

**RECYCLED PLASTICS IN  
HIGHWAY CONSTRUCTION  
AND MAINTENANCE**

**Final Report**

**State Research Project #525**

by

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Prepared for

Oregon Department of Transportation  
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July 1997

1. Report No. <b>OR-RD-98-02</b>		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle "Recycled Plastics in Highway Construction and Maintenance"  Final Report				5. Report Date July 1997	
				6. Performing Organization Code	
7. Author(s) Wes Heidenreich, T2 Coordinator				8. Performing Organization Report No.	
9. Performing Organization Name and Address  Oregon Department of Transportation Policy/Research Section 2950 State Street Salem, OR 97310				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No.	
12. Sponsoring Agency Name and Address  Oregon Department of Transportation Policy/Research Section 2950 State Street Salem, OR 97310				13. Type of Report and Period Covered  Final Report  October 1992 - December 1995	
				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract  Installation and serviceability were examined for several products manufactured, in part, from recycled products. The following recommendations were reached:  The type of recycled plastic snow pole employed in this study is not recommended for general use by ODOT.  Though the recycled plastic fence posts used in this study have higher initial cost than the more customary wooden posts and have greater labor requirements during installation, they should be considered when high quality wooden fence posts are unavailable.  The recycled plastic sign support posts used in this study, both hollow and solid core, are not suitable for use by ODOT.  The general use of the FHWA approved TREX (Timbrex) recycled plastic guardrail offset blocks is encouraged.  TRIMAX boards and Carsonite panels are suitable sound wall materials.  As the emphasis on using recycled materials increases, products suitable for highway construction and maintenance will become more common. The continued use of products with recycled materials should be encouraged and the successes and failures of such use publicized.					
17. Key Words  RECYCLED PLASTICS, SOUNDWALL, FENCEPOSTS, SIGNPOSTS, SNOWPOLES, COMPOSITES			18. Distribution Statement  Available through the Oregon Department of Transportation, Research Unit		
19. Security Classif. (of this report) unclassified		20. Security Classif. (of this page) unclassified		21. No. of Pages 24	22. Price

## SI\* (MODERN METRIC) CONVERSION FACTORS

### APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
<u>LENGTH</u>				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
<u>AREA</u>				
in <sup>2</sup>	square inches	645.2	millimeters squared	mm <sup>2</sup>
ft <sup>2</sup>	square feet	0.093	meters squared	m <sup>2</sup>
yd <sup>2</sup>	square yards	0.836	meters squared	m <sup>2</sup>
ac	acres	0.405	hectares	ha
mi <sup>2</sup>	square miles	2.59	kilometers squared	km <sup>2</sup>
<u>VOLUME</u>				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft <sup>3</sup>	cubic feet	0.028	meters cubed	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.765	meters cubed	m <sup>3</sup>

NOTE: Volumes greater than 1000 L shall be shown in m<sup>3</sup>.

#### MASS

oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg

#### TEMPERATURE (exact)

°F	Fahrenheit temperature	5(F-32)/9	Celsius temperature	°C
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### APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
<u>LENGTH</u>				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
<u>AREA</u>				
mm <sup>2</sup>	millimeters squared	0.0016	square inches	in <sup>2</sup>
m <sup>2</sup>	meters squared	10.764	square feet	ft <sup>2</sup>
ha	hectares	2.47	acres	ac
km <sup>2</sup>	kilometers squared	0.386	square miles	mi <sup>2</sup>
<u>VOLUME</u>				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m <sup>3</sup>	meters cubed	35.315	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	meters cubed	1.308	cubic yards	yd <sup>3</sup>
<u>MASS</u>				
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T

#### TEMPERATURE (exact)

°C	Celsius temperature	1.8 + 32	Fahrenheit	°F
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\* SI is the symbol for the International System of Measurement

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## 1.0 INTRODUCTION

Four types of highway related recycled plastic products were selected in 1991 for evaluation by the Research Unit: snow poles, fence posts, sign supports, and sound wall materials from five manufacturers.

Descriptions of these products and information on availability and costs, installation procedures and locations, and concerns for recyclability, flammability and the health of workers handling the products are contained in the "Construction Report" of December 1993. *Recycled Plastic Vendors' Addresses and Costs, Table A.1, and Soundwall Vendors and Costs, Table A.2 (renumbered)*, of the Construction Report are attached to this report.

