093	1,944,804	1,185,723	115,178	22,547,605	100%

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All three tire shredder operators expressed the opinion that some use should be developed for the shredded tires as the procedure of burying the tires in a sanitary landfill is a gross waste of a potentially valuable resource. Also, the steel beads on some of the newer steel-belted tires cause excessive wear and tear on the shredders.

Currently there are about ten shredder manufacturers who sell equipment capable of shredding from about 50 to 500 tires per hour. The tires can be shredded into several chip sizes ranging from 1/4" to 3" size.

Some potential uses for the shredded tires include:

(1) Use as a fuel energy supplement
(2) Placed into landfills for footpaths
(3) Landscaping
(4) Ground rubber soil conditioner to improve soil conditions for crop growth
(5) Filler with crushed stone for road construction.

14. Lutz Tire Company

The Lutz Company operates one of the largest retreading plants in California, producing (recycling) about 250,000 tires per year. The plant operation was investigated and revealed the following information.

250,000	Retread tires produced per year
100,000	Gallons of fuel oil consumed per year to generate steam to cure the tires and heat the plant
25,000	Tires scrapped per year
500	Tons of buffings generated per year.

It was noted that the scrap tires and buffings are hauled to a disposal site. If a small, economical incinerator-boiler could be developed to incinerate these "waste" materials and generate steam for plant operations, the savings in disposal fees and energy consumed could possibly offset the cost of the incinerator-boiler equipped with required pollution control equipment.

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B. Input From Public Agencies

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Input From Public Agencies

Several interested public agencies were contacted by phone and correspondence for input to possible solutions and problems concerning the used tires. Correspondence relating to public agencies is filed in Appendix D. Information received from the various agencies is summarized below:

1. California Solid Waste Management Board (SWMB)

The SWMB provided substantial information and assistance throughout this investigation and reviewed a draft of this report. The SWMB recognizes tire disposal as a problem area in solid waste management and is in the process of developing new policies in this area. All pertinent information within their department was made available for use in this report.

2. California Air Resources Board (ARB)

The ARB was contacted and noted that it was interested in possible solutions to the tire disposal problem from the standpoint of air pollution. A copy of a report entitled "Scrap Tires Can Yield Marketable Products" was forwarded for our use. A draft of this report was reviewed and pertinent commments were provided on the air pollution aspects of the methods discussed.

3. California Department of General Service (DGS)

The Fleet Administration Division installs approximately 7,000 new tires per year through the State Garage system on their pool as well as agency-owned state vehicles.

For the past three years, they went to bid for a vendor that would purchase their surplus tires statewide. The successful bidder was a company in Visalia. This vendor paid 29¢ a carcass for tires picked up in Fresno and Sacramento and 25¢ a carcass for used tires in San Diego, Los Angeles and the Bay Area Garages. The used tires were disposed of by the vendor in several ways: 1) Sold as used tires to the farming industry for use on field wagons, 2) Sold to recappers and 3) junked. The costs of trucking and saturation of his market has caused this vendor to cancel his contract prematurely.

The State Garages are now disposing of their surplus tires on a local bid basis and bids are extremely difficult to obtain. In July 1974, the Los Angeles Garage solicited bids from more than 20 junk tire dealers and received only one bid for 5¢ each. San Diego is disposing locally to the high bidder. In the past, they have had excellent bids from Mexican nationals. Mexicans use the tires that have sound carcasses on their personal cars until they are completely worn out. Our tires are removed as a matter of safety policy when the tread gets less than 2/32". Mexicans do not have the 1/32" Vehicle Code restriction so they

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can get up to 5,000 additional miles on these surplus U.S. tires. They also have a number of handcraft industries that manufacture shoes, door mats and other household items from junk tires. Fresno is still able to dispose of their surplus tires to the vendor in Visalia (who originally bought Statewide) for 29¢ each. Bay Area and Sacramento Garages are now selling to local bidders.

4. California Department of Parks and Recreation (DPR)

The DPR utilization of used tires for erosion control at San Elijo Beach and at the Salton Sea was investigated. The process was partially effective at San Elijo and totally ineffective at the Salton Sea location.

5. California Division of Forestry (DF)

Under section 437 of the Public Resources Code, the DF issues permits for disposal sites and is interested in tires from a fire hazard standpoint. A tire fire is almost impossible to extinguish. The DF had no information to offer to this report at the time of the study.

6. Caltrans

The Headquarters Equipment Shop was contacted and indicated that about 9,000 tires are disposed per year by selling them to used tire dealers on a contract basis. The ultimate disposition of the tires is unknown although it is assumed some of the tires are recapped.

7. California Department of Public Health (DPH)

It was noted that Senate Bill 5 requires that the DPH develop regulations for the disposal of solid wastes and DPH expressed interest in this study for possible input into their proposed regulations. Present recommendations for sanitary landfills suggest that tires be placed near the bottom of the fills and not be segregated. A draft of this report was reviewed and pertinent comments were presented.

8. Humboldt State University (HSU)

Mr. Eric Prince of HSU prepared his Masters Thesis on the utilization of used tires as artificial reefs. His thesis was entitled "Food and Behavior of the Copper Rock Fish Associated With an Artificial Reef in South Humboldt Bay" and indicated that used tires could be effective as artificial reefs.

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9. California Highway Patrol (CHP)

The CHP noted that it does not have literature from which research material could be drawn with respect to the problem of collecting and disposing of used tires. The CHP disposes of about 22,000 used tires per year to used tire dealers on a contract basis. Bids have ranged from 50¢ to $3.00 per tire.

10. California Department of Consumer Affairs (DCA)

The DCA had no information to provide to this study.

11. California Department of Fish and Game (DFG)

The DFG provided extensive information on the use of tires in the construction of artificial reefs. A history of used tire artificial reef construction in California, including details on construction configurations, costs and tire sources was presented. These data are documented in Appendix D.

12. California Department of Aeronautics (DA)

The DA has developed a new use for used tires in the operation of small airports. The tires are used to construct segmented circle airport marker systems. Each system requires about 200 tires. Details of a typical system are illustrated on page B-4.

13. United States Forest Service (USFS)

The USFS had no information to provide to this study.

14. United States Soil Conservation Service (USSCS)

The SCS had no information to provide to this study.

15. New York Department of Transportation (NYDOT)

The NYDOT reported that based on field observations, they found that rubberized joint sealers last at least twice as long as asphalt sealers without any additives. The "in-place" cost is about 30% more for rubberized joint sealers than it is for plain asphalt joint sealers.

16. California Department of Motor Vehicles (DMV)

The DMV was contacted and provided statistics on California motor vehicle registration during the period 1965 to 1973. The data were analyzed and are tabulated by county on Table D. Data indicate that over 31% of the vehicles in California are registered in Los Angeles County.

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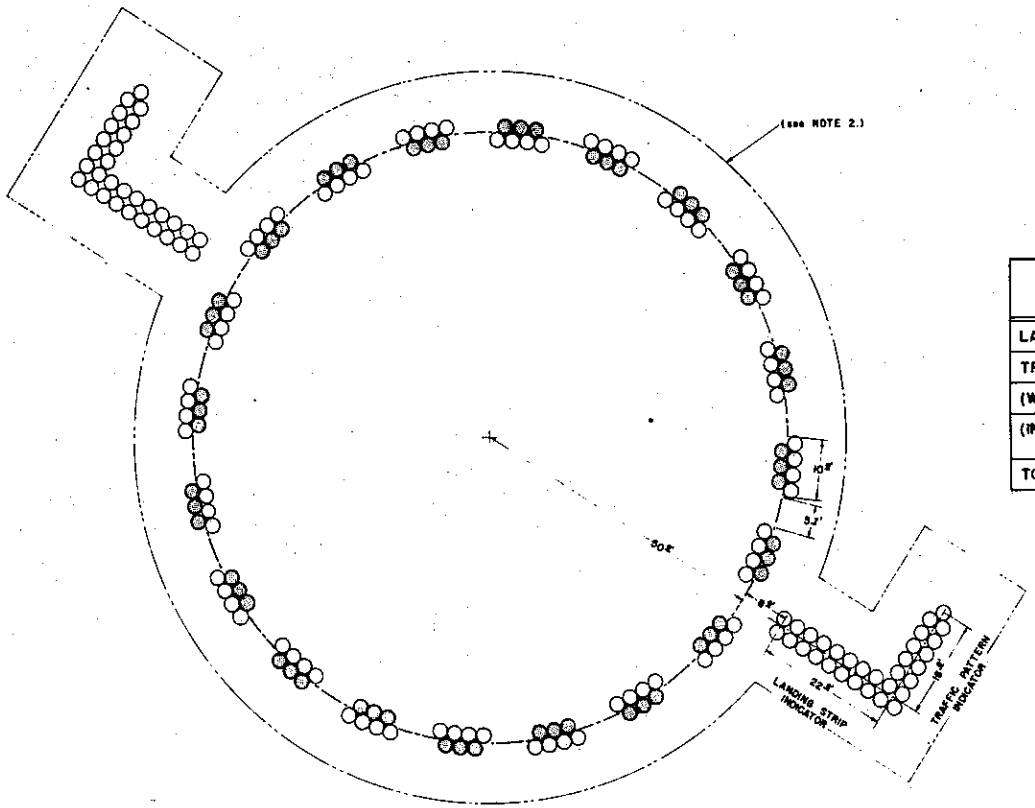
SEGMENTED CIRCLE
AIRPORT MARKER SYSTEM



SEGMENTED CIRCLE FEATURES	Number of (2.5' dia.) AUTOMOBILE TIRES Required
LANDING STRIP INDICATORS ○	40
TRAFFIC PATTERN INDICATORS ○	22
(WHITE) SEGMENTED CIRCLE ELEMENTS ○	80
(INTERNATIONAL ORANGE or WHITE) SEGMENTED CIRCLE ELEMENTS ◎	60
TOTAL TIRE REQUIREMENT	202

NOTES:
1. Select the most visible color that will provide distinct contrast between ground cover and segmented circle. The colors indicated above are suggestions only. A rubber base latex point is recommended for covering the tire body.
2. Keep the area within the segmented circle, as well as a 10' wide area adjacent to the circle perimeter and indicators, clear of tall grass and shubs.
3. Additional information and other design alternates are available in ADVISORY CIRCULAR AC 150/5540-5A, Department of Transportation, Federal Aviation Administration.
4. When site limitations exist, the circle diameter may be reduced (75' min.), and accompanied by proportional changes in segment, spacing, landing strip indicator, and traffic pattern indicator dimensions.

