Long Term Performance of CCA-Treated Southern Pine Posts

LSU AgCenter
Research & Extension

Wood Durability Laboratory

ACCREDITED

Submitted To:

Arnold Forest Products Corp.
Doug Arnold
10818 Providence Rd.
Shreveport, LA 71129
Tel. (318)925-6903

Submitted By:

Todd Shupe, Ph.D.
Wood Durability Lab
Louisiana Forest Products Development Center
School of Renewable Natural Resources
LSU Agricultural Center
Baton Rouge, LA 70803
Tel. (225)578-4255
Fax (225)578-4251

May 24, 2012

We kindly request that all public references to the contents of this report be attributed to "LSU AgCenter's Wood Durability Lab"

TABLE OF CONTENTS

Report Authorized By:

Todd F Shupe

Date: 5-21-12

T.F. Shupe, Ph.D.
Professor, Wood Science
Phone: (225) 578-6432
Fax: (225) 578-4251
E-mail: tshupe@agcenter.lsu.edu

BACKGROUND

The Wood Durability Laboratory (WDL) at the LSU AgCenter became an ISO 17025 accredited laboratory through the International Accreditation Services (IAS) accreditation system on March 1, 2008. Additional test standards were added by IAS to the WDL approved scope of services on July 24, 2008 (Table 1). The lab essentially has been operating under ISO 17025 Guidelines for over eight years. This report is an AC-85 compliant report as determined by IAS guidelines the report has not been reviewed by a licensed professional engineer or a third party skilled in the art.

Samples and information sheets on traceability of samples were provided by the sponsor. The results from this test only relate to the items tested.

The LSU Wood Durability is not ISO 17025 to perform the tests described herein but is accredited to perform similar testing (Table 1) and has the expertise and equipment to perform all testing reported herein.

Table 1. Current WDL test methods accredited by IAS.

Wood testing	ASTM Standards D 143[2], D 1037[2]; Test methods referenced in Section 4.0 of ICC-ES Acceptance Criteria AC257[3]
Wood preservatives	ASTM Standards D 1413[1], D 1758[1],D2481[3], D 3273, D 3345[1], and D 4445[3]; AWPA Standards E1[1], E5[3], E7[1], E9[3], E10[1], E11[1], E12[1], E16[3], E18[3], E22[2], E23[2] and E24[1]; WDMA Standards TM-1[1] and TM-2[1]

[1]Approved March 1, 2008. [2]Approved July 24, 2008. [3]Approved November 20, 2009.

OBJECTIVES

The goal of this project was to project the useable service life expectancy of CCA-C treated southern pine guard rail posts and blocks.

MATERIALS AND METHODS

This study was conducted at two inspection sites in Louisiana.

The first inspection site was located on LA Hwy. 431, 1 mi. north of US Hwy. 61 in Ascension Parish. The installation date was 1995, and the members were inspected on April 10, 2012. The material sampled were 7in. x 6ft. 3in. D.T. guard rail posts. The blocks were not sampled and measured 6in. x 6in. x 14in. blocks. The structure was identified as #2670200351.

The second inspection site was located on I-49, 2 mi. north of LA Hwy. 175 (southbound lane) in DeSoto Parish. The installation date was 1985, and the members were inspected on April 27, 2012. The blocks (6in. x 8in. x 14in.) were not sampled. The structure was identified as #4550729052.

At each site, (20) increment cores measuring 3/16in. x 4in. were removed at the ground line in accordance with AWPA M2-07. For the DeSoto Parish site, cores were taken on the 6in. face. All sampled posts were inspected visually and by using a sounding hammer to determine any sign of decay. All increment cores and fras were visually inspected and sent to the laboratory for further analysis. Core #14 from the DeSoto Parish site was damaged in transit and omitted from analysis.

Increment cores were tested in the lab for preservative penetration in accordance with AWPA A3-08. This was done visually for most samples and assisted with heartwood indicator on some older samples. The length of preservative penetration and percentage of penetration was recorded. The length of the sapwood and heartwood zone in each core was also recorded. All cores for each site were combined into one composite sample and analyzed using an Oxford Lab-X for retention (pcf) of the treating metals based on AWPA A9-01. Values are reported on an oxide basis.

RESULTS

All posts for both sites were determined to be in excellent condition based on the visual inspection. There was no indication of decay. The visual inspection of all of the increment cores and fras from both signs indicated sound wood and no presence of decay.

The cores from Ascension Parish site had excellent penetration due to the fact that they were taken from round stock which typically shows better preservative penetration due to a smaller and well centered heartwood zone as compared to rectangular stock. The retention analysis for the DeSoto Parish showed CrO_3, CuO, and As_2O_5 to be 0.300, 0.113, and 0.195 pcf, respectively. The total pcf was found to be 0.608. All metals were in balance according to AWPA P5-09.

The cores from the DeSoto Parish site (rectangular posts) had good penetration. Two samples showed no penetration due to the absence of sapwood in the cores. The retention analysis for the DeSoto Parish showed CrO_3, CuO, and As_2O_5 to be 0.301, 0.109, and 0.192 pcf, respectively. The total pcf was found to be 0.602. All metals were in balance according to AWPA P509.

AWPA T1-09 allows for a charge to be accepted if 80% of the material sampled satisfies the penetration requirement of 2.0 inches or 85% of sapwood. The posts with no penetration still had adequate preservative retention to allow for excellent long-term durability. An increment core in a different location likely would show some penetration and in fact the increment taken for analysis had slight penetration but was judged to be zero for simplicity.

