A COMPARISON OF PRESSURE TREATED WOOD AND CEDAR SIGNPOSTS

Final Report

STATE RESEARCH PROJECT #549

RESEARCH

Oregon Department of Transportation

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by

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16. Abstract

This report compares the use of pressure treated wood and cedar for signposts. Both materials are being used by the Oregon Department of Transportation (ODOT), however sign crews are now primarily using Port Orford cedar posts.

There are two types of pressure treated posts used by ODOT, Douglas-fir treated with Ammoniacal Copper Zinc Arsenate (ACZA) and Hem-fir treated with Chromated Copper Arsenate (CCA). There are environmental concerns about the use of pressure treated wood. However, studies cited in this report have shown it is not detrimental to the environment.

Based on price data provided by pressure treated wood suppliers, the purchase price for ACZA treated Douglas-fir is slightly higher than Port Orford cedar. Some of the suppliers expressed concerns about the availability of Hem-fir posts that would meet ODOT specifications.

The average disposal cost for pressure treated wood based on disposal at a landfill or waste transfer facility is slightly higher than cedar. In actual practice, sign crews dispose Port Orford cedar wastes in existing waste containers, thus eliminating the added disposal fee incurred by taking it directly to a landfill or waste transfer facility.

In a survey of ODOT sign crews, they unanimously favor using Port Orford cedar posts over pressure treated posts.

In Oregon State University's wood post studies, Port Orford cedar posts lasted an average of 20 years, whereas pressure treated wood posts remained in service one-and-a-half to three times longer than Port Orford cedar. ODOT sign crews assert that only a small number of posts are replaced because of rotting, indicating a 20 year life is adequate for a signpost.

Based on the information presented in this report, Port Orford cedar is the most appropriate signpost material to meet ODOT requirements.

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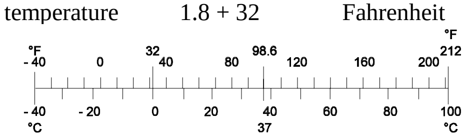
SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
In	Inches	25.4	Millimeters	Mm
Ft	Feet	0.305	Meters	M
Yd	Yards	0.914	Meters	M
Mi	Miles	1.61	Kilometers	Km
		AREA		
in^2	Square inches	645.2	millimeters	mm^2
ft^2	Square feet	0.093	meters squared	M^2
yd^2	Square yards	0.836	meters squared	M^2
Ac	Acres	0.405	Hectares	Ha
mi^2	Square miles	2.59	kilometers squared	Km^2
		VOLUME		
fl oz	Fluid ounces	29.57	Milliliters	ML
Gal	Gallons	3.785	Liters	L
ft^3	Cubic feet	0.028	meters cubed	m^3
yd^3	Cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		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

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	Millimeters	0.039	inches	in
m	Meters	3.28	feet	ft
m	Meters	1.09	yards	yd
km	Kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
ha	Hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
mL	Milliliters	0.034	fluid ounces	fl oz
L	Liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
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



***** SI is the symbol for the International System of Measurement

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A COMPARISON OF
PRESSURE TREATED WOOD AND CEDAR SIGNPOSTS
FINAL REPORT

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1.0 INTRODUCTION

Since August 1998, the Oregon Department of Transportation (ODOT) has had a commodities contract in place to provide Port Orford cedar signposts for their sign crews. Since that time, the majority of signposts installed by ODOT sign crews have been Port Orford cedar. Prior to August 1998, the sign crews were primarily using pressure treated wood signposts.

Additionally, ODOT's Standard Specifications for Highway Construction require pressure treated wood signposts on highway construction projects. However, recently the option for using naturally decay resistant wood (Port Orford cedar and Western Red cedar) signposts has been incorporated into the Contract Special Provisions for Highway Construction. As a result of this change, the ODOT Research Group was asked to complete an objective comparison of the use of cedar vs. pressure treated wood signposts.

Figure 1.1: A Pressure Treated (left) and a Port Orford Cedar Signpost (right)

In ODOT's contract specifications for highway construction, wood signposts (pressure treated or cedar) must be "free of heart center." Free of heart center means that the post is cut from the heartwood or sapwood with the pith excluded. The pith is the small soft center of the tree trunk or branch. Heartwood is the portion of the log extending from the pith to the sapwood. It contains cells that no longer participate in the life processes of the tree and is generally more decay resistant than the sapwood. Sapwood is the living wood near the outside of the tree. It is the portion of the tree extending out from the heartwood to just under the bark. Sapwood is more susceptible to decay than heartwood, but it is easier to treat and can be more effectively injected with preservatives than heartwood. To ensure that the heartwood is penetrated, the wood is usually incised with small slits along the surface prior to pressure treatment. Figure 1.2 presents a diagram showing a cross section of the tree's constituents.