CALIFORNIA DIVISION OF AERONAUTICS

19703 767573 657084

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TABLE D

CALIFORNIA TOTAL VEHICLE REGISTRATION FOR 1973

Source: California Dept. Motor Vehicles

County	Number of Vehicles	%	Trend*
Alameda	747,494	4.8	-
Alpine	505	0.003	0
Amador	13,601	0.1	0
Butte	104,779	0.7	0
Calaveras	14,115	0.1	0
Colusa	12,799	0.1	0
Contra Costa	424,874	2.7	0
Del Norte	14,360	0.1	0
El Dorado	47,311	0.3	0
Fresno	342,295	2.2	0
Glenn	19,160	0.1	0
Humboldt	89,558	0.6	0
Imperial	62,808	0.4	0
Inyo	18,539	0.1	0
Kern	282,450	1.8	0
King	49,913	0.3	0
Lake	28,948	0.2	0
Lassen	16,128	0.1	0
Los Angeles	4,918,510	31.3	-
Madera	38,430	0.2	0
Marin	154,246	1.0	+
Mariposa	7,335	0.1	+
Mendocino	50,835	0.3	0
Merced	84,639	0.5	0
Modoc	7,736	0.1	0
Mono	5,462	0.04	0
Monterey	178,447	1.1	0
Napa	71,254	0.5	0
Nevada	29,620	0.2	0
Orange	1,220,697	7.8	+
Placer	76,878	0.5	0
Plumas	14,083	0.1	0
Riverside	401,864	2.6	+
Sacramento	510,193	3.2	0
San Benito	15,587	0.1	0
San Bernardino	522,777	3.3	0
San Diego	1,064,461	6.8	+
San Francisco	374,276	2.4	-
San Joaquin	235,395	1.5	0
San Luis Obispo	96,592	0.6	0
San Mateo	443,290	2.8	0
Santa Barbara	203,758	1.3	0
Santa Clara	847,353	5.4	+
Santa Cruz	120,688	0.8	0
Shasta	84,425	0.5	0
Sierra	2,449	0.02	0
Siskiyou	33,821	0.2	0
Solano	128,550	0.8	0
Sonoma	196,874	1.3	+

* Trend
- Decreasing %
0 No change %
+ Increasing %

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CALIFORNIA TOTAL VEHICLE REGISTRATION FOR 1973 (continued)

County	Number of Vehicles	%	Trend*
Stanislaus	177,558	1.1	0
Sutter	39,144	0.2	0
Tehama	30,251	0.2	0
Trinity	8,515	0.1	0
Tulare	157,191	1.0	0
Tuolumne	24,124	0.2	0
Ventura	300,132	1.9	+
Yolo	77,855	0.5	0
Yuba	35,279	0.2	0
Out of State	230,968	1.5	+
Exempt Vehicles	225,762	1.4	0
Total	15,738,941	100%	

* Trend
\- Decreasing %
0 No change %
\+ Increasing %

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C. Correspondence From Private Organizations

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Deston

Atomics International Division
Rockwell International

8900 De Soto Avenue
Canoga Park, California 91304

AMES
FORSYTH
NORDIN
SHERMAN
SPELLMAN
HARTFORD
CLARK
LIBRARY
GEN. FILE

November 14, 1973

In reply refer to 73AT-6825

Mr. John B. Skog
Chief, Environmental Improvement
Section
Department of Transportation
Division of Highways
Transportation Laboratory
5900 Falsom Boulevard
Sacramento, California 95819

Dear Mr. Skog:

Atomics International acknowledges receipt of your letter of November 1 relative to the Division of Highways research project on "Abandoned tires."

We are extremely interested in this project, both from the standpoint of disposal as well as utilizing the tires for the production of energy.

AI has developed and perfected a Molten Salt Combustion Process suitable for the disposal of solid wastes. This process has proven completely effective in the disposal of plastics, rubber products, agricultural wastes, hospital wastes, general trash, harmful and toxic chemicals, pesticides, etc.

AI has completed bench scale laboratory tests of this system on many diverse materials and has now designed and built a large scale system for demonstration and test to satisfy potential customer requirements.

11/16/73

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On this large scale pilot plant, we are currently under contract with the Navy for film disposal with silver recovery. Tests have also been effectively completed for the Navy at another facility for the disposal of explosives, and we anticipate an early contract with the Army for special toxic waste disposal. Also, we are currently negotiating a contract with the Office of Coal Research, Federal Department of Interior, for the design, fabrication, installation, and test of a large scale pilot plant in conjunction with an eastern utility for coal gasification (see enclosed brochure). In addition, we have recently submitted a proposal to the State of California for a portable system for pesticide and used pesticide container disposal.

The above applications represent examples of the use of the system for disposal and heat generation. Tires have a high heating value (BTU/lb) and utilization of this heat may be an important by-product of this process. Large scale installation of this system for solid waste disposal can be utilized as a source of energy production.

This system insures complete destruction of the material with no air pollution (meets Federal and California air pollution standards), and produces a disposable, sterile, odor-free residue. The system is compact and can be designed for either a fixed site or mobil operation.

Enclosed is a copy of our brochure on the Molten Salt Process for Special Applications. Please note that this document is proprietary, and we would appreciate your handling it accordingly.

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We welcome an opportunity to meet with you and your staff to discuss in detail the system and its application to this special problem. Additional information may be obtained by contacting the undersigned on area code (213), 341-1000, extension 2268.

Very truly yours,

C. R. Spencer

C. R. Spencer
Environmental & Utility
Systems Marketing

Enclosures:
1. AI Molten Salt Process for Special Applications (AI-73-63)
2. Brochure - Molten Salt Process for Combustion and Gasification of Coal

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U. S. RUBBER RECLAIMING CO., INC.

POST OFFICE BOX No. 54

VICKSBURG, MISS. 39180

November 27, 1973

Dear: Mr. Beaton:

Thank you for your query and for your interest in the reclamation of discarded tires.

In response to the many questions we receive from all over the world regarding what can be done with discarded tires, how much they are worth, etc., we have developed the enclosed folder. It contains brief, non-technical explanations of the several methods for the mass utilization of scrap tires. As the enclosed editorial reprints will demonstrate, these applications have proven their values in actual use.

Solving the waste tire problem, however, is going to require the active interest of the public. Concerned individuals such as yourself can urge Government officials at all levels to recognize this problem and utilize reclaimed rubber in the many areas where it results in a better product with long-term cost benefits, such as its use in highway construction and repair.

Our Company has been engaged in the reclaimation of waste rubber since 1883. We are a leader in developing new processes and equipment; our patented Reclaimator process, for example, has been licensed in several foreign countries. We also maintain a very active research program of our own, and sponsor University research as well.

From time to time as more material develops, we will forward this to you. In the meantime, if you have further questions or require more specific data, please contact us at the above address.

Sincerely yours,

Bobby D. LaGrone

Bobby D. LaGrone
Technical Director

BDL:os

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FLUOR UTAH, INC.

177 BOVET ROAD
SAN MATEO, CALIFORNIA 94402
TELEPHONE: (415) 574-1111

January 2, 1974

Mr. William D. Lyle
Executive Director
California State Tire Dealers Assn. Inc.
Suite 405
303 Hegenberger Road
Oakland, California 94621

Dear Sir:

In accordance with our discussion I have worked up some numbers for a typical Lucas tire incinerator in terms of fuel potential. I have used 100 tire/hr as a base so that fuel values for other size furnaces can be quickly determined by means of a simple ratio.

DESIGN BASE

100 Tires/Hour
30 Pounds/Tire
13,000 BTU's/Pound of Tire
66.7% Boiler/Furnace Thermal Efficiency

DISPOSAL RATE

100 Tires/Hour
2400 Tires/Day
876,000 Tires/Year (365 Days)

FUEL EQUIVALENT

No. 6 Fuel Oil (147,330 BTU/Gal.)

265 Gal/Hour
6360 Gal/Day
2,321,400 Gal/Year

Natural Gas (1,000 BTU/Cu. Ft.)

39,000 Cu. Ft./Hr.
936,000 Cu. Ft./Day
341,640,000 Cu. Ft./Year

TELEX NO.: 340152 FLUORUTAH SMT

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STEAM GENERATION

21,650 Pounds/Hour (250 psig, saturated)
778 Horsepower

I have also enclosed, our brochure describing the Lucas tire furnace.

As we can be of further service, please call upon us.

Yours very truly,

FLUOR UTAH, INC.

F. Michael Lewis

F. Michael Lewis
Technical Director/Furnace Group

FML:ams

cc: Big O Tires
1175 59th Street
Oakland, CA 94608
Attn: Mr. William B. Thomas

State of California
Dept. of Public Works
Division of Highways
Materials & Research Dept.
5900 Folsom Street
Sacramento, CA 95819
Attn: Mr. Mike Quint ✓

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3M COMPANY

GENERAL OFFICES • 3M CENTER • SAINT PAUL, MINNESOTA 55101 • TEL. (612) 733-1110

Scientific and Technical Communications Department

January 17, 1974

Mr. John B. Skog, Chief
Environmental Improvement Section
Department of Transportation
State of California
5900 Folsom Blvd.
Sacramento, California 95819

Dear Mr. Skog:

This is in answer to your letter of November 1, 1973 inquiring about disposal of abandoned rubber tires.

There is not much I can tell you about our work in this area. However, I can refer you to Professor Norman R. Braton, Department of Mechanical Engineering, University of Wisconsin, Madison, Wisconsin. Professor Braton and his colleagues have developed a method of hammer-milling tires frozen in liquid nitrogen to obtain granular rubber which can be used in a variety of ways.

I hope that this information will be of assistance to you.

Very truly yours,

John G. Erickson

John G. Erickson, Director
Scientific & Technical
Communications

fp

1/21/74

MINNESOTA MINING AND MANUFACTURING COMPANY

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TIRE DEALERS
RETREADERS

B. WALKER NOYES
1st Vice President
CHARLES E. EDWARD
2nd Vice President
JESSE CASTLEBERRY
Corporate Treasurer
LEON LUBEL
Executive Vice President
W. W. MARSH

February 4, 1974

Mr. John Skog, Chief
Environmental Improvement Section
Department of Transportation
Division of Highways
Transportation Laboratory
5900 Folsom Blvd.
Sacramento, California 95819

Dear Mr. Skog:

We received your letter dated January 23rd relative to your study on "Abandoned Tires", and request for information on tire incineration.

Several companies in England have pioneered the use of scrap tires for generating energy. Information relative to these companies is enclosed. The Goodyear Tire and Rubber Company have installed an incinerator in Jackson, Michigan. When operational, the furnace will burn three-thousand scrap tires daily and the resultant energy will be used for plant operations.

The net BTU value of rubber is 11,330 per lb., which is much higher than coal. The Wasteco Company, Inc. has developed considerable data relative to utilization of scrap tires as an energy source. A copy of the study is enclosed for your information. The Wasteco Company is located at 20675 SW 105th, Tualatin, Oregon 97062.

Other methods of disposing of scrap tires are included in a NTDRA pamphlet recently published entitled THE PROBLEM IS SCRAP TIRE DISPOSAL, and a copy is enclosed for your review and study.

If we can be of further assistance to you, please do not hesitate to let us know.