At this time, all the products tested remain available with the exception of Harbor Sales and Enviro-Lumber (supplied by Environmental Plastics). Unit prices have not risen significantly over those shown in the Construction Report and greater economy can be achieved through truck or railcar size purchases.

The "Construction Report" contains the following conclusions and recommendations.

### **Previous Conclusions:**

The following general conclusions were reached following installation of the recycled plastic snow poles, fence posts, sign support, and sound wall:

- 1) Recycled plastic materials for construction and maintenance may be more difficult to obtain than standard wood products.
- 2) Upfront material and shipping costs are more expensive than comparable wood products.
- 3) The equivalent uniform annual material costs of wood and plastic products should be considered when evaluating costs of recycled materials.
- 4) Handling of recycled plastic materials is similar to handling treated wood products. Both materials come with recommendations for inhalation, skin and eye protection.
- 5) Recycled materials may be more readily recyclable than treated wood products which must be disposed of in a landfill or burned in accordance with state and federal regulations.

- 6) Recycled plastic snow poles are easier to install than standard snow poles, but may sag during heavy snow periods.
- 7) Recycled plastic fence posts are more difficult to install than standard treated wood posts because of the lack of a tip or the difficulty in creating a tip to facilitate installations. Depending on the type of plastic, stapling may also be a problem with plastic fence posts.
- 8) Solid core recycled plastic sign posts are more difficult to install than standard treated wood posts. In general, extra effort is needed to attach the signs to the plastic sign supports.
- 9) Recycled plastic lumber is heavier and requires more effort to work with than comparable wood lumber as noted during fence and signpost installation and sound wall construction.
- 10) Recycled plastic sound wall panel boards manufactured with shiplap joints may not lock sufficiently to prevent bowing.

Recycled plastic products provide a means for reusing pre- and post-consumer waste. The costs of recycled plastic, however, still exceed standard material costs. When comparing costs, the life expectancy of the given product should be included in the analysis since plastic materials may last longer than wood products. As more information is available, installation, shipping, and maintenance costs should also be included in the price comparison.

A premium should be paid for recycled materials only if the products are expected to outperform standard wood products. With long term performance characteristics currently unknown, the attributes and value of recycled plastic products need to be determined.

### **Previous Recommendations:**

Additional recycled plastic material installations should be encouraged. Since the materials are relatively new, some of the construction problems could be due to inexperience in handling. As the plastic materials become more common, handling and installation concerns should decrease.

Recycled plastic fence posts for installations in areas with dense soils should be ordered with a point at one end. The pointed end will facilitate installation and decrease the chance of breakage.

Recycled plastic fence posts should be installed by pushing with steady pressure rather than driven with repeated blows. Repeated blows to the recycled plastic fence posts increase the chances of breakage.

Recycled plastic boards used for sound wall facing should have tongue and groove joints to insure proper interlocking and to reduce the amount of bowing.

## **2.0 PRODUCT PERFORMANCE**

Product performance was evaluated annually.

### **2.1 SNOW POLES**

The snow poles were only used during one season (winter 92-93) as they did not provide satisfactory performance. While they were easy to handle and were readily seen, they were not rigid enough to remain vertical in the wet snow prevalent on Mt. Hood. They may be suitable for use in eastern Oregon where the snow is typically drier.

### **2.2 FENCE POSTS**

During summer 1997 inspections of the posts installed in the coastal area, the following were observed:

- The TREX (Mobil Chemical Co.) and TPLC (The Plastic Lumber Co.) posts exhibited slight color fading. There was algae growth on some surfaces, but the posts appeared sound and are performing satisfactorily.
- The Enviro-Lumber posts in some cases exhibited distress. There were instances of peeling and of bug infestation (see Figure 2.1). The posts were erect and supporting the fencing material.
- The wood posts exhibited a noticeable amount of checking (see figure 2.2).

Reports from maintenance forces in eastern Oregon indicate the posts installed there – TREX and TPLC – were performing satisfactorily. There has been no loss of support of the fencing materials.

Until failure of the installed posts is recorded, life cycle cost comparisons cannot be made between the recycled plastic and the standard treated wooden posts. The higher cost of the recycled plastic posts and the extra labor involved in installation means a decision to use them must be based, at this time, upon considerations other than cost/benefit.