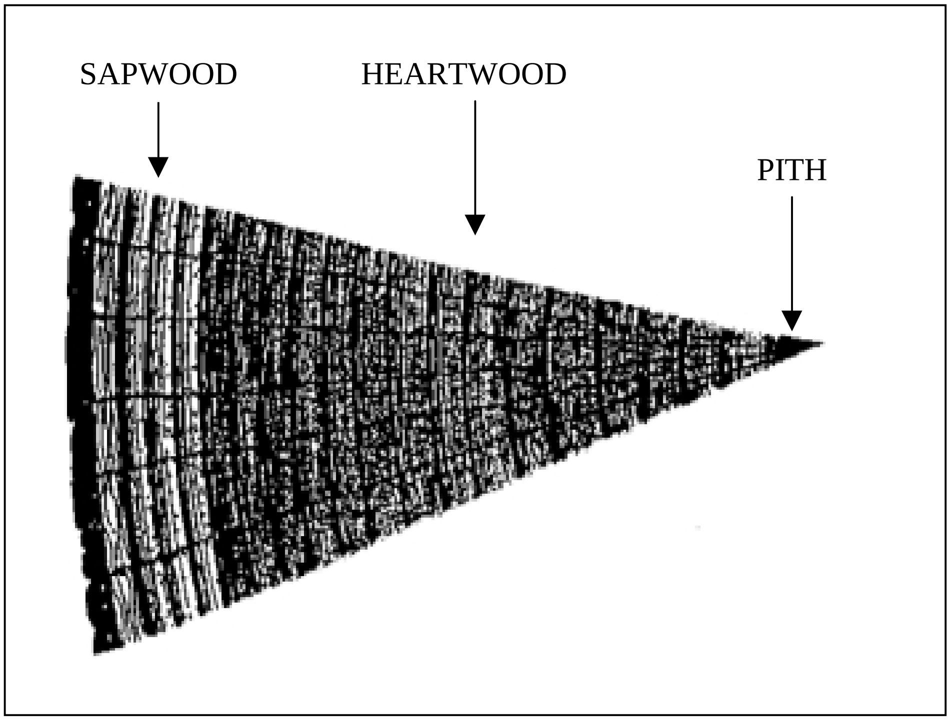

Figure 1.2: Diagram Showing the Major Tree Trunk Constituents

1.1 PRESSURE TREATED WOOD POSTS

The use of Douglas-fir or Hem-fir wood for signposts requires pressure treatment. The pressure treatment process forces chemical preservative into the wood, providing deep protection against decay caused by fungi, or insects such as termites and wood-eating ants.

ODOT's Standard Specifications allow one of the following preservatives:

- Creosote
- Pentachlorophenol (Penta)
- Ammoniacal Copper Zinc Arsenate (ACZA)
- Chromated Copper Arsenate (CCA), Type A, B, C

Creosote and penta are oil-borne preservatives; ACZA and CCA are waterborne preservatives. Of the four, ACZA and CCA (Type C) are the most widely used and therefore, the discussion that follows will address only ACZA and CCA (Type C) when referring to pressure treated wood. In the rest of the report, CCA (Type C) wood is referred to as just "CCA."

Chromated Copper Arsenate (CCA) is used to treat Hem-fir wood posts. Its chemical constituents include chromium, copper, and arsenic. The chromium fixes the preservative to the wood through a series of chemical reactions that take place in the wood, minimizing the leaching of preservative components (*Lebow 1996*). Chromium binds the protective components (copper and arsenic) to the wood and copper protects the wood from fungi decay. Arsenic resists attack from insects and helps protect against some of the copper tolerant fungi.

Ammoniacal Copper Zinc Arsenate (ACZA) is used primarily in the treatment of Douglas-fir because Douglas-fir is harder to penetrate. The ammonia in ACZA improves preservative penetration *(Morrell and Rhatigan 1999).* The preservative's other constituents include copper, zinc, and arsenic. Copper acts as a fungicide and arsenic protects the wood against insect attack. Zinc also protects the wood against fungi and helps fix the arsenic to the wood fibers to resist leaching. Wood treated with ACZA is similar in characteristics and performance to wood treated with CCA *(Forest Products Laboratory 1999).*

The unit weight of treated Douglas-fir is about 550 kg/m^3 and the unit weight of treated Hem-fir is 472 kg/m^3. The unit weights for each are based on 12 percent moisture content. The sapwood of untreated Douglas-fir has a white to pale yellow color and the heartwood is yellowish to reddish brown. The sapwood and heartwood of untreated Hem-fir is lighter in color, varying from a creamy white to a light straw brown color.

1.2 NATURAL WOOD POSTS

Naturally decay resistant posts allowed by highway construction contract specifications include either Western Red cedar or Port Orford cedar. The majority of signposts within ODOT's inventory however, are installed by its sign crews. As stated earlier, the sign crews are using Port Orford cedar posts as the naturally decay resistant alternative to pressure treated posts.

Port Orford cedar is found along the coastal regions of northwestern California and southwestern Oregon. It is highly resistant to decay. In tests of durability, Port Orford cedar has an average service life that is 60 to 70 percent longer than untreated Douglas-fir.

Western Red cedar grows in the Northwest along the Pacific Coast from California to Alaska and also in Idaho and Montana. It is very resistant to decay because it contains natural oils that act as preservatives. Although it is naturally decay resistant, the Western Red Cedar Lumber Association recommends that "if exposed for prolonged periods to conditions where decay could be a factor, such as where the wood is in contact with the ground, cedar should be treated with suitable wood preservatives."

The unit weight for Western Red cedar is 375 kg/m^3 and the unit weight for Port Orford cedar is 470 kg/m^3. The unit weights for each are based on 12 percent moisture content. The sapwood of Western red cedar is almost white and its heartwood has a reddish or pinkish brown color. The color of Port Orford cedar's sapwood and heartwood is white to pale yellow.