Sincerely yours,

NATIONAL TIRE DEALERS AND
RETREADERS ASSOCIATION, INC.

John G. Pallo
Director, Dealer Development

JGPmw

cc: W. W. Marsh

The Men Who Know Tires Best

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UNIROYAL

UNIROYAL, Inc.
Oxford Management & Research Center
Middlebury, Connecticut 06749

March 19, 1974

Mr. John Skog, P.E.
Chief, Environmental Improvement Section
Department of Transportation
5900 Folsom Blvd.
Sacremento, California 95819

Dear Mr. Skog:

We have received your letter of March 7th wherein you request information regarding the ultimate disposal of used tire casings. As a company, our inputs have been made through RMA, and I believe you have met with Dan Pennington in this regard.

As Chairman of RMA's Environmental Committee, I am very interested in your study and pending report. I also would like you to feel at liberty to call upon Mr. Pennington or myself to assist your group in any way.

Sincerely,

Robert C. Niles

Robert C. Niles, P.E.
Director
Environmental Control

RCN:lsm
cc: Mr. D. G. Pennington
Rubber Manufacturers' Assoc.
1346 Connecticut Ave., N.W.
Washington, D.C. 20036

3/25/74

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The Goodyear Tire & Rubber Company

Akron, Ohio 44316

March 20, 1974

Department of Transportation
Division of Highways
Transportation Laboratory
5900 Folsom Blvd
Sacramento, California 95819

Attention: Mr John Skog, P.E.
Chief, Environmental Improvement Section

Subject: Abandoned Tires

Reference: Your Letter of 3-1-74, File 647152

Dear Mr Skog:

You are aware of the Rubber Manufacturers' report on this subject. Goodyear's active participation has been with the use of old tires in reef projects off the coasts of Florida and the application of the Lucas Furnace at Jackson, Michigan.

The furnace is rated at 3000 tires per day and the flue gasses exhausted through a 30,000 pound/hour rated waste heat boiler.

Our contract for this furnace is with Lucas Recycle Company of California. This company obtained the basic principle for the furnace from Lucas Furnace Development, Ltd. in England. In the detail engineering of the Jackson unit they failed miserably in their efforts to design a workable unit. Having failed, they engaged Fluor-Utah, Inc to redesign and alter the original installation. This contract was let last spring and the rework is essentially complete.

We have been in start up trials for the past week and we have ascertained the unit will consume the rated number of tires. The unit is now in 'cool down' to permit internal inspection this week end. We were generating 20,000 pounds of steam per hour with a portion of the gases by-passing the heat exchange boiler.

3/22/74

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We will make some change to the control panel and the tire inserter. We will then endeavor to place the unit in a 30-day acceptance run. Based on our past week of experience, we are optimistic as to the unit meeting its guarantee, and perhaps exceed it by 20 to 30 per cent. We expect some minor modifications in the tire feed conveyors will be required.

As you know, we won't be able to discuss this unit in a positive manner until we have some months of background experience. We invite your future inquiry as to adequacy of this unit in about six months. As a bit of information, a newly purchased unit at the rating of 3000 tires per day would probably cost a million dollars.

Mr Arnold R Gaunt is the Manager-Furnace Group for Fluor Utah, Inc. This group is now handling the Lucas Furnace account in this country.

Very truly yours,

Manager,
Corporate Engineering

C Hiss
ft

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FLUOR UTAH, INC.

177 BOVET ROAD
SAN MATEO, CALIFORNIA 94402
TELEPHONE: (415) 574-1111

March 22, 1974

State of California
Department of Public Works
5900 Folsom Boulevard
Sacramento, California 95819

Attention: Mr. Mike Quint
Environmental Studies

Subject: Lucas Cyclonic Furnace Systems

Dear Sir:

Enclosed herewith is a copy of the paper presented at the recent meeting of the American Institute of Chemical Engineers. We are also enclosing a copy of the article as published in the Electric Light and Power magazine, the energy and generation edition of January, 1974.

As mentioned in our conversation of yesterday, the Goodyear Tire Furnace has been put into operation and is operating in a very satisfactory manner. We expect to be making our air pollution test sometime during the month of April during the final commissioning of this facility. We should have the results of these tests approximately May 1 and would be most happy to discuss them with you at that time.

Yours very truly,

FLUOR UTAH, INC.

A. R. Gaunt
Manager, Furnace Group

ARG:dq
enclosures

3/28/74

TELEX NO.: 340152 FLUORUTAH SMT

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AUTOMOTIVE-INDUSTRIAL MARKETING CORPORATION
P.O. Box 16457 • Portland, Oregon 97233
Phone: 503/255-7364

March 13, 1974

Department of Transportation
Division of Highways
Transportation Laboratory
5900 Folsom Blvd.
Sacramento, California 95819

Attention: John Skog

Dear Mr. Skog:

We are a little perplexed on just how to answer your letter of March 7th relating to California House Resolution number 37.

Because of our long involvement with the situation of scrap tire disposal we could write a very lengthly disertation on the subject, however perhaps for now it might be better just to describe the current stage of the art and the market as it exists.

Almost all cities and counties across the United States have now developed very strict laws against landfilling with tires, either whole or split. Strangely enough, a very progressive city in most ways, Los Angeles, is totally indifferent to the problem and has no restrictions.

Currently there are about ten machines of various types that claim they will process a tire and make it acceptable for landfills.

We are among the ten, however we have carried the opportunity one step further, and (to the best of my knowledge) are the only machine that prepares the tire for recycling.

It is our firm belief that none of the chips produced by a Tire-Gon operation will ever see a landfill. Currently agreements have been reached with Fisher Body Division of General Motors, Cowlitz Power Company and Northern States Power Company for the purchase of the chips as a fuel booster to upgrade the BTU output of lower grade fuels such as low grade coal, wood chips and general refuse.

Agreements have also been reached with rubber reclaimers. It is far more economical for them to process rubber chips rather than whole scrap tires.

These agreements are generating a recovery of .15¢ to .25¢ per tire. Since most of our operations charge .25¢ per tire for processing (since they can't be dumped) the economics are there to encourage a private operation to make the investment and get into the business. However, as long as situations exist such as in Los Angeles no progress will be made in those areas.

"Let Our AIM Be Yours"

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Most areas tend to encourage private enterprize, although cities such as Dallas, Texas and Baltimore, Maryland have ordered their own units.

It would seem that you could accomplish the result you want by initiating action in several areas;

1. Develop a strong ordinance against the dumping of "unprocessed" tires.

2. Allow for a disposal charge of at least .25¢ per tire (in most cases passed on to the new tire buyer).

3. Encourage the use of the by product by burning as a fuel where practical and developing a program specifying the state use of rubber asphalt. This is now being done by the province of Saskatchwan in Canada.

We have enclosed quite a bit of material. If you feel we can supply you with anything else please let us know.

Yours very truly,

W. Dennis Hall
President

WDH/pb

CC: R. Turner
T. Miller

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CONSUMERS UNION / A NONPROFIT ORGANIZATION / PUBLISHER OF CONSUMER REPORTS

March 28, 1974

John Skog, P.E.
Chief, Environmental
Improvement Section
Dept. of Transportation
Division of Highways
5900 Folsom Blvd.
Sacramento, Calif. 95819

Dear Mr. Skog:

Referring to your letter of March 13th, we have, through the years, tested most types and models of tires, ranging from the so-called 3rd line (many years ago) on up to modern bias-belted and radial-ply tires.

Unfortunately, our tests of "2nd-line" and "3rd-line" tires are so old as to have no validity.

Our more recent test reports, however, may be of some use to you in indicating relative tread life of the various tire types, as well as of specific models.

I am enclosing copies of those reports for your convenience.

Very truly yours,

Bertram Strauss

Bertram Strauss
Associate Technical Director

BS:lm

256 WASHINGTON STREET / MOUNT VERNON, NEW YORK 10550

TNG 3 4/1/74

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(415) 324-4744
Telex No. 348-471

Combustion Power Company, Inc.
1346 WILLOW ROAD • MENLO PARK • CALIFORNIA 94025

March 28, 1974

In Reply Refer To:
671:74:1:3

Mr. Mike Quint
California Department of
Transportation
Transportation Lab
5900 Folsom Blvd.
Sacramento, CA 95819

Dear Mr. Quint:

Thank you for your telephone call of March 14 requesting information about our CPU-400 system for the disposal of solid waste.

The Combustion Power Unit-400 (CPU-400) is an advanced technology system that will economically recover energy from solid waste in a pollution-free manner. Energy from the combustible material is recovered in the form of electrical power by using a gas turbine. The CPU-400 will be a completely automated, packaged plant capable of consuming all types of unsegregated municipal solid waste. Since the units will be clean, compact, and quiet, they can be located in or near a metropolitan area to substantially reduce hauling costs.

The CPU-400 is based on a modular concept. Each module will be capable of disposing of 130 tons of solid waste per day while generating 2200 kilowatts of electrical power. The "power module" units can be used in any number of multiples to fit the solid waste quantity requirements of a city.

In addition to solid waste, each CPU-400 module has the capability of simultaneously disposing of up to 38,000 gallons of non-dewatered liquid waste per day. Adding waste water to the CPU-400 combustor raises the capacity of each power module to 160 tons of solid waste per day and increases power output to 3,000 kilowatts. Therefore, in addition to providing an economical method to ultimate sludge disposal, an improvement in capability of the basic module is gained requiring only a minimal increase in capital investment.

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Combustion Power Company, Inc. has been building and testing air classification systems for the past five years in sizes from 3 to 40 tons/hour and has developed the expertise to provide an air separation system which can be used in conjunction with any shredder installation. Provision for a shredder/air classifier system is necessary in any facility considering fuel and mineral recovery from the solid waste stream, since 75 percent to 85 percent of the total stream is burnable and is removed by air separation. The accessibility of the remaining 15 to 25 percent mineral rich fraction to separation techniques is thus improved.

Combustion Power Company in 1971 assembled a "wet" solid waste mineral recovery system utilizing a rising current separator and two-stage heavy media system. Although the system worked reasonably well, there were problems inherent in the process which generated interest in developing a more advanced process. This research culminated in a dry recovery process which utilizes ferrous magnets, trommels, vibrating feeders, aluminum magnets, and the other nonferrous metals separator.

The use of a "dry" separation system rather than "wet" or sink-float separation systems has several obvious advantages: simple controls requiring no manual attention; constant performance efficiency; no product contamination; minimum supplemental hardware or space requirements; only conventional electrical power required with power consumption less than that of wet system; and no water contamination or water treatment facilities are required.

The CPU-400, which has been continuously sponsored by the U. S. Environmental Protection Agency, Office of Research and Monitoring, is now in its fifth year of development. Over 3 years of component research and testing preceded the pilot plant. The pilot plant will be capable of demonstrating an ecologically and economically sound solid waste disposal system on a significant scale for concise evaluation. The pilot plant will be capable of disposing of up to 105 tons of solid waste and 25,000 gallons of liquid waste per day while generating 1,000 kilowatts of power. The pilot plant was operated as a total system for the first time on April 13, 1973 and will now undergo extensive testing.