Figure 2.1 Enviro-Lumber Fence Post



Figure 2.2 Wood Post

## **2.3 SIGN POSTS**

The recycled plastic sign supports used in this study do not provide a reasonable alternative to the customary steel or treated wooden posts. Noted during annual visits, the recycled plastic posts exhibited color fading, bowing, and loosening of soil support. ODOT maintenance personnel who monitored the performance of the posts would not choose to use them again. The solid posts are heavier than the standard steel or wooden posts, making for extra handling, and the density of the material requires drilling for insertion of lag bolts, a step not required with wooden posts.

The RPM signposts, being hollow, are easily damaged from tightening of the bolts and nuts holding the sign to the post (see Figure 2.3). Using a plate against the post instead of washers, or a special sleeve available from the vendor can offset this problem. The need for these additional precautions is a further detraction from the value of the post. The vendor reports the manufacturer is now supplying posts with greater wall thickness.

In October 1994, a TREX post was found broken off at ground level. There was no indication the post had been struck by a vehicle or been vandalized. The post is presumed to have failed from being subjected to strong wind gusts at its location in the coastal area near Humbug State Park.

## **2.4 OFFSET BLOCKS**

Guardrail offset blocks made from recycled plastic were accepted for evaluation after the start of the research project. These blocks have been approved by FHWA for use on steel and wooden posts. Thirty blocks have been placed at locations in Portland and in Ashland. Installation of the blocks is the same as that for the customary wooden block, though in at least one instance, the sides of the blocks facing the post and the rail were slightly convex making for a tighter fit than is normal with wooden blocks.

Only one incident has been reported of guardrail damage at the location of a recycled plastic block installation. The recycled plastic blocks, placed alternately in line with wooden blocks, were undamaged while two adjoining wooden blocks split and had to be discarded (see Figure 2.4). Maintenance personnel recommend continued use of the recycled blocks.

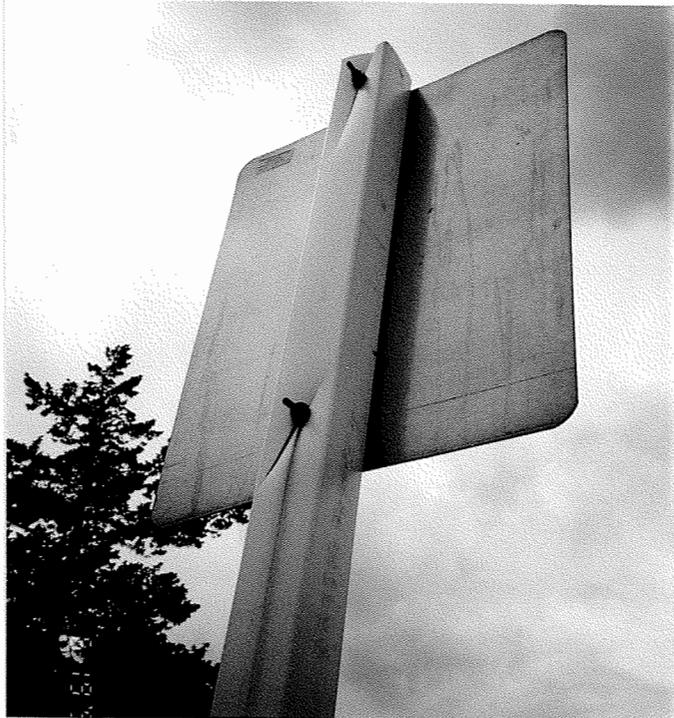


Figure 2.3 RPM (Hollow) Sign Post



Figure 2.4 Recycled plastic block placed alternately in line with wooden blocks.

## **2.5 INITIAL COST AND DISPOSAL**

For those recycled plastic products that perform satisfactorily, the issues of high initial costs and ultimate disposal must be addressed. The recycled plastic products are currently more expensive to purchase than the products customarily used, generally treated wood, and in some cases require extra effort to install. These disadvantages may be reduced as more experience is gained with the products, and manufacturing economies lower the cost. Disposal of the recycled plastic products should have an advantage over treated wooden posts. The recycled plastic products themselves are potentially recyclable, while treated wooden posts have special disposal requirements. Local recycling facilities, however, may not accept the recycled products for reprocessing, and the costs of shipment to return the products to the manufacturer make such returns impractical. The producer of the TREX products, Mobil, is planning to build a manufacturing facility in the western part of the US, which will make recycling their products easier. This will add incentive to purchasing their products.

Duck's Marine, suppliers of TriMax Lumber, will accept small quantities of used materials for recycling but does not anticipate nor has it made provision for large scale recycling.