There are advantages and disadvantages associated with either naturally decay resistant or pressure treated wood for use as signposts. The information presented in the remainder of the report provides a comparison of the two types material. The comparison of naturally decay resistant material is generally limited to Port Orford cedar since Western Red cedar signposts require treatment below the groundline. In the following sections, the environmental concerns with using pressure treated wood are addressed as well as worker protection requirements for both materials. Other areas covered in the report include waste disposal, price, and durability. The results of an ODOT Sign Crew Survey are also presented.

2.0 ENVIRONMENTAL ASSESSMENT OF PRESSURE TREATED WOOD

The U. S. Environmental Protection Agency (EPA) conducted extensive research in the 1980s on the use of CCA. The EPA concluded that wood treated with CCA “did not pose unreasonable risks to children or adults, either from direct contact with the wood (e.g., as used for playgrounds and decks) or from contact with surrounding soil where some releases might have occurred.” Based on this research, the EPA does not consider arsenical (CCA and ACZA) treated wood a toxic substance or a hazardous waste when it is disposed. However, it is classified as a “restricted use” pesticide, meaning that the preservative can only be applied by certified applicators and the preservatives must be registered with the EPA *(EPA Office of Pesticide Program 1997).*

Although the EPA has not identified any significant health concerns from short or long term exposure to arsenical residues, the leaching of metals from pressure treated wood is still a contentious environmental issue. There are concerns with direct contact to humans working with pressure treated wood and the harmful effects to ecosystems if there is leaching and migration of metals through the surrounding soil or groundwater. As a result of these concerns, considerable research has been conducted in recent years about the leaching characteristics of chemicals from pressure treated wood.

Brooks *(1997)* reviewed previous research and assessed the risks of contaminants leaching from CCA and ACZA treated wood used in aquatic environments. Copper, chromium, and arsenic metals in treated wood are harmful to an aquatic habitat at certain levels. Copper is the most dangerous to aquatic life in fresh and salt water. Brooks developed models to predict metal concentrations from the use of ACZA and CCA in aquatic environments. On the basis of the models and analysis, Brooks concluded that the levels of contaminants associated with the use of properly treated CCA and ACZA wood products in moderately well-circulated bodies of water are well below regulatory standards. Brooks also found that leaching rates decrease exponentially with time.

A study at Oregon State University conducted by Morrell and Rhatigan *(1999)* looked at preservative movement from Douglas-fir decking and timbers treated with ACZA. The wood was treated with ACZA using “Best Management Practices” (BMP) developed by the Western Wood Preservers’ Institute for use of treated wood in aquatic environments. The researchers tested the soil for copper, zinc, and arsenic before the deck was installed, and then monitored the soil for a 22-month period. One of the six sample sites showed elevated copper levels after 14 months. The researchers attributed this to the topical copper naphthenate/boron paste that was applied to the cut ends of the timbers when the deck was constructed. They suggested that the movement and dimensional changes in the deck may have scraped residual paste from the cut ends or exposed the paste to rain water. Overall, the researchers found that the levels of zinc, arsenic and copper (at the other five sample sites) remained at close to soil background conditions over the 22-month period.

In another recent study in Oregon for the U. S. Forest Service *(Brooks 1999)*, the effects of pressure treated wood used on an extensive boardwalk system was studied. The boardwalk site was located at the Wildwood Wetland Recreational Area in the Mt. Hood National Forest. Three different preservatives were used to treat the wood at three different test sites on the boardwalk. Two of the sites included a viewing platform treated with ACZA and a bridge treated with CCA. Water and sediment samples were taken prior to construction and at 15, 162, and 336 days after construction. At the ACZA site, the sediment slightly exceeded copper threshold levels on the Day 15 sampling for a sample taken 3.0 m downstream from the platform. A water column sample exceeded the EPA chronic copper criteria in the vicinity of the structure (1.0 m downstream). The other ACZA sample locations for Day 15 and the entire sample set for Days 162 and 336 were within regulatory limits and thresholds.

At the CCA site, the water column samples tested for copper did not exceed the EPA chronic copper criteria for all sample locations. The sediment samples for copper, chromium, and arsenic were below threshold levels.

Jin and Preston *(1993)* studied the effects of treated wood on the germination and growth of tomato plants. They grew plants in beds surrounded with CCA pressure treated Southern pine stakes. They also grew plants that were surrounded by stakes that were pressure treated with water to use as controls. The researchers observed a higher level of chromium and arsenic in the soil surrounding the CCA stakes than in the soil containing plants with untreated stakes. Copper levels in the soil were about the same for the plants surrounded with treated stakes and those adjacent to untreated stakes. In the root systems of the plants surrounded by CCA pressure treated stakes, the content of arsenic was about the same as the control site plants. Levels of chromium and copper were slightly higher in the plants surrounded with treated stakes. Comparing the development of the plants over time under the treated and untreated conditions, the researchers observed little to no change in the growth of the tomato plants.

In studies at the Southwest Research Institute and Texas A & M University's Agricultural Extension Service from 1992 to 1999, Finch and Dainello conducted research to determine the amount of the leaching in CCA pressure treated timbers used in raised garden beds *(Finch 1999)*. They have found some small amount of leaching of arsenic in their samples (less than 10 parts per million) which was within the normal background range for the soils that were being used in their raised beds. When tested for copper and chromate leaching, they found some absorption of copper by the plants and some leaching of chromium in the soil, but these levels were also very low.