After testing of the pilot plant, which constitutes the end of the research and development phase, the program is expected to transition to a demonstration grant for construction of the first prototype. Following this, the CPU-400 units will be available for other communities. Our present schedule calls for the commercial introduction of the CPU-400 in Mid-1975.

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We have also developed a series of simplified, lower capital cost systems that may interest you. These systems do not generate power, but have the capability of disposing of sewage sludge (or any other type of liquid waste) and solid waste at the same time. The basic system, called the LSW (Liquid and Solid Waste Disposal System), consists of a shredder, air classifier and fluid bed combustor. The system is able to utilize the solid waste from a community as a fuel to dispose of, in a pollution-free manner, sewage sludge of a very high water content. The LSW is being sold in four basic sizes. The smallest will dispose of 1500 lb/hr of solid waste and 100 gal/hr of liquid waste. The largest system will dispose of 4.5 ton/hr (9000 lb/hr) of solid waste and 700 gal/hr of liquid waste. Modules of the largest system can be provided to double and triple the solid and liquid waste consumption. We are currently operating the 1500 lb/hr system at our Menlo Park facility as a demonstrator and to provide an engineering tool for product improvement.

Our CPU-400 pilot plant and LSW prototype are at a point now where observation of the operations will be quite meaningful. Should you or any of your associates have the opportunity to come to Menlo Park, California, we would be very pleased to show you our systems.

We have enclosed for your information a copy of the CPU-400 brochure which will define the system in greater detail.

Very truly yours,

COMBUSTION POWER COMPANY, INC.

Samuel P. Eveleth

Samuel P. Eveleth
Information Services

SPE:lb

Enclosures

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4day Enterprises Retreading, 445 W. Walnut St., Gardena, Ca 90248. 213 323-6452.

April 30, 1974

John Skog
Dept of Transportation
Division of Highways
Transportation Laboratory
5900 Folsom Blvd
Sacramento, Ca 95819

With regard to the Department's recent letter apparently to selected tread rubber and retreading equipment manufacturers on the subject of "Abandoned Tires", we ask that we be placed on your mailing list to receive any information on recycling or disposing of these "abandoned tires".

Thank you.

Al DeWeese

mr

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UNIROYAL

UNIROYAL DEVELOPMENT COMPANY
Division of UNIROYAL, Inc.
Oxford Management & Research Center
Middlebury, Connecticut 06749

203-573-2312

March 15, 1974

Mr. Michael Quint
California Department of Transportation
Transportation Laboratories
5900 Folsom Boulevard
Sacramento, California 95819

Dear Mr. Quint:

Following our conversation earlier this week, your request was discussed with F. M. Crehan, Manager of Marketing Services, UNIROYAL Tire Co., and through this letter we are extending permission to utilize the tire potentials estimated in our 1973 Tire Sales Opportunity.

UNIROYAL is keenly aware of the scrap tire disposal problem and welcomes this opportunity which in some way may contribute toward a solution in your state.

Our Company has been especially active with Connecticut's Department of Environmental Protection, e.g., in establishing guidelines for handling the scrap tire portion of the Solid Waste Management Program and independently have investigated rubber in roads (asphalt additive), stockpiling, shredding for land fills, and utilization as an energy source.

If possible we would appreciate receiving the results of your analysis and learning how your program progresses.

Very truly yours,

J. E. Niedermeyer

J. E. Niedermeyer

JEN:lc
cc: F. M. Crehan

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Atomics International Division
Rockwell International

8900 De Soto Avenue
Canoga Park, California 91304

August 19, 1974

In reply refer to 74AT-5813

Mr. John L. Beaton, P.E.
Chief Engineer, Transportation Laboratory
State of California
Department of Transportation
5900 Folsom Boulevard
Sacramento, California 95819

Dear Mr. Beaton:

Atomics International (AI) has reviewed your report on "The Problems and Possible Solutions to Disposing of or Recycling Used Tires" and wish to compliment you on its thoroughness and completeness.

We have, in accordance with your request, included our comments which are indicated in red on page L-1 (20) of the report.

AI is also interested in the disposal problems associated with used tires and feel that our Molten Salt Combustor offers, on a large scale basis the capability for effective, non-polluting disposal, and energy conversion.

We would greatly appreciate receiving a copy of the final report.

Very truly yours,

C. R. Spencer

C. R. Spencer
Environmental & Utility Systems Marketing

Enclosure: State of California Report on the Problems and Possible Solutions to Disposing of or Recycling Used Tires

ecl: 1/8

ECS 8/23

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The Gates Rubber Company
999 South Broadway
Denver, Colorado 80217
(303) 744-1911

November 12, 1973

John L. Beaton PE
Chief, Transportation Laboratory
California Department of Transportation
5900 Folsom Blvd.
Sacramento, California 95819

Dear Mr. Beaton:

I have reviewed with interest, your recent letter on "Abandoned Tires".

The Rubber Manufacturer's Association (RMA) Environment Committee has been "wrestling" with the problem for some time.

The enclosed copy of a paper, to be given by Dan Pennington, of the RMA, is the committee's latest thinking on the scrap tire disposal problem.

The committee is presently working on "up-dating" the costs of the various disposal and recycling systems.

I will make it known to Dan that you are interested in the economics of the problem and also in having someone discuss the overall problem with you.

Very truly yours,

E. W. Karger
Chief, Environmental Protection Engineer

jk
cc: H. D. Harris
Dan Pennington, RMA
Bob Niles - Chairman, RMA Environmental Committee, Uniroyal

11/16

11/16/73

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Firestone

November 6, 1973

Mr. John B. Skog, P.E.
Chief, Environmental Improvement Section
STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
Division of Highways
Transportation Laboratory
5900 Folsom Boulevard
Sacramento, CA 95819

Dear Mr. Skog:

Your letter of November 1, 1973 to The Firestone Tire & Rubber Company has come across my desk for handling. I am more than pleased to supply what information I have on the problem of used tire disposal.

Firestone, for many years, has had active, meaningful programs in progress on recycling used or road-worn tires, a major solid waste management problem of the rubber industry.

For years, Firestone has operated three major road-worn tire reclaiming plants utilizing the devulcanization process to recycle tires back to the production cycle. (The devulcanization process yields a good product that contains about 50% inert material and 50% re-vulcanizable rubber.) These three plants are located in Akron, Ohio; Memphis, Tennessee; and Los Angeles, California. Due to the extremely high cost and the competition from new rubber and substitute materials, two of these plants were shut down in the past two years. These were the Akron, Ohio, and Los Angeles, California, plants. The Memphis, Tennessee, plant continues to operate.

In addition to our conventional reclaim process, Firestone as part of their advanced research and development program, starting in 1968, began work on another process to reclaim tires and convert them to usable products in a pollution-free process. This process, which we feel is the best chemical process we know of to date, is known as the Firestone Destructive Distillation Process for the pollution-free disposal of used tires. We do not want to raise any false hopes in your mind as to this being a total answer to the problem. It is a possible answer. At this point in time, Destructive Distillation is a technically feasible process, which means the process can convert tires into usable products

11/7/73

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in a pollution-free manner, but the cost is extremely high and the products need further refinement. We are continuing work on this process, but it appears it will take years to perfect it and make it commercially feasible. We define commercially feasible as the process standing on its own merit and not requiring subsidization.

Firestone has received worldwide acclaim on this far-reaching process. We are attaching the following three reports (Exhibits A, B, and C) which cover this work in great detail:

Exhibit A - "Destructive Distillation of Used Tires," by Dr. J. A. Beckman and Mr. J. R. Laman, dated May, 1970. This report covers work done in a batchwise pilot plant.

Exhibit B - "The Destructive Distillation of Used Tires in a Continuous Pilot Plant," by Dr. J. A. Beckman, Dr. Grant Crane, Dr. E. L. Kay, and Mr. J. R. Laman, dated April, 1972. This report covers work done in a continuous pilot plant.

Exhibit C - Publication of the Firestone Paper in this field delivered at the Spring Meeting of The Akron Rubber Group - April 21, 1972 in Akron, Ohio. A paper on this work was also presented at the Solid Waste Management Conference conducted by the University of Massachusetts on May 12 and 13, 1970.

At the risk of being self-serving, Kobe Steel has a pyrolysis pilot plant similar to Firestone's Destructive Distillation Process. I am sure that when you obtain a copy of this report, you will find it essentially a duplication of our work.

Our Environmental Engineering Group and the Research Department have been requested to publish a paper on the "state of the art or status of this problem" by The American Chemical Society. The paper has been prepared and it will be published in the April, 1974 Issue of "Rubber Chemistry & Technology Technical Review," Special Edition, entitled "Scrap Tire Disposal." This paper was written by Dr. J. A. Beckman, Dr. Grant Crane, Dr. E. L. Kay, and Mr. J. R. Laman. We trust you will watch for this very "in depth" study of this problem offered by the subject paper.

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We would like to offer the following additional technologies, Exhibit D, under study by many companies and research organizations on the subject of pollution-free disposal of road-worn tires. Firestone is actively investigating some of these technologies, but in fairness to ourselves, we cannot pursue all of them; we are concentrating on the technologies that, if proven successful, will consume huge inventories of road-worn tires.

You may ask what viable technology is available now and what course we should chart both long and short range.

The viable technologies available presently for the pollution-free disposal of used tires are as follows:

1. Fuel Energy in an incinerator/boiler or as a fuel additive in selected boiler equipment.

2. Tire Shredding followed by burial in a sanitary landfill.

To summarize at this time, there is no cure-all solution to this problem. Please find attached a copy of our brochure entitled, "Excellence in Environmental Engineering," which is a case study that summarizes Firestone's efforts in improving the total environment; past, present, and future. If we can be of further service, please call on us.

Very truly yours,

J. R. Laman

J. R. LAMAN, P.E.
Manager
Environmental Engineering

JRL/sp
Attachments

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Branick

November 5, 1973

Mr. John B. Skog, P. E.
Chief, Environmental Improvement Section
Department of Transportation
State of California
5900 Folsom Blvd.
Sacramento, California 95819

Your Letter of November 1, 1973

Dear Sir:

Thank you for your recent letter requesting information which would prove helpful in completing your research project on abandoned tires.

We appreciate your inquiry and the opportunity to send you literature and information pertaining to the Branick Tire Cutting Machine which has been designed to cut passenger and truck tire casings in half in order to greatly reduce handling expenses and more important make the cut casings more suitable for burial in sanitary landfills.