Vanco, vendors for TPLC, is unaware of any recycling practices for its products. The Plastic Lumber Co., Inc. does not accept its products for reprocessing. Anyone considering the purchase of recycled plastic products should thoroughly investigate existing conditions of cost, installation, and disposal.

## 3.0 SOUNDWALL MATERIAL PERFORMANCE

The soundwall was inspected on a regular basis until it was dismantled for freeway widening in 1996. The following issues were considered:

### 3.1 GRAFFITI REMOVAL

The soundwall panels were marred by graffiti which appeared to have been done using paint or lacquer from aerosol cans. No attempt was made to establish the nature of the product. Some attempt to remove the graffiti was made using commercially available chemicals and also high-pressure water spray. The high-pressure water cleaning did well on the smooth surfaces and moderately well on the porous surfaces. The Carsonite panel with its smooth surface responded best to all cleaning efforts. Of the several commercial products used, none worked well on the TREX product, its surface being the roughest of the recycled plastic materials. A TREX supplier recently recommended sanding the graffiti off.

Graffiti removal from the other panel materials was best accomplished using 3M Citrus Based Natural Cleaner from the 3M Company. Other products used included Graffiti Master by Harris Specialty (Watson Bowman) and types B&C of Graffiti-Gone from Multiseal. Hand scrubbing was done to remove cleaner and graffiti. No provision was made for spray rinsing of the panels after application of the cleaners. Allowing the cleaners to remain on the graffiti 20 to 30 minutes before scrubbing aided in cleaning. Because the commercial cleaners were used under very dissimilar conditions, no final ranking of their effectiveness can be made.

### 3.2 VISUAL EXAMINATION

The following observations were made during examination of the wall panels on December 7, 1995:

Wooden Panels: There was no discernible outward bowing of any of the wooden panel pieces (these are 3" x 6" tongue and groove fir). Only one board in each of two panels exhibited some warping vertically, the most severe being the very narrow piece at the top of the second wooden panel.

TRIMAX Panels: There was no obvious upward warping of any of the panels, and no obvious surface deterioration. General appearance is the same as at installation.

#### Harbor Sales Panels

Panel 1: There is obvious upward warping of some pieces, and when the panel is viewed from the side, outward bowing is apparent. The top most piece, cut narrow at time of installation, is severely warped.

Panel 2: The most obvious distress in this set of panels is sagging in the lower portion. The panels have a wide variation in color between and within panels. The first panel is a bluish gray overall while the second is orchid. Within each panel color ranges from very pale to very dark. These color variations existed at the time of the installation. No deterioration in the surface is apparent.

Carsonite Panel: There are no obvious changes in the character of this panel.

TREX Panels:

Panel 1: The only apparent distress in this panel is a warping of two boards in the upper half of the panel.

Panel 2: This panel has conspicuous bowing in the lower half. The bowing is to the rear of the panel below center and frontward in the lower quarter.

For both panels, the surface texture and appearance are unchanged from the time of installation.

Collins and Aikman Panel: Sagging and outward bowing are apparent in the bottom ten of the seventeen boards making up the panel. Unlike the TREX boards of the same dimensions, a steel rod through the bottom boards did not support the Collins and Aikman boards. Surface texture and color appear unchanged.

## 4.0 RECOMMENDATIONS

- 1) The type of recycled plastic snow pole employed in this study is not recommended for general use by ODOT.
- 2) Though the recycled plastic fence posts used in this study have higher initial cost than the more customary wooden post and have greater labor requirements during installation, they should be considered when high quality wooden fence posts are unavailable.
- 3) The recycled plastic sign support posts used in this study, both hollow and solid core, are not suitable for use by ODOT.
- 4) The general use of the FHWA approved TREX (Timbrex) recycled plastic guardrail offset blocks is encouraged.
- 5) TRIMAX boards and Carsonite panels are suitable sound wall materials.

As the emphasis on using recycled materials increases, products suitable for highway construction and maintenance will become more common. The continued use of products with recycled materials should be encouraged and the successes and failures of such use publicized.