According to information provided by the Institute for Environmental Toxicology at Michigan State University, the risk of contamination in soils from pressure treated wood is low *(Kamrin 1999)*. Relatively small amounts of chemicals (copper, arsenic, chromium, etc.) leach out of the wood because of their fixation to the wood fiber. Additionally, the chemicals that do leach, move slowly so migration through the soil is limited. Movement from treated wood would not be expected to cause a significant increase in the amount of these elements in the soil (above background levels) except within 150 mm of the treated wood. Beyond 150 mm, only trace amounts of the elements would be found.

Although these studies indicate that there is little leaching of metals from pressure treated wood after installation, posts should be stored in covered shelters, properly supported and arranged off the ground. This prevents excess preservative from leaching and minimizes drying defects (warping, drying, checking, etc.) associated with excess drying.

3.0 WORKER PROTECTION

The risks to workers for both pressure treated wood and cedar are comparable. Dusts from any wood product can irritate sensitive areas of the eyes and nose, causing sneezing and tearing. Depending on the individual and the degree of exposure, both types of material can be a hazard to the worker.

3.1 PRESSURE TREATED WOOD

Skin rashes have been reported in workers who use pressure treated wood. Irritation of the nose, eyes and throat can also occur. The most serious risk for workers handling pressure treated wood is the development of a contact skin allergy to the preservative, which occurs in about one to five percent of those workers who handle these materials *(Pittman 1999)*.

ODOT has published a Safety Advisory about using pressure treated wood. The hazard information covered in the advisory for CCA or ACZA treated wood includes:

- Exposure to wood dust may cause eye irritation.
- Prolonged or repeated direct skin contact with treated wood may cause a mild rash or skin allergy to the wood.
- Inhaling treated wood dust may cause irritation to the nose and throat.
- Long term exposure to treated wood may result in the worker developing a skin allergy to the wood.
- Small amounts of chromium, copper and arsenate can be ingested if you do not clean up before eating, drinking and smoking after handling this wood.
- There are no cases of workers being poisoned by this type of treated wood. The metal and arsenic concentrations are so low within this wood that worker poisoning is unlikely.
- Arsenic from treated wood is not absorbed through the skin.

The entire section of the advisory for CCA or ACZA treated wood (Parts A and D) is contained in Appendix A.

3.2 CEDAR

Western Red cedar can cause skin rashes on those skin surfaces exposed to the wood. Additionally, approximately one to five percent of workers exposed to Western Red cedar contract red cedar asthma. The exposure period to asthma can be as little as six weeks, to three years (*Pittman 1999*).

The health concerns associated with Port Orford cedar are similar to Western Red cedar. Wood dust from Port Orford cedar can cause rhinitis (an inflammation of the mucous membrane of the nose) and bronchial asthma (Alden *1997*).

3.3 PERSONAL PROTECTIVE EQUIPMENT (PPE)

ODOT's industrial hygienist recommends the following personal protective gear when working with either pressure treated wood or cedar:

- **Pressure Treated Wood - Long sleeved shirt, leather gloves and dust mask (when sawing wood)**.
- **Cedar - Leather gloves and dust mask (when sawing wood)**.

NOTE: Dust masks are recommended when sawing both treated and non-treated wood.

4.0 DISPOSAL CONSIDERATIONS

Oregon Administrative Rules (OAR) allow for the disposal of CCA or ACZA pressure treated wood in a solid waste landfill. Specifically, OAR 340-093-0190(1)(g) states "wood described in OAR 340-101-0040(2) may be disposed of at a solid waste landfill if the site meets the design criteria of **40 CFR 258.40** for new municipal solid waste landfill sites." OAR 340-101-0040(2) defines pesticide treated wastes and it states that they are not subject to the hazardous waste provisions of the OAR or the Code of Federal Regulations (CFR). **40 CFR 258.40** discusses the landfill design criteria. The criteria require sanitary landfills that accept pressure treated wood, to be lined with a composite liner system and contain a leachate collection system.

To verify the locations and costs for disposal of pressure treated wood, county municipal waste facilities were contacted in August 1999. Based on the information provided, most counties in Oregon have a permitted disposal site (sanitary landfill or waste transfer facility) that will accept CCA or ACZA pressure treated wood. Seven counties, including Clatsop, Hood River, Lake, Marion, Polk, Tillamook, and Wheeler do not accept CCA or ACZA pressure treated wood. Polk County does not have a permitted municipal disposal facility for any solid wastes.

The costs for disposal vary greatly depending on where the disposal facility is located. In places where CCA or ACZA pressure treated wood is accepted, the disposal costs (tipping fees) range from $6.80/Mg ($7.50/ton) in Malheur County to $92.50/Mg ($102.00/ton) in Columbia County. The average is $35.60/Mg ($39.20/ton). The rates for cedar disposal are the same in the 29 counties that accept pressure treated wood. However, there are six additional counties in Oregon that take cedar wastes. The rates in these counties lower the overall average for cedar to $32.70/Mg ($36.0/ton).

In actual practice, sign crews are disposing their Port Orford cedar wood waste (broken posts, cut ends, etc.) in existing solid waste containers located in their respective maintenance areas. The containers are placed for construction debris generated by ODOT District maintenance crews, including the sign crews. The waste containers are a fixed cost and the amount of cedar disposed is only a small part of the total wastes being placed in the container. Thus, the cost attributed to the added cedar in the containers is negligible when compared to the cost for separate transport and disposal at a waste disposal facility (*Hedlund 99*).