As illustrated, the Branick Tire Cutter is equipped with a special type of cutting blade which enables it to cut both passenger and truck tire casings, including the wire cord or steel belted type tires. The machine is equipped with a Tire Guide Roller Assembly, as well as additional safety features designed to provide the operator with protection during the tire cutting process. The actual cutting process requires only one operator who with a few hours of operating experience should be able to cut approximately 120 passenger tires per hour and 50 to 60 truck tire casings.

The current price of the Branick Tire Cutter is $4,031.85 F.O.B. Fargo, North Dakota with usual deliveries ranging from three to four weeks after receipt of purchase order. We are also taking this opportunity to send you one of our complete Branick Tire Handling Equipment Catalogs illustrating many items of equipment designed for all phases of the retreading process, as well as vehicle maintenance and servicing.

BRANICK MFG. CORP., BOX 1937 FARGO, N. DAKOTA 58102 PHONE: 701/235-4446 AN APPLIED POWER INDUSTRY

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Please note we are referring a copy of this correspondence to our West Coast Sales Representative, Mr. John C. Huber, 9505 Paramount Blvd., Downey, California 90240, Phone: (213) 928-2635, who will be pleased to answer questions you might have concerning Branick Equipment and also refer you to one of our local distributors for availability.

Thank you for your inquiry.

Sincerely,

BRANICK MFG. CORP.

Clark Wurl

Clark Wurl
Sales Order Supervisor

cc: John Huber

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D. Correspondence From Public Agencies

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State of California THE RESOURCES AGENCY

Memorandum

To : Mr. John L. Beaton, P.E.
Chief Engineer
Transportation Laboratory
Department of Transportation
5900 Folsom Boulevard
Sacramento, CA 95819

Date : October 2, 1974

	AMES
	FORSYTH
	NORDIN
X	~~SHIRLEY~~
	SKOG
	SPELLMAN
	HAGLUND
	FIELDS
	LIBRARY
	GEN. FILE

From : **STATE SOLID WASTE MANAGEMENT BOARD**

Subject: Tire Disposal or Reuse Report Review

Thank you for the opportunity to review the draft report on "The Problems and Possible Solutions to Disposing of or Recycling Used Tires".

It is apparent that considerable effort was expended to determine the current fate of used tires and the efforts of the tire industry to salvage materials or energy from them. Unfortunately, the suggested solutions are in the form of conclusions but offer no clear-cut plan to achieve those solutions to the used tire problem. House Resolution No. 37 states that abandoned tires are a health and fire hazard and an eyesore. The report offers no solutions to these problems. Possible solutions mentioned are actually conclusions describing current practices.

We suggest that one approach to the problems connected with the storage, stockpiling of tires, or their disposal at sanitary landfills would be a requirement that all tires from sources such as retreaders or service stations that are not going to be retreated, be split. This would alleviate the problem of tires "floating" in landfills and would also greatly reduce a source of prolific mosquito breeding, since rainwater would drain from split tires. Tire splitters are fairly low in cost and are simple to operate.

Considerable discussion is given to materials and energy systems which are being developed. However, no recommendation is made concerning the continued monitoring of these developmental efforts. We believe that the State responsibility for monitoring these programs and initiating adequate procedures which will ensure the use of developed systems should be identified in the report. The report should place more emphasis on the critical economic problem of transporting tires to a central processing plant. Initiation of your proposed tire collection system should also be addressed. We suggest that a definite program be recommended and that appropriate legislation be drafted and proposed (we would be happy to assist in this effort).

It is our opinion that the management and enforcement of a program along the lines described above should be assigned to the State Solid Waste Management Board and that any necessary research and testing should be contracted with other appropriate agencies or firms. For example, research work on the use of tires in the highway construction program would logically remain with your agency.

Beaton 10/3
ECS 10/9

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Our other comments and questions are keyed to the page numbers of your draft report as follows:

Page

4 The word "consumer" is not consistent with the customary usage where it relates to the person who would be buying the tire.

7 If CPU-400 is given mention, then other systems such as pyrolysis should also be noted. We suggest that it would be better to delete the reference to CPU-400.

8 The word "recycling" should be used instead of "recycle".

10 Another collection alternative exists -- require old tires to be returned to the manufacturer.

17 Pyrolysis systems, such as the Purox and Garrett systems should be discussed under energy recovery and the economics of these systems. The numbers furnished us on the Atomics International system indicate a cost of $200 per ton to dispose of solid waste materials, which is a very high cost.

18 Can Lucas system meet emission limits adopted by the various Air Pollution Control Districts in California?

20 Delete reference to CPU-400 or rewrite it so that it does not appear so optimistic (i.e., that is implying it is "near operational"). No mention is made that small particle sizes are necessary for feeding into the combustor.

20 The Atomics International system is perfected as far as a pilot plant only is concerned. Sodium carbonate serves as a "heat" transfer medium. This unit also requires grinding the tires, and, as you point out, shredded waste is then fed to the unit.

Table A is a mixture of systems, methods, and aspects of disposal techniques (i.e., shredders and tire splitting still require land-filling). The table should be restructured.

We have enclosed for your use a copy of an excellent report concerning the "Incentives for Tire Recycling and Reuse". Starting with page 23, a number of reuse strategies are suggested. We will be available to work with your staff if we can be of further help.

Albert A. Marino
Executive Officer

Enclosure

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State of California | Department of Health

Memorandum

To : Department of Transportation
Division of Highways

Attention: John L. Beaton, P.E.
Chief Engineer
Transportation Laboratory

Date : October 8, 1974

Subject: The Problems and Possible Solutions to Disposal of, or Recycling Used Tires

From : Kenneth Buell, Program Manager
Environmental Health Services Program

This Department has reviewed the draft report entitled The Problems and Possible Solutions to Disposal of, or Recycling Used Tires. In general, the statement of the problem, the factual material presented, and the proposed solutions are adequate and in concurrence with the extent of known health hazards and existing problems of disposal and reuse. Some comments for consideration in the final draft have been prepared by our Waste Management Unit staff and are included below.

The extent of the problem associated with the incorporation of used tires into existing sanitary landfills is somewhat understated. It is pointed out that about 30% of the 63 disposal site operators surveyed reported a problem with the disposal of tire carcasses. Whole tires are difficult to compact and must be placed under a very large volume of other refuse or they will "float" to the top and disrupt the compacted soil cover. In addition, we can add that in cases where tires have been placed solely in cells at landfill sites, they have created harborage for rodents; they are a potential fire hazard; they cannot be adequately compacted; and voids are left in the covered tires which eventually may erode, causing problems with cells placed on top of the cells containing tires. Some disposal sites are stockpiling tires, a practice which can lead to mosquito breeding and is a fire hazard. Others discourage tire disposal by increased rates, which leads to illegal dumping at unauthorized sites. The report, however, concludes that "disposal of used tires in sanitary landfills does not pose a major problem at the present time."

We feel that the 30% problem factor is significant and may be higher, as our experience has shown that landfill operators tend to minimize their problems in responding to mailed questionnaires. Also, California is faced with decreasing capacity for landfill space such that landfills cannot be considered a long-term solution to the tire disposal problem. Thus, landfill disposal is a significant problem unless the tires are processed by shredding or cutting prior to disposal. This will only add to the cost of disposal and further increase the stockpiling and illegal dumping.

10/15
10/16

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In regard to the utilization of used tires for fuel energy, the report points out that there are presently three possible solutions. One, the Lucas cyclonic furnace, currently is operational. However, the report fails to point out that the furnace as it exists today will not meet existing California air pollution standards. It is possible that scrubbers could be added to this furnace which would make the furnace feasible for use in California. Another system mentioned is the CPU-400, a pyrolysis unit currently under development by Combustion Power Company under contract with the U. S. Environmental Protection Agency. At present, this process must be considered in the experimental stage. The economics have not been proven, and it will probably be at least five years before a unit is operational. The third method mentioned is the Molten Salt Combustion Process. This is still essentially in the laboratory phase and the implication of the statement of page L-1(20) that the method has been perfected for industrial use seems a little premature. While it is true that the BTU content of tires is higher than that of coal, the wide distribution of tire sources does not make their use commercially feasible to sustain a power plant (e.g., the tires accumulating in New York City could supply the power needs of only 15,000 people). At best, such use would probably be on a standby basis for use when a sufficient number of tires have been accumulated, with the resultant fire and health hazards associated with such accumulations.

The use of tires for the construction of artificial reefs is reported as a good solution on a short-term basis. However, although used tires appear to be virtually indestructable in sea water, there is not enough data yet to fully assess the impact of such reefs on the ocean environment. Another problem is that such usage would be limited to the coastal areas and large inland lakes. Hauling costs would pose a problem for used tires located remote from these areas.

A major factor in used tire utilization is retreading, which extends the life of existing tires. While not eliminating ultimate disposal of these tires, retreading reduces the number of carcasses that must be disposed of annually in relationship to the number of vehicle miles driven per year. The report points out that for several reasons, use of retread tires for passenger cars has dropped from 25% in 1963 to 17% in 1968, and there has been a similar reduction in truck tire retreading. Reduced speed limits on the highways because of the recent energy crisis would permit wider use of retreads than are currently being used. The report might consider mentioning a number of economic incentives that could be employed to increase the use of retreads by the consumer:

1. Increasing the excise tax on new tires.

2. Tire sizes could be standardized to increase the percentage of tires retreaded. Molds are not produced for some sizes because of low volume.

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3. Education of drivers to maintain proper tire pressure and change tires while still retreadable. This could be incorporated in the DMV testing program.

4. Inspection of cars to see that tires are removed while still retreadable.

5. Renting of tires as done by some bus companies. The tires are inspected and maintained by the renting agency and replaced as required. This could be handled through local service stations.

The use of smaller cars by the consumer would also extend the life of existing tires and serve as a factor in source reduction as would increased use of retreads. With the maximum vehicular speed limit of 55 miles per hour, and an average passenger trip loading of approximately 1.6 persons per trip, smaller cars could serve the public transportation needs adequately. With such cars tire mileage could be increased to possibly 50,000 miles. In addition, there would be substantial fuel savings by increasing the mileage per vehicle. Such incentives as increased gasoline tax, horse power tax, engine size displacement tax, and gross weight tax would tend to have the public accept a smaller vehicle which would adequately serve transportation needs without excessive consumption of tires and other energy consuming raw materials. The report might include an analysis of the effect on the tire disposal problem if the average passenger sedan weighed 2,500 pounds (unladen) rather than the current 4,000+ pounds.

Thank you for the opportunity to review and submit comments on this important report. We would appreciate receiving a copy of the final report when it becomes available.

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DEPARTMENT OF GENERAL SERVICES

August 14, 1974

J. L. Beaton
Chief Engineer, Transportation Lab
5900 Folsom Blvd.
Sacramento, California 95819

Dear Mr. Beaton:

We have received your "Report on the Problems and Possible Solutions to Disposing of or Recycling Used Tires". This report is a very impressive compilation of the research that has been applied to the subject. Your people have certainly explored every possible facet of the problem and are to be commended for a very thorough job.