**APPENDIX A**

**RECYCLED PLASTIC VENDORS' ADDRESSES  
AND COSTS**

**Table A.1 Recycled Plastic Vendors' Addresses and Costs**

Manufacturer or Product	Vendor	Snow Poles	Fence Posts	Sign Posts	Size	Price/Item	Ship Costs
Dapco	Dapco Davidson Plastics 18726 E Valley Hwy Kent WA 98032 (206) 251-8140	*			10' Long; 1.3" Diam.	\$3.52	-0-
Timbrex <sup>1</sup>	Ecoversion Products Inc. 87 Stillman Street San Francisco CA 97107 (415) 882-5515			*	4"x4"x8'	\$12.60	\$190.00
The Plastic Lumber Co., Inc.	VANCO Associates Inc. 220 Main Street Edmonds WA 98020 1-800-223-2183			*	6"x6"x7'	\$47.11	\$100.00
Timbrex <sup>1</sup>	Ecoversion Products Inc.			*	6"x6"x8'	\$30.49	\$953.00
The Plastic Lumber Co., Inc.	VANCO Associates			*	6"x6"x7.5'	\$51.16	\$700.00
Enviro-Lumber <sup>2</sup>	Environmental Plastics 18574 South HWY 99E Oregon City OR 97045 (503) 655-0758			*	6"x6"x8'	\$60.00	\$166.12
RPM	Traffic Safety Supply 2324 SE Umatilla Street Portland OR 97202 (503) 235-8531			*	4"x4"x12' (Hollow)	\$18.00	\$25.00
Timbrex <sup>1</sup>	Ecoversion Products Inc.			*	4"x4"x12' (Solid)	\$18.90	\$80.00
Timbrex <sup>1</sup>	Ecoversion Products Inc.			*	4"x4"x14' (Solid)	\$22.74	\$80.00
Timbrex <sup>1</sup>	Ecoversion Products Inc.			*	4"x4"x14' (Solid)	\$22.05	\$97.00
Hammer Plastics	Charles R. Watt Inc. P.O. Box C-70708 Seattle WA 98107 (206) 783-8400			*	4"x4"x12' (Solid)	\$50.43	\$45.00
Trimax	Ducks Marine Distributors 18699 NE Marine Drive Portland OR 97230 (503) 665-8348			*	6"x6"x20' (Solid)	\$84.00	\$75.00

<sup>1</sup>Timbrex is now called Trex. Trex is a product of Mobil Chemical Company (1-800-BUY-TREX). The local vendor is OREPAC Building Products, Wilsonville (503-682-5050)

<sup>2</sup>This product is not available.

**Table A.2 Sound Wall Vendors And Costs (Renumbered)**

Manufacturer or Product	Vendor	Date Installed	Material	Dimensions	Material Cost/sf	No. of Boards	No. of Panels	Material Costs	Shipping Costs	Total Costs
T&G Lumber	Disdero Lumber 1504 SE Woodward Portland OR 97202 (503) 239-8888	6/23/93	Treated Lumber	2.5" x 5.5" (T&G)	\$4.71	22	3	\$1,139.69	-0-	\$1,139.69
Carsonite	Carsonite International 7458 Black Tree Lane Citrus Heights CA 95610 (916) 969-5373	6/23/93	Virgin Plastic/ Rubber	8' x 10' (1 piece)	\$15.00	1	1	\$1,200.00	-0-	\$1,200.00
Trimax	Ducks Marine Distributing 18699 NE Marine Dr. Portland OR 97230 (503) 9665-8348	6/23/93	Recycled Plastic	2.5" x 8.75" (T&G)	\$4.34	14	2	\$708.40	\$563.00	\$1,271.40
Harbor Sales <sup>4</sup>	Harbor Sales Co. 2945 SW Fairview Blvd. Portland OR 97201 (503) 936-0500	6/23/93	Recycled Plastic	2.5" x 7.5" (Ship Lap)	\$7.73	16	2	\$1,236.00	\$251.00	\$1,487.00
Trex <sup>1</sup>	Mobil Chemical Co. Composite Products Div. 800 Connecticut Avenue Norwalk CT 06856 (203) 831-4204	10/18/93	Recycled Plastic/ Wood Fibers	2" x 7.5"; 2" x 5.5" (T&G)	\$2.90 <sup>2,3</sup>	17; 24	2	Donated	NA	NA
Collins & Aikman	Collins & Aikman Corp. P.O. Box 1447 Dalton GA 30720 (706) 259-9711	12/3/93	Recycled Plastic/ Recycled Carpet Fibers	2" x 7.5" (T&G)	NA <sup>2</sup>	17	2	Donated	NA	NA

<sup>1</sup>Trex is the new name for Timbrex.

<sup>2</sup>Donated Materials.

<sup>3</sup>The cost shown is based on the manufacturer's projected cost of \$1.75/board foot (actual dimensions).

<sup>4</sup>This product is not available.