An alternative to disposal for Port Orford cedar and pressure treated posts is recycling. When damaged posts are replaced, they can be shipped to ODOT's Surplus Property Distribution Center in Salem, Oregon for resale. To be eligible for recycling, the posts should be at least 1.2 m long. There is an additional transport cost incurred when shipping the recycled posts to Salem. However, the benefits with recycling not only include the additional revenue from the resale, but a reduction in the waste stream.

The burning of cedar wastes for disposal can also be an alternative to landfilling if permitted by the local jurisdiction. Pressure treated wood wastes cannot be burned under any circumstances.

5.0 PRICE COMPARISON

As discussed earlier, ODOT has a commodities contract in place to purchase Port Orford cedar signposts. There are 15 post sizes contained in the contract, ranging in size from 89 mm x 89 mm x 3.66 m to 140 mm x 190 mm x 7.32 m. The average unit price per m^3 for the 15 Port Orford cedar signposts is $391.06/$m^3$.

A market survey of pressure treated wood suppliers in the Northwest was conducted to obtain purchase prices for CCA and ACZA pressure treated signposts. Seven suppliers were contacted: five supply ACZA treated Douglas-fir posts and two supply CCA treated Hem-fir posts. The average unit price for CCA treated signposts was $262.31/$m^3$. The average unit price for ACZA treated signposts was $402.50/$m^3$. Below is a comparison by post size of the Port Orford cedar contract prices with the average prices from the survey for pressure treated wood.

Table 5.1: Price Comparison of Port Orford Cedar and Pressure Treated Wood Posts

Post Size	Contract Port Orford Cedar $/post	Average Price per Post CCA $/post	Average Price Per Post ACZA $/post
89 mm x 89 mm x 3.66 m	15.20	9.08	13.33
89 mm x 89 mm x 4.27 m	17.75	10.65	16.60
89 mm x 89 mm x 4.88 m	20.26	12.33	19.01
89 mm x 140 mm x 4.27 m	26.60	16.36	25.23
89 mm x 140 mm x 4.88 m	30.40	19.01	28.89
89 mm x 140 mm x 5.49 m	34.20	21.36	32.48
89 mm x 140 mm x 6.10 m	38.00	23.71	36.07
140 mm x 140 mm x 4.88 m	42.00	28.75	47.47
140 mm x 140 mm x 5.49 m	47.00	32.35	53.41
140 mm x 140 mm x 6.10 m	52.50	37.94	59.34
140 mm x 140 mm x 6.71 m	57.75	43.45	66.00
140 mm x 140 mm x 7.32 m	77.00	49.20	72.00
140 mm x 190 mm x 6.10 m	70.00	51.63	80.74
140 mm x 190 mm x 6.71 m	77.00	59.52	90.09
140 mm x 190 mm x 7.32 m	84.00	68.16	98.30

The ACZA treated Douglas-fir posts are slightly lower in price than the Port Orford cedar in the smaller sizes (89 mm x 89 mm and 89 mm x 140 mm). In the lager sizes, the Port Orford cedar posts are lower than the ACZA treated Douglas-fir posts.

The costs for CCA treated Hem-fir posts are much less (in all sizes) than ACZA treated Douglas-fir posts and Port Orford cedar posts. However, there is limited availability of Hem-fir posts that can meet ODOT's specification requirement for "free of heart center." One of the two suppliers that provided price cost information to ODOT for CCA treated Hem-fir posts expressed doubts about meeting ODOT specifications. Additionally, two of the suppliers that provided prices for ACZA treated posts treat Hem-fir with CCA. However, they did not furnish CCA treated post prices because they could not meet ODOT's specification requirements for treated Hem-fir posts.

6.0 SURVEY OF ODOT SIGN CREWS

An important part of collecting data about signpost material is to take note of the opinions of the people who maintain and install signposts for ODOT. Therefore, each ODOT sign crew was surveyed to obtain their views on the use of Port Orford cedar versus pressure treated wood for signposts. The survey questionnaire is included in Appendix B.

The sign crews overwhelmingly prefer Port Orford cedar to any pressure treated wood post material. Table 6.1 provides a summary of their preferences ranked in order, i.e., one the most preferred to four, the least preferred.

Table 6.1: Preference Ranking Summary Provided by Sign Crews

	Port Orford Cedar	ACZA Treated Douglas-fir	CCA Treated Hem-fir	Other (Steel)
Average of Ranking	1.0	2.0	2.8	3.0
Number of Crews That Ranked the Material	12	11	9	3
Standard Deviation	0	0.5	0.4	1.0

The sign crews were also asked what they liked and disliked about Port Orford cedar and pressure treated posts. Their comments were consistent statewide. The following summarizes their comments regarding each post material.

6.1 PORT ORFORD CEDAR – LIKES

- The posts are lighter in weight.
- They are easy to handle.
- There is no preservative to worry about.
- The edges on the smaller sizes are shaved.
- There is less splintering.
- It is easier to drill and lag.
- The posts have less knots.
- It is durable; some of the posts that were placed about 20-25 years ago are still standing.
- The price is comparable to pressure treated posts.
- It does not have to be covered (tarped) in the rain.
- The posts are much lighter because they are kiln dried.

6.2 PORT ORFORD CEDAR – DISLIKES

- There has been a batch that had a lot of knots and bowing.
- Warping and bowing have been occasional problems.
- There has been some minor twisting.
- There have been long vertical cracks in the wood.
- The milled finished surface is slick.
- Like other posts, there have been some crooked posts.
- There are no particular dislikes.
- Compared to Doug-fir, it is more costly.
- It seems more likely to twist and warp.