In reviewing the report, we find that Item 3 on page L-2 (19) is not accurate and does not give the details of our experience in the problem of tire disposal. We are submitting the attached revision describing the methods of tire disposal we have used for the past several years, to substitute for the existing #3 paragraph. Feel free to edit or condense as you may desire. We perhaps have gone into too much detail but we did want to furnish as much information as possible so you would have a very clear picture of our operation.

In passing, we noted that there was one method of disposal that was not mentioned in your report. Guided by our experience with Mexican buyers, it would appear there is need to explore the export potential of surplus tires. Used tires could conceivably be welcomed by emerging nations as the basis for small industry in those countries that have vast supplies of low cost of manpower. With some engineering expertise applied, there is possibility that old tires could be used to construct housing that would provide better shelter than culvert sections as now used in Bangladesh and Pakistan.

Yates 8/16

ECX 8/18

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Filled with earth and stacked, they could make sturdy outside walls with no fasteners or framework required. Roofing could be made using the same size tire sections as with sandals. Squares of tire carcass material would make shingles that would never wear out. You might care to add some research along these lines to your report if you feel it would be constructive.

In all other respects, we feel your report is very satisfactory; there is really nothing new we could add other than the attached revision of the General Services paragraph.

Kindest Regards,

Lawrence R. Robinson, Jr.
Director

By
Robert G. Edwards
Program Manager

RGE/jan

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#3 The Fleet Administration Division installs approximately 7,000 new tires per year through the State Garage system on their pool as well as agency-owned state vehicles.

For the past three years, they went to bid for a vendor that would purchase their surplus tires statewide. The successful bidder was a company in Visalia. This vendor paid 29¢ a carcass for tires picked up in Fresno and Sacramento and 25¢ a carcass for used tires in San Diego, Los Angeles and the Bay Area Garages. The used tires were disposed of by the vendor in several ways: 1) Sold as used tires to the farming industry for use on field wagons, 2) Sold to recappers and 3) junked.

The costs of trucking and saturation of his market has caused this vendor to cancel his contract prematurely.

The State Garages are now disposing of their surplus tires on a local bid basis and bids are extemely difficult to obtain. In July 1974, the Los Angeles Garage solicited bids from more than 20 junk tire dealers and received only one bid for 5¢ each. San Diego is disposing locally to the high bidder. In the past, they have had excellent bids from Mexican nationals. Mexicans use the tires that have sound carcasses on their personal cars until they are completely worn out. Our tires are removed as a metter of safety policy when the tread gets les s than 2/32". Mexicans do not have the 1/32" Vehicle Code restriction so they can get up to 5,000 additional miles on these surplus U.S. tires. They also have a number of handcraft industries that manufacture shoes, door mats and other household items from junk tires. Fresno is still able to dispose of their surplus tires to the vendor in Visalia (who originally bought Statewide) for 29¢ each. Bay Area and Sacramento Garages are now selling to local bidders.

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DEPARTMENT OF Consumer Affairs
1020 N STREET, SACRAMENTO, CALIFORNIA 95814

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September 11, 1974

John L. Beaton, P.E.
Chief Engineer
Transportation Laboratory
Division of Highways
Department of Transportation
5900 Folsom Blvd.
Sacramento, CA 95819

Dear Mr. Beaton:

Re: Draft Report on Used Tire Disposal

Based on the information provided in the draft report from your office, we have the following comments.

Aside from the derivation of energy from the chemical/mechanical destruction of used tires, the consequent saving of heat producing fossil fuels, and the esthetic enhancement of the environment, the recycling of used tires via retreading could be a partial answer to the problem of disposal of used tires.

The statistics indicate that other than outright disposal, retreading is a major means of delaying the ultimate disposal of the used tire, while at the same time deriving increased utility from the tire carcass. There is a trend away from use of retreads at the present time which may be reversed by a combination of: (1) consumer awareness of the benefits of purchasing retreads; (2) reduced prices; (3) additional media advertising by the industry; and (4) consumer awareness of improved safety and reliability of the product.

The report indicates that the development of new production technology and better quality control will lead to a better retread. In the past, retreads have been dangerously defective due to negligence in selecting carcasses and the existence of an air space between the carcass and the new tread which resulted in the "cap" coming off at high speed. Should this situation be relieved, the Department of Consumer Affairs would support the furtherance of the plans as advanced in the report relative to retreading.

gcl 9/17/74

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Please send us a copy of the final report and the determinations made by the appropriate hearing body.

Sincerely,

Patricia Gayman

PATRICIA GAYMAN
Director

PG:pv

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State of California

Memorandum

The Resources Agency

To : John L. Beaton, P.E.
Chief Engineer, Transportation Laboratory

Date : September 9, 1974

Subject : Problems and Possible Solutions to Disposing of or Recycling Used Tires.

From : Air Resources Board

We have reviewed the draft report The Problems and Possible Solutions to Disposing of or Recycling Used Tires. Our evaluation indicates that the disposal and recycling methods discussed in the report may result in significant emissions of air pollutants. Because the control of these emissions are the responsibility of local air pollution control districts, it is suggested that a brief discussion be included in the report explaining the types of emissions control regulations that would apply to these sources and the capability of the sources to conform to such regulations.

Sincerely,

Harmon Wong-Woo, Chief
Div. of Implementation & Enforcement

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State of California

The Resources Agency

Memorandum

To : John L. Beaton, P.E.
Chief Engineer, Transportation Laboratory
Department of Transportation
Division of Highways
5900 Folsom Blvd.
Sacramento, California 95819

Date : August 22, 1974

File No.: BD-8-22

From : **Department of Conservation—Division of Forestry**

Subject: FIRE PREVENTION ENGINEERING
General
Used Tire Disposal

The various staff functions of the Division of Forestry have reviewed the draft of "A Report on Problems and Possible Solutions to Disposing of or Recycling Used Tires." They find the areas of concern to this Division well covered and have no additional comments to make.

Thank you for the opportunity of reviewing this material before it is finalized.

L. A. MORAN, STATE FORESTER

C. W. Holmes

C. W. Holmes
Fire Prevention Engineer

Enclosure

07

8/23

ECS 8/23

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State of California

The Resources Agency

Memorandum

To : John L. Beaton, P.E.
Chief Engineer, Transportation Laboratory
Department of Transportation
5900 Folsom Boulevard
Sacramento, California 95819

Date: August 19, 1974

AMES
[illegible]
[illegible]
X ~~SHIRLEY~~
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From : Department of Fish and Game

Subject: A Report on the Problems and Possible Solutions to Disposing of or Recycling Used Tires

This is in regard to your letter of August 2, 1974 requesting our review and comments on your response to California Legislative House Resolution No. 37.

We have reviewed and concur with the portion of the report that deals with the use of tires for artificial reefs.

E C Fullerton

FOR Director

JS ECS 8/23

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STATE OF CALIFORNIA—BUSINESS AND TRANSPORTATION AGENCY RONALD REAGAN, Governor

DEPARTMENT OF CALIFORNIA HIGHWAY PATROL

P.O. BOX 898
SACRAMENTO, CALIFORNIA 95804

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August 29, 1974

File No.: 1.2801.A3532

Mr. John L. Beaton, P.E.
Chief Engineer
Transportation Laboratory
Department of Transportation
5900 Folsom Boulevard
Sacramento, CA 95819

Dear Mr. Beaton:

Thank you for forwarding a copy of the draft report on used tire disposal. It is evident that the report is the product of careful study.

While there presently appears to be no aspect of the study in which this Department would be involved, it is reassuring to see the results that can be obtained when public and private resources work to solve a problem.

Of particular interest are the proposals to use tires for fuel-energy and as vehicle impact attenuators. It would be especially appropriate if a waste material from our transportation system could be used to advantage in these areas.

Should this Department be able to assist you or your staff in this project, please feel free to contact us.

Very truly yours,

W. Pudinski

W. PUDINSKI
Commissioner

CS
9/3

Beaton 9/3

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State of California | The Resources Agency

Memorandum

To : Mr. John L. Beaton, P. E.
Chief, Transportation Laboratory
Division of Highways
5900 Folsom Boulevard
Sacramento, California 95819

Attention: John Skog, Chief
Environmental Improvement Section

Date: January 18, 1974

From : **Department of Fish and Game**

Subject: Use of Discarded Tires for Constructing Artificial Reefs

This is in answer to your request for information on the use of tires for the construction of artificial reefs.

The Department frequently receives offers of various materials (including tires) to be used in man-made reef construction in the marine environment. However, due to the problems encountered in obtaining permits and funds for reef construction, we usually are unable to accept these offers. When investigating the cost of transportation for a recent offer of free asbestos cement pipe rejects, estimates as high as $13,000 per barge load (1,000 tons) were received for towing the material from Long Beach to Redondo Beach, where an artificial reef was proposed.

Those tire reefs constructed by the Department have relied heavily on volunteer labor for installation. The following constitute our use of tires for reefs in the marine environment:

The first artificial reef consisting of discarded tires was constructed in Humboldt Bay during the month of October 1968. The reef consisted of 800 tires set out singly, and in groups of three and four. The reef was approximately 30 meters long by 8 meters wide, providing relief of 1 to 2 meters. It was located in Southport Channel at a depth of 7.3 meters (MLW). This reef was constructed by the Eureka Kiwanis Club, using volunteer labor, at a cost of $460. At the suggestion of the Department, this reef was expanded in June 1971 to provide additional vertical relief. This was accomplished, again by volunteer action, by the addition of 120 automobile tires assembled into units of 12 tires. These ten units, when in place, raised the relief to approximately 3 meters.

The next tire reef to be installed was located under the Santa Cruz pier, in Monterey Bay. This pier is subjected to extremely heavy angling pressure (80,000 angler days/year) and is located on a flat sandy bottom. This reef was constructed in August 1971 by a coalition of volunteers from the Santa Cruz Hunting and Angling Club and the Santa Cruz Aquatechs, a local dive club. Funds for this reef were obtained by charging tire dealers a fee to dispose of the used tires. The money, in excess of $200, plus a donation of 6,000 meters of 19 millimeter polypropylene line, provided by the Pacific Gas and Electric Company, was used to construct the reef. The reef

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consists of 1,100 automobile tires assembled into 42 units of 28 tires, which were tied to the pilings under the pier.

The City of Los Angeles Life Guard Service, stationed at Cabrillo Beach, was the next group to build a tire reef under a fishing pier. This reef, modeled after the Santa Cruz reef, was constructed by city lifeguards as part of their diving team search and rescue training. The city entered into an agreement with the Wildlife Conservation Board on August 18, 1972, and was to receive $1,000 to provide materials for the construction of the reef. This reef consists of about 3 units of 28 tires, suspended below the pier.