6.3 PRESSURE TREATED POSTS – LIKES

- Hem-fir has less knots, seems stronger than Doug-fir.
- I have no likes about pressure treated wood.
- The Doug-fir posts are OK compared to the Hem-fir posts.
- The cost.
- I have no strong opinion about likes. There is no difference in straightness or warping.
- I do not have anything positive to say about pressure treated wood.
- There are no likes other than longevity of the post.
- The price is better.
- The supply is not as limited with Port Orford cedar.
- Lower cost; readily available.

6.4 PRESSURE TREATED POSTS – DISLIKES

- Getting the preservative on your clothes and in your skin with a splinter. Need to wash clothes separately.
- There are more knots and splinters.
- Too many lags break when attaching the signs to Hemlock posts.
- The grade we use has a lot of knots. It is more difficult to drive lags through the material.
- They are heavy because of the moisture and tend to twist when drying out.
- I don’t really like dealing with the chemical preservative.
- In the past with Hem-fir, there was a lot of warping.
- Too heavy; they were hard to drill and lag.
- It requires additional personal protective gear when working with the material.
- There is a lot of twisting with the larger posts.
- The material needs to be covered when stored.
- Hem-fir posts are hard to drill break-a-way holes; the wood clogs drill bits.
- The texture is rougher and there is more splintering; some have gone through my shirt and gloves.
- There is an environmental impact of having thousands of chemically treated signposts being installed along our waterways.

- Crooked posts.

The sign crews were also asked to rate on a scale from one to five the effectiveness (ease in installation, amount of defects, durability, etc.) of each sign post material they use or have used in the past. A score of five was regarded as highly favorable and one was considered the least favorable. The results are presented in Figure 6.1.

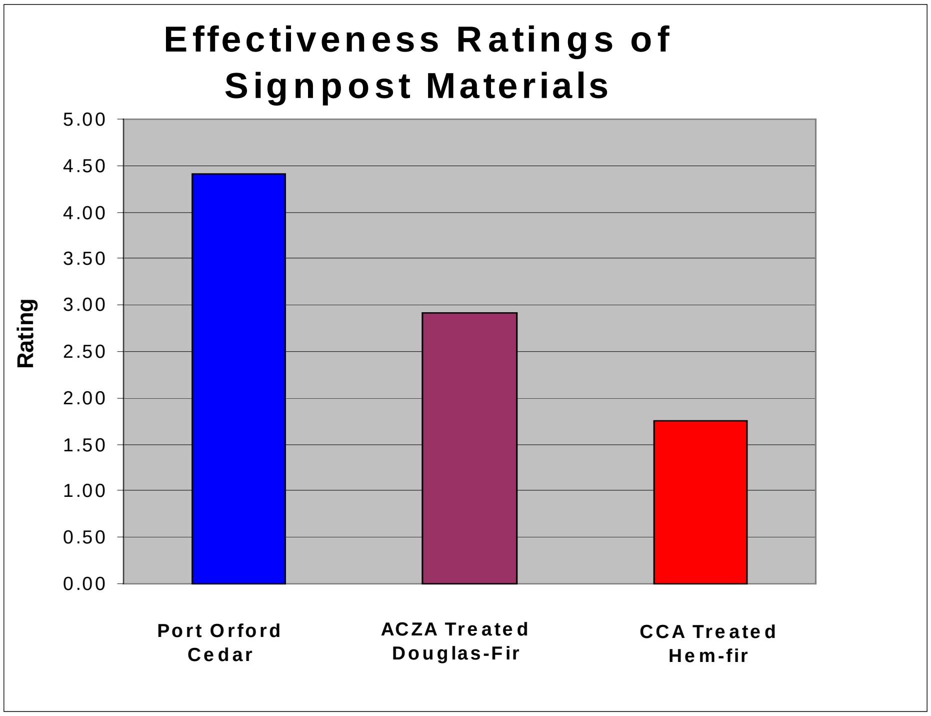

Figure 6.1: Effectiveness Rating of Signpost Materials

Port Orford cedar received the highest rating at 4.4 and treated Douglas-fir posts were rated next higher at 2.9.

One-half of the crews also rated steel posts. The crews that rated steel like using them, but because of their much higher purchase costs, their application was limited to areas where vandalism was a recurring problem or where the wind loads were high.

The comments and ratings confirm the ODOT Sign Crews' avid support for Port Orford cedar. Every crew was generally very satisfied about using the material and its performance.

7.0 DURABILITY

Signposts that are pressure treated with preservatives will have a long service life because the preservatives are forced deep into the cellular structure of the wood. Preserved wood provides a chemical barrier against termites, fungi and weather for long periods of time. Studies have shown that without treatment, Douglas-fir and Hem-fir will last less than 10 to 15 years. With preservative treatment, the service life is much greater. Naturally decay resistant cedars will also provide longer service lives than untreated Douglas-fir and Hem-fir.

In tests conducted at Oregon State University's fence post test site, untreated and preservative treated fence posts have been placed at Peavy Arboretum 11 km north of Corvallis, Oregon. The post test site has been in place since 1927. The posts installed after 1947 are 1.5 m long (0.6 m below groundline) and 200-675 mm^2 in cross-sectional area. Posts installed before 1947 were 1.2-2.1 m long and 750-1750 mm^2 in cross-sectional area. Based on a 1996 inspection report, the average age at failure of posts treated with CCA was 54 years for Douglas-fir posts and 66 years for Hem-fir posts. Since ACZA is a newer preservative, there are no posts with this treatment older than five years. However, Douglas-fir posts treated with a forerunner of ACZA, ammoniacal copper arsenate (ACA), have had an average life of 33 years at failure. The original ACA treated Douglas-fir posts have been in place 59 years and 32 percent still remain in place (*Morrell and Rhatigan 1999*).

The average service life for Port Orford cedar posts tested at Oregon State University's test site was 20 years. The average service life for Western Red cedar posts was 22 years (*Morrell and Rhatigan 1999*).

The U. S. Forest Service provided results of treated wood stake tests in a 1995 Progress Report. At their stake test sites in Mississippi and Wisconsin, one of 59 Douglas-fir test stakes (50 mm x 100 mm x 450 mm) treated with CCA had decayed after 17 years of service. Five of 59 Douglas-fir stakes (50 mm x 100 mm x 450 mm) treated with ACA had decayed after 17 years of service (*Gutzmer and Crawford 1995*).

Based on these tests, pressure treated wood posts are expected to last significantly longer than untreated cedar posts. A key factor to ODOT in selecting post material is the expected service life of a signpost. The service life of signposts is affected by a number of factors including vandalism, traffic accidents, change in sign standards, and highway construction. If the expected service life is 20 years, Port Orford cedar signposts can meet the requirement. If it is longer, pressure treated posts offer a more effective alternative. In the Sign Crew Survey, most of the respondents indicated they replace a very small percentage of posts due to rot or decay. This would indicate that the majority of posts within ODOT's inventory are replaced prior to the post reaching the end of its service life. Therefore, the longer expected service life of pressure treated posts might not be an important factor.

8.0 SUMMARY AND CONCLUSION

Pressure treated wood and Port Orford cedar are acceptable materials for signposts. Though there are environmental concerns about the use of pressure treated wood, studies have shown it is not harmful to the environment and can be installed in sensitive aquatic habitats. In using either type of material, workers should wear recommended personal protective equipment, including dust masks when sawing.

Pressure treated wood wastes are not hazardous and there are disposal facilities that accept these wastes in 29 Oregon counties. There are 35 counties in Oregon with disposal facilities that accept Port Orford cedar. The average disposal cost for cedar based on disposal at a landfill or waste transfer facility, is slightly lower than pressure treated wood. In actual practice, sign crews dispose of Port Orford cedar in existing waste containers, thus eliminating the added disposal fee incurred by taking it directly to a landfill or waste transfer facility.

Based on price survey data, the purchase price for ACZA treated Douglas-fir is slightly higher than Port Orford cedar. The smaller sized ACZA treated posts (89 mm x 89 mm and 89 mm x 140 mm; all lengths) cost less than the Port Orford cedar, but the larger sized ACZA treated posts are higher priced than the Port Orford cedar. The purchase price for treated Hem-fir is about 30 percent lower than Port Orford cedar. However, some suppliers of pressure treated wood have expressed concerns about the availability of Hem-fir posts that will meet ODOT specifications.

In Oregon State University's wood post studies, Port Orford cedar posts lasted an average of 20 years, whereas pressure treated wood posts remained in service one-and-a-half to three times longer than Port Orford cedar.

Port Orford cedar is currently used by ODOT sign crews throughout the State. The crews prefer working with Port Orford cedar and they have unanimously ranked it as their number one choice for signpost material. Among the pressure treated posts, the sign crews favor Douglas-fir posts over Hem-fir posts.

Pressure treated Douglas-fir and Hem-fir wood, and naturally decay resistant Port Orford cedar offer viable alternatives for signpost material. However, based on the information presented in this report, Port Orford cedar is the most appropriate material to use for signposts to meet ODOT requirements. This conclusion assumes that a 20 year service life for posts is adequate.

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APPENDIX A

Safety Advisory for Pressure Treated Wood (Sections A & D)

ODOT OCCUPATIONAL SAFETY & HEALTH

SAFETY
FIRST
ADVISORY

Number	Date of Issue
ADV98005	8/1/98
Revision Number	**Number of Pages**
0	4

PRESSURE TREATED WOODS

Purpose: To notify all ODOT employees exposed to treated woods.

Scope/Distribution: To all managers who employees are subjected to this risk.

Safety/Health Information: See below.

PRESSURE TREATED WOOD

A. BACKGROUND

Pressure treated wood is a long-lasting building material used in decks, fences, retaining walls, picnic tables, docks and other places where wood is exposed to rot, insect attack or fungi. Pressure treated wood will last 10 to 20 times longer than untreated wood. In the pressure-treatment process, lumber is loaded into a horizontal cylinder. The cylinder door is sealed, and a liquid preservative solution is pumped in. The pressure in the cylinder is then raised, forcing the preservative into the wood. At the end of the process, the excess treatment solution is pumped back to a storage tank for reuse. Because this treatment renders the wood useless as a food substance for fungi, termites and other wood-destroying agents, the wood is protected and much less subject to deterioration.

Three preservatives predominate for treating wood: creosote; pentachlorophenol; chromated copper arsenate. Creosote is a coal-tar derivative used primarily in railroad ties, highway bridges, guardrail posts and pilings. Pentachlorophenol is an EPA registered pesticide and is the most widely utilized of the oil-borne preservatives for wood. Pentachlorophenol is used most frequently for utility poles. Chrominated copper arsenate (CCA) is a water-borne solution most commonly used on wood made for fencing, play ground equipment, animal enclosures and decking.