The Wildlife Conservation Board, on January 5, 1973, entered into another agreement to provide $2,000 in funds to assist in the expansion of the Santa Cruz pier reef. The original groups, with additional volunteers from the Santa Cruz Sea Urchins and the Benjamin Franklin Marine Institute, incorporated 3,000 additional tires into the reef at Santa Cruz. These were located off the pier on the seafloor and were installed by volunteer divers.

The first open ocean reef constructed in California was installed in July 1973, approximately 3.2 kilometers west of the Ventura Marina in 18 meters of water. It was assembled by volunteers from the Explorer Scouts of Ventura County and was installed by Department personnel. This reef, consisting of 16 units of 6 tires (4 automobile, 2 truck) has been expanded by the addition of 36 additional units in November 1973. This reef provides approximately 1 meter of relief, and covers an area of 200 meters by 20 meters.

At the Salton Sea the department-initiated plans to use large earthmoving equipment tires were dropped when the costs involved in transporting those tires were found to be too great. Plans now call for the use of 1,600 light truck and passenger car tires. A four-tire tetrahedral configuration will be utilized, resulting in 400 units. One-gallon tin cans, available from Chino Institute for Men, will be filled with cement for anchors, and placed one can per tire. We will rely on volunteer labor and boats to place these tire units in the Salton Sea.

List of Materials

2	Information Buoys, @ $55.30	$ 110.60
2	Buoy Lights, @ $26.00	52.00
1,500 Feet	Yellow Braided Polyethylene Rope, @ 3¢	450.00
50 Feet	Galvanized Chain	54.00
7 Rolls	Black Polyethylene Film, 6 mil. x 16' x 100'	N/A
100 Bags	Cement	190.00
9,400 Lbs.	Sand-Gravel Mix	47.00
	Approximate Total Cost	$ 903.60

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Other costs will consist of mileage on vehicles used to transport the reef units to the Sea, seasonal time including travel expenses, and miscellaneous expenditures for emergency purchases.

At Lake Perris, the artificial reef was secured prior to filling of the basin, which resulted in substantial savings in the cost of installation. This reef is composed of approximately 360 to 380 giant earthmoving equipment tires. They range in size from 5 feet to 8 feet in diameter, and weigh from 1,500 to 3,000 pounds. Two hundred and fifty to 300 of the tires were placed on the site by the Perris Dam Constructors. An additional 70 were transported from a tire dealer in Pomona to Lake Perris. The following costs were incurred:

Per diem expenses	$ 120.00
Equipment rental (electric drill)	30.00
Material to anchor the reef (10 yards of pre-mixed concrete), approximately	220.00
1,000 Feet of Polypropylene rope	100.00
Transportation costs to move 70 tires (Pomona to Perris)	600.00
1 Day's Rental of a tire-moving truck and driver (for stacking and building pyramids)	100.00
10 Man-days (salaries) expended to drill air holes in each of the tires to permit trapped gases to escape and to tie the tires together and pour concrete into the tires set up for anchoring of each pyramid	470.00
Total	$1,640.00

Enclosed for your information is a copy of an article on the use of tires for artificial reefs from our May/June 1972 issue of Outdoor California. You may also be interested in a publication of the American Littoral Society on artificial reefs. The reference for this publication is: Unger, Iris. 1966. Artificial Reefs, A review. Amer. Littoral Society Spec. Pub., (4):1-74.

If you have any further questions please do not hesitate to contact me at 5-8386.

Dave Zeiner

Dave Zeiner
Wildlife Manager Biologist
Marine Resources Branch

Enclosure

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State of California

The Resources Agency of California

Memorandum

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To : Mr. John L. Beaton, P.E., Chief Engineer
Transportation Laboratory
Department of Transportation
Division of Highways
5900 Folsom Boulevard
Sacramento, California 95819

Date : August 14, 1974

Subject : Report - The Problems and Possible Solutions to Disposing of or Recycling Used Tires

From : **Department of Parks and Recreation**

Thank you for the opportunity to comment on the Department of Transportation's study regarding the problem of used tire disposal. The section of the report dealing with the experience of the Department of Parks and Recreation in utilizing used tires for erosion control is correct. We found your report to contain very timely information on the subject and have no further comments to add.

DEPUTY DIRECTOR
for William Penn Mott, Jr.
Director

M-3/4

Beaton 8/21

EES 8/21

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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
650 Capitol Mall, Rm. 3400
Sacramento, California 95814

December 11, 1973

John L. Beaton, P. E.
Chief, Transportation Laboratory
Department of Transportation
Division of Highways
5900 Folsom Blvd.
Sacramento, California 95819

Dear Sir:

We have received your letter of December 6, 1973, requesting any information we might have on disposing of or recycling abandoned tires. I'm sorry we do not have any information to furnish you on this subject.

Yours truly,

AUSTIN D. WARNKEN,
Area Conservationist

12/12/73

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US DA
Forest Service
630 Sansome Street
San Francisco, California 94111

Skog
(Copy sent to Forsyth)

7100
December 20, 1973

Mr. John L. Beaton, P.E.
Chief, Transportation Laboratory
Department of Transportation
5900 Folsom Blvd.
Sacramento, California 95819

Dear Sir:

We regret we have no information to forward you on the problems of and or possible solutions disposing of abandoned tires. Abandoned tires found along roads throughout the National Forest have not become an issue of significance as yet.

Sincerely,

JON D. KENNEDY

JON D. KENNEDY
Acting Regional Engineer

12/28

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Agricultural Extension

UNIVERSITY OF CALIFORNIA

RIVERSIDE COUNTY

21150 BOX SPRINGS ROAD RIVERSIDE, CALIFORNIA 92507 683-6491 / 4-H – 784-2505

June 14, 1974

Mr. Mike Quint
California Transportation
Laboratory
5900 Fulsom Boulevard
Sacramento, California 95819

Dear Mr. Quint:

With regard to your questions about using ground up tires for soil conditioning, I finally managed to get a hold of our Soils Specialist who for quite a while was gone when I was in and here when I was out and the gist of his information is as follows:

From the known composition of at least some tires, there are toxic elements that could be injurious to plants. Having said this, however, we cannot make the statement that the material would not, after a proper waiting period, turn out to be a good soil conditioning material. The fact is, we simply do not know for certain nor do we know of any research on the subject. Further, it is the suggestion of Dr. Roy Branson that since you are a laboratory and perhaps have chemists on your staff, that you could do one of several things. You could get various analyses made of the various makes of tires that you are considering grinding up and then also follow this up with an experiment, perhaps in a nursery or even in an outdoor area, where you use the material as a soil conditioner but leach it (apply excessive water) over a period of time, all the while growing plants of some sort in the medium until you learn the time it takes until the toxicity is leached out.

I realize this is a very unsatisfactory answer from your point of view but it is about the best we can do at the moment and I sincerely hope the above information will be helpful.

Very sincerely,

Otis A. Harvey

Otis A. Harvey
Farm Advisor

OAH:ms

Co-operative Extension work in Agriculture and Home Economics, U.S. Department of Agriculture, University of California, and Riverside County

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NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
Raymond T. Schuler, Commissioner

1220 Washington Avenue, State Campus, Albany, New York 12226

December 14, 1973

Mr. John Skog, P. E.
Chief, Environmental Improvement
Section
Division of Highways
Materials and Research Department
5900 Folsom, Boulevard
Sacramento, California 95819

Dear Mr. Skog:

This letter is in reply to your request for information on our use of rubber additives for sealing pavement joints.

We do not have a formal report describing our experience with joint sealers containing rubber additives. However, based on field observations, we have found that rubberized joint sealers last at least twice as long as asphalt sealers without any additives.

The "in-place" cost is about 30 percent more for rubberized joint sealers than it is for plain asphalt joint sealers.

For your information, I am enclosing a copy of our current specifications for the rubber admixture and the asphalt sealer we use. Also attached is a copy of instructions for field personnel describing how to mix and apply the rubberized asphalt sealer.

All the reclaimed rubber we use is bought from outside sources. We do not get involved in the collection or processing of the tires from which the additive is made.

Our present supplier is the U. S. Rubber Reclaiming Company in Vicksburg, Mississippi. The delivered cost of their material runs a little over 10 cents a pound.

If you are interested in further details on the manufacturing or use of reclaimed rubber, I suggest you contact:

Mr. Paul Dolan, Sales Manager
U.S. Rubber Reclaiming Co., Inc.
P.O. Box 54
Vicksburg, Mississippi

Very truly yours,

T. Koch for

G. RUSSELL, P. E.
Director of Highway Maintenance

GR:TK:csm
Attachments

D-22

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SPECIFICATION FOR ASPHALT FILLER

ITEM 702-05

MATERIAL PROPERTIES	ASPHALT FILLER
Pen. @ 77° F., 100 g., 5 sec.	50 - 60
Pen. Ratio (39.2° F/77° F) 100	55 - 70
Loss on Heating, 325° F., %, Max.	1.0
Pen. of Residue, % of Original, Min.	60
Solubility in CCl_4, % Min.	99.5
Flash Point, °F, Min., COC	392
Ductility @ 77°F, Min.	10
Softening Point, °F	140 - 167
Typical uses	Crack and Joint Filler

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INSTRUCTIONS FOR MIXING AND POURING RUBBERIZED ASPHALT JOINT SEALER

1. Start with not more than 2/3 of a kettle of heated Item 702-05 (asphalt filler).

2. Add to this the powdered rubber at the rate of two bags (100 pounds total weight) to one 55-gallon drum of asphalt sealer, or one part rubber to two parts sealer by volume.

3. Do not overload the kettle during this operation as a certain amount of foaming action is to be expected for about 15 minutes.

4. When the foaming has subsided, add additional sealer and rubber as required.

5. Heat the mixture to a temperature of 350°-375°F for 30 to 45 minutes. At the end of this time the rubber should have gone into solution. Draw off a small amount of the heated compound from the kettle. It should have a smooth consistency. If lumps of rubber are evident, continue heating until all the rubber has gone into solution. Care must be taken that the asphalt is not heated to its flash point temperature.

6. The rubberized asphalt is handled in the same ways as straight asphalt sealer.

7. Make only enough material for each day's use. Prolonged heating or reheating will cause a hard residue to form on the bottom of the heating kettle. Therefore, every effort should be made to use up the contents of the kettle so it is empty at the end of the day. Drain the kettles regularly and remove residue from the bottom to prevent plugging the screens in the kettle and pouring pots.

April 1, 1973

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DETAILED SPECIFICATION

General Description

The powdered, devulcanized rubber additive shall be moisture free, black in color, free flowing and contain no tire fabric or tire cord material.

Gradation

Sieve Size	Minimum % Passing	Maximum % Passing
#4	100	100
#8	85	100
#12	65	100
#20	35	80
#30	15	40

The gradation shall conform to the above sieve analysis; percent passing total weight.

Bulk Density

Approximately 37 pounds per cubic foot.

Cured Specimen Analysis *

Specific Gravity	1.28 - 1.33
Tensile Strength (p.s.i.)	750 minimum
Percent Elongation	220 minimum

* See Manual of Reclaimed Rubber, latest edition, Rubber Reclaimers Association, Inc.