D. CHROMINATED COPPER ARSENATE TREATED WOOD & AMMONIA COPPER ARSENATE

DESCRIPTION

- This type of treated wood contains a very small amount of chromium (a metal), copper (a metal) and arsenic.
- The amount of preservative used on the wood can change depending on the manufacture of the treated wood and the use the wood was intended for. Amount of material added to wood can range from 0.25 - 0.60 pounds per square foot of wood.
- Arsenate treated wood is not harmful to the environment. According to an EPA study, very little arsenate and metal leaches from treated wood into the soil surrounding the wood.

HEALTH HAZARD INFORMATION

- Exposure to wood dust may cause eye irritation.
- Prolonged or repeated direct skin contact with treated wood may cause a mild rash or skin allergy to the wood.
- Inhaling treated wood dust may cause irritation to the nose and throat.
- Long term exposure to treated wood may result in the worker developing a skin allergy to the wood.
- Small amounts of chromium, copper and arsenate can be ingested if you do not clean up before eating, drinking and smoking after handling this wood.
- There are no cases of workers being poisoned by this type of treated wood. The metal and arsenic concentrations are so low within this wood that worker poisoning is unlikely.
- Arsenic from treated wood is not absorbed through the skin.

USE SITE PRECAUTIONS

- Wood treated with arsenate's should not be used for any of the following: furniture; interiors of buildings or homes; in brooding facilities; where it can come into contact with drinking water for domestic animals or livestock.
- If wood is "bleeding" you may wish to let them dry further before handling them. Exposure to sunshine or heat will cause bleeding wood to dry quicker.
- If "bleeding" wood must be handled make sure skin protection is used and workers wash up after handling this material.

WHEN WORKING WITH ARSENATE TREATED WOOD

- Wear long sleeved shirt and pants, avoid skin contact, use gloves (leather or rubber - preferred).
- Avoid frequent or prolonged inhalation of sawdust from treated wood. When sawing and machining treated wood, use a dust mask and perform the job outside, when possible.
- Wear goggles when sawing and machining pressure treated wood.
- After working with the wood, and before eating, drinking, and use of tobacco products, wash exposed areas thoroughly.
- If sawdust accumulate on clothes, launder before reuse. Wash work clothes separately from other household clothing.

DISPOSAL OF ARSENATE TREATED WOOD

- Dispose of treated wood by ordinary trash collection or burial.
- DO NOT burn in open fires or in stoves, fireplaces because toxic chemicals may be produced as a part of the smoke and ashes.

APPENDIX B

Survey Questionnaire for ODOT Sign Crews

Survey for Sign Crew Comparing
Port Orford Cedar Posts and Pressure Treated Wood Posts

You are being asked to complete this survey for ODOT's Research Group. Recently, a request for information came to the Research Group from one of our Region design offices. They wanted an objective comparison on the use of cedar vs. pressure treated signposts. An important part of collecting data about signpost material is to take note of the opinions the people who maintain and install signposts for ODOT. The purpose of this survey is to obtain your views on the use of Port Orford cedar versus pressure treated wood for signposts. The survey results will help give us a more complete picture of the performance characteristics (costs, workability, environmental considerations, durability, etc.) of each type of material. We appreciate you taking a few minutes to complete this short questionnaire. If you have any questions you can contact Andrew Griffith at 503-986-3538. Thank you.

1. Do you use Port Orford cedar for signposts?

Yes____ **No_____**

If yes, how long have you used it? ________________

2. Do you use pressure treated wood for signposts?

Yes___ **No____**

If yes, what type of wood posts do you use?

Doug fir _________
Hem-fir _________
Other _________ **(specify type)**

3. If you do not currently use pressure treated wood for signposts, have you used them in the past?

Yes___ **No____**

If yes, what type of wood posts did you use?

Doug fir _________
Hem-fir _________
Other _________ **(specify type)**

4. If you have used Port Orford cedar posts, what do you **like** about this material?

5. If you have used Port Orford cedar posts, what do you **dislike** about this material?

6. If you have used pressure treated posts, what do you **like** about this material? If you have experience with more than one type of pressure treated wood post (Hem-fir, Doug fir, or other), please provide a separate answer for each type.

7. If you have used pressure treated posts, what do you **dislike** about this material? If you have experience with more than one type of pressure treated wood post (Hem-fir, Doug fir, or other), please provide a separate answer for each type.

8. What is your preference for one particular signpost material? Please rank them in order of preference (i.e., 1 most preferred to 4 least preferred).

Port Orford Cedar__________
Doug fir ____________
Hem-fir ____________
Other ____________ (specify type)

9. On a scale of 1 to 5, (1 being least favorable and 5 being highly favorable) how would you rate the effectiveness (ease in installation, amount of defects, durability, etc.) of each of the following signposts materials:

Port Orford cedar	**1**	**2**	**3**	**4**	**5**	**No opinion**
Doug- fir	**1**	**2**	**3**	**4**	**5**	**No opinion**
Hem-fir	**1**	**2**	**3**	**4**	**5**	**No opinion**
Other _________ (specify)	**1**	**2**	**3**	**4**	**5**	**No opinion**

10. Is there anything else you want to discuss about pressure treated or Post Orford cedar posts that have not been previously addressed?

11. Please provide Name and Crew **(Optional)** ______________________________

____