Testing

The material shall be capable of meeting the following laboratory test:

When 40 to 50 grams of material are placed in a tight 6" rubber mill the material will band on the mill roll in one pass and will usually be retained on the mill roll.

Sample

A five pound sample of the material offered shall be submitted with the bid for testing purposes.

Certification

Bids must be accompanied by a certificate from an independent testing laboratory certifying the material meets or exceeds the provisions of this specification. Failure to submit such certification will be sufficient cause to reject the bid.

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Packaging

The material shall be packaged in multiple layer heavy paper bags containing 50# of material per bag. Delivery shall be made on disposable wood pallets when specified.

TK:csm

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E. Input From Disposal Site Operators

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Disposal companies and agencies in each county were contacted by telephone in regards to the problems associated with used tire disposal at their facility. The following tables present the responses received.

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TABLE E: SUMMARY OF RESPONSES FROM DISPOSAL COMPANY QUESTIONNAIRE

County	Company-Agency	Disposal Problems			DISPOSAL FEES					
					TIRES				General Refuse	
							$/Tire			
		Yes	No	Notes	$/Cu.Yd.	$/Ton	Auto	Truck	$/Cu.Yd.	$/Ton
Alameda	Oakland Scavenger			(1)	-	-	-	-	-	$4.00
Alameda	Oakland Scavenger	x		(2)	-	$20.00	-	-	-	$4.00
Alpine	Road Dept.		x		No Charge				No Charge	
Amador	Public Works		x		-	-	10¢	25¢	50¢	-
Butte	Public Works		x		$2.00e	-	-	-	25¢	-
Calaveras	Road Dept.	x		(3)	No Charge				No Charge	
Colusa	Health Dept.		x		No Charge				No Charge	
Contra Costa	Richmond Sanitary		x		-	-	15¢	15¢	50¢	-
Contra Costa	Acme Fill Co.		x		-	-	20¢	50¢	$1.25	-
Del Norte										
El Dorado	Road Dept.		x		-	-	10¢	25-50¢	-	$1.00
Fresno	City Public Works	x		(4)	No. Charge				No Charge	
Fresno	Solid Waste Indus.		x	(5)	-	-	50¢	50¢	50¢	-
Glenn										
Humboldt	El River Garbage	x		(4)	-	$1.50	-	-	-	$1.50

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TABLE E: SUMMARY OF RESPONSES FROM DISPOSAL COMPANY QUESTIONNAIRE (con't.)

County	Company-Agency	Disposal Problems			DISPOSAL FEES					
					TIRES				General Refuse	
							$/Tire			
		Yes	No	Notes	$/Cu.Yd.	$/Ton	Auto	Truck	$/Cu.Yd.	$/Ton
Imperial	Public Works	x		(4)	50¢e	-	-	-	50¢e	-
Inyo	Road Dept.		x		50¢	-	-	-	50¢	-
Kern	City Public Works		x		No Charge				No Charge	
Kern	Public Works		x		No Charge				No Charge	
Kings	Public Works		x		-	$2.30	-	-	-	$2.30
Lake	Public Works			(6)	-	-	-	-	No Charge	
Lassen	City of Susanville		x		No Charge				No Charge	
Los Angeles	Sanitation Dist.		x		-	$3.00	-	-	-	$2.00
Madera	Engineering Dept.		x		-	-	10¢	25¢	No Charge	
Marin	San Quentin Disposal		x	(7)	-	-	25¢	$1.00	$1.00	-
Mariposa	Board of Supervisors		x	(8)	No Charge				No Charge	
Mendocino	Ukiah Public Works	x		(9)	75¢	-	-	-	75¢	-
Merced	Public Works		x		-	-	25¢	$1.00	-	$3.50
Modoc	Public Works		x		No Charge				No Charge	
Mono	Public Health		x	(10)	No Charge				No Charge	

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					TIRES					
							$/Tire		General Refuse	
		Yes	No	Notes	$/Cu.Yd.	$/Ton	Auto	Truck	$/Cu.Yd.	$/Ton
San Mateo	So. County Disposal	X		(4)	$2.00	-	-	-	$1.00	-
San Mateo	S.M. Disposal		x		------Not Open to Public-------					
Santa Barbara	Public Works	x		(4)	-	$6.00	-	-	-	$3.40
Santa Clara	Easley & Brassy		x		-	$25.00	-	-	-	$8.90
Santa Cruz	Public Works		x		-	-	25¢	25¢	$1.00	-
Shasta	Redding Public Wk		x		No Charge				No Charge	
Sierra	Public Works		x	(10)	No Charge				No Charge	
Siskiyou	Weed Public Wks.		x	(8)	No Charge				No Charge	
Solano	Solano Garbage Co.		x		-	-	25¢	50¢	$2.50e	
Sonoma	Public Works		x		No Charge				No Charge	
Stanislaus	Public Works		x		-	-	10¢	20-50¢	-	$1.75
Sutter	Yuba-Sutter Disp.			(4)	-	-	25¢	50¢	75¢	-
Tehema	Road Dept.	x		(13)	$2.00e	-	-	-	25¢e	-
Trinity	Bd of Supervisors		x	(10)	No Charge				No Charge	
Tulare	Public Works		x	(8)	No Charge				No Charge	

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TABLE E: SUMMARY OF RESPONSES FROM DISPOSAL COMPANY QUESTIONNAIRE (con't.)

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					TIRES				General Refuse	
							$/Tire			
		Yes	No	Notes	$/Cu.Yd.	$/Ton	Auto	Truck	$/Cu.Yd.	$/Ton
Monterey	Monterey Peninsula Garbage Disposal	x		(4)	-	$ 4.00 Residents $10.00 Non-Residents			-	$1.00
Napa	Upper Valley Dispo.		x		-	-	25¢	25¢	$1.00	-
Nevada	Public Works	x		(4)	$2.00	-	-	-	No Charge	
Orange	Road Dept.	x		(4)	No Charge				No Charge	
Placer	Auburn Disposal		x		-	-	25¢	50¢	-	$1.00
Plumas	Sanitation Dept.	x		(3)	No Charge				No Charge	
Riverside	Road Dept.		x		No Charge				No Charge	
Sacramento	Co. Landfill	x		(11)	-	$20.00	-	-	-	$1.25
San Benito	Hollister Public Wk		x		$1.00e	-	-	-	$1.00e	-
San Bernardino										
San Diego	City Public Works	x			-	-	10¢	10¢	No Charge	
San Francisco	Easey & Brassey		x		-	$25.00	-	-	-	$8.90
San Joaquin	Tracy Public Works		x		-	-	10¢	25¢	50¢	-
San Luis Obispo	Paso Robles Public Works		x		-	-	10¢	20-70¢	$1.50e	-

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TABLE E: SUMMARY OF RESPONSES FROM DISPOSAL COMPANY QUESTIONNAIRE (con't.)

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					TIRES					
							$/Tire		General Refuse	
		Yes	No	Notes	$/Cu.Yd.	$/Ton	Auto	Truck	$/Cu.Yd.	$/Ton
Tuolumne	Sonora Public Wk.	x		(12)	No Charge				No Charge	
Ventura	Ventura Refuse Disp.	x		(4)	-	-	10¢	25-50¢e	$1.75e	-
Yolo	Davis Public Works		x	(1)	-	-	-	-	No Charge	
Yuba	Yuba-Sutter Disp.	x		(4)	-	-	25¢	50¢	75¢	-

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Notes on Tire Disposal Problems

1. No longer accepting tires due to lack of space.
2. Accepting limited quantities of tires due to tires being a fire hazard.
3. What do you do with used tires?
4. Tires won't stay buried in fill.
5. Will accept tires on a limited basis.
6. Do not accept tires.
7. Hire a private firm to haul to another disposal site.
8. Stock piling tires - not burying.
9. Area around tires are hard to compact.
10. Still burning tires and refuse.
11. Private truckers were hauling in tires from as far away as Salt Lake City, Utah and Seattle, Washington.
12. Large quantities dumped at one time are very hard to handle.
13. People dump tires in unauthorized areas (old dump sites).

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EASLEY & BRASSY CORP.

SOLID WASTE MANAGEMENT ■ ENGINEERING CONTRACTORS ■

April 23, 1974

Mr. John Skog
Chief, Environmental
Improvement Section
Department of Transportaion
Division of Highways
5900 Folsom Boulevard
Sacramento, CA - 95819

Dear Mr. Skog:

In response to your letter of March 20, 1974, I hope the following information will help in your study.

Tire disposal has not presented a problem in our operations because tires are handled on a daily basis with the rest of the waste through our transfer station. We do not accumulate them in a storage area and therefore, do not have any problems with mosquitoes, fires, or visual pollution.

At the landfill we do not place tires in the top 4 feet of the fill, but remove them and place them at the bottom of the fill.

In 1973 we recieved between 15-25 tons of tires a week as compared to 10,000 tons of waste a week. Our present disposal rate is $25 per ton for tires - $8.90 a ton for other waste.

If you have any further questions please contact our office.

Very truly yours,

EASLEY & BRASSY CORPORATION

Tom Meichtry

Tom Meichtry

TM/pam

4/25/74

411 TUNNEL AVENUE ■ SAN FRANCISCO, CALIFORNIA 94134 ■ (415) 467-2552

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COUNTY OF ORANGE

L. McCONVILLE
ROAD COMMISSIONER AND COUNTY SURVEYOR

ENGINEERING BUILDING
400 CIVIC CENTER DRIVE WEST
SANTA ANA, CALIFORNIA 92701

TELEPHONE 714-834-3456

ROAD DEPARTMENT
April 2, 1974

Mr. Martin Nolan
Department of Transportation Lab
State of California
9500 Folsom Boulevard
Sacramento, California 95819

SUBJECT: Tire Disposal at Landfills

Dear Mr. Nolan:

In response to your questions via telephone conversation of March 28, 1974 be advised as follows:

Orange County does not charge a fee for disposal of tires or any other solid wastes at its landfill sites.

After tires are placed and covered with refuse and soil they tend to rise to the surface, however, by cutting tires in half or shredding them, the problem is eliminated.

The number of tires disposed in 1973 is unknown.

Present practices for tire disposal are adequate and no future problems are anticipated. Tires do provide an ideal solid waste for resource recovery.

If not covered daily with dirt, tires represent a possible fire hazard and mosquito breeding area.

Only solid wastes, including tires, originating in Orange County are disposed at County landfills.

Very truly yours,

L. McCONVILLE
Road Commissioner and County Surveyor

By: T. P. O'Brien
T. P. O'BRIEN
Refuse Disposal Engineer

LM:TPO:RJF:Ca

In the interest of waste resource recovery, this is recycled paper.

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Proposed Distribution for "A Report on the Problems and Possible Solutions to Disposing of or Recycling of Used Tires"

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