If we assume that the poles were treated to applicable AWPA standards at the time of installation (0.60 pcf), we see that there has been extremely little if any leaching. This finding is consistent with the previous research done on long-term leaching of CCA in ground contact. In short, there may be a small, insignificant amount of initial leaching (approximately 2 months) but virtually no leaching is also common (Lebow et al. 2000).

These minor differences are largely attributable to differences in fixation that may be used in the studies as well as site differences (climate and soil) as well as differences in individual samples.

CCA works extremely well in real world exposures. The common CCA toxic threshold for most organisms is 0.12-0.18 pcf. The exception is white rot fungi attacking hardwood. The threshold for these organisms with hardwood is much higher due to more difficult fixation and micro-distribution in hardwoods (Freeman 2012).

A comprehensive study on long-term CCA treated southern pine wood was published by Woodward et al. (2011) with the USDA Forest Products Lab. They reported of the waterborne preservatives in tests that contain copper and arsenic (24 to 61 years in Mississippi), the formulations of chromated copper arsenate (CCA) are better performers with only 30% failures using retention levels of 0.29 pcf (oxide basis) or 20% using 0.44 pcf or greater for CCA. It should be noted that larger sized members, such as posts and poles, almost always perform better than the smaller sized stakes used in this study. They reported the average life of 0.26 pcf treated CCA Type 1 2x4 treated samples to be 28.7 years. All of these CCA formulations are salt formulation and not the oxide formulation used today. Lebow et al. (2010) showed excellent ratings and no failures for 1.5 x 3.5 in. CCA-C treated at both 0.2 and 0.4 pcf southern pine field stakes after 35 years of exposure in Saucier, MS.

CONCLUSIONS

This study has shown that CCA-treated southern pine posts (round and sawn) placed in service in Louisiana has excellent long-term durability. The Ascension Parish site was 17 years old and the DeSoto Parish site was 27 years old. The posts, increment cores, and fras from both sites showed no signs of biological attack. Moreover, the retention of the posts remained at virtually the same level at what they likely were at the time of installation. There is virtually no chance of any additional leaching to occur to these posts. Given this high level of preservative retention and excellent condition of these posts, it is reasonable to project a usable service life of these posts of in excess of 50 years. This projection is supported by the long-term studies of the USDA Forest Products Lab and anecdotal observations of long-term (i.e., over 50 years) performance of CCA-treated southern pine utility poles in the US South, which has the most severe climate in the continental US.

REFERENCES CITED

American Wood Protection Association. 2009. AWPA Book of Standards. Birmingham, AL.

Freeman, M. 2012. Personal communication with T. Shupe on May 21, 2012.

Lebow, ST.., P.K. Lebow, and D.O. Foster. 2000. Environmental impact of preservative-treated wood in a wetland boardwalk. USDA For. Serv. Forest Products Lab. FPL-RP-582.

Lebow, S., C. Hatfield, B. Woodward. 2010. Long-term durability of CCA and ACA: How is 0.4 doing? In: Proceedings of American Wood Protection Association. 106:174-183.

Woodward, B.M., C.A. Hatfield, and S.T. Lebow. 2010. Comparison of wood preservatives in stake tests 2011 progress report. USDA For. Serv. Forest Products Lab. FPL-RN-02.

RESULT TABLES

Table 2. Increment core analysis from Ascension Parish site.

Sample #	Sapwood in.	Hartwood in .	Penetration in.	Percent
1	0-2.50	2.50-4	2.5	100
2	0-3.25	3.25-4	3.25	100
3	0-3.00	3.00-4	3	100
4	0-1.75	1.75-4	1.75	100
5	0-2.00	2.00-4	2	100
6	0-3.50	3.50-4	3.5	92.9
7	0-3.25	3.25-4	3.25	92.3
8	0-3.00	3.00-4	3	100
9	0-2.25	2.25-4	2.25	100
10	0-3.25	3.25-4	3.25	100
11	0-2.50	2.50-4	2.5	90
12	0-2.00	2.00-4	2	100
13	0-2.75	2.75-4	2.75	100
14	0-3.25	3.25-4	3.25	92.3
15	0-3.00	3.0"-4	3	100
16	0-2.25	2.25-4	2.25	100
17	0-2.50	2.50-4	2.5	100
18	0-2.50	2.50-4	2.5	100
19	0-3.25	3.25-4	3.25	100
20	0-2.75	2.75-4	2.75	100
Mean			2.73	98

Analysis By Oxford Lab - X			AWPA Standard	
Compund	Retention	% Balance	Min	Max
CRO3	0.300 pcf	49.3	43.00%	51.00%
CUO	0.113 pcf	18.6	12.00%	21.00%
AS205	0.195 pcf	32	30.00%	43.00%
Totals	0.608 pcf	100		

Table 3. Increment core analysis from DeSoto Parish site.

Sample #	Sapwood in.	Hartwood in.	Penetration in.	Percent
1	0-2.00	2.00-4	2	100
2	0-3.00	3.00-4	3	100
3	0-1.00	1.00-4	1	100
4	0-4.00		3.5	87.5
5	0-2.00	2.00-4	2	100
6	0-3.00	3.00-4	3	100
7	0-2.25	2.25-4	2.25	100
8	0-1.50	1.50-4	1.5	100
9	0-3.25	3.25-4	3.25	92.3
10	0-2.00	2.00-4	2	100
11	0-0.00	0.00-4	0	0
12	0-1.25	1.2-4	1.25	100
13	0-2.25	2.25-4	2.25	100
14				
15	0-0.00	0.00-4	0	0
16	0-1.75	1.75-4	1.75	100
17	0-1.50	1.50-4	1.5	100
18	0-0.00	0.00-4	0	0
19	0-3.50	3.50-4	3.5	85.7
20	0-3.00	3.00-4	3	100
Mean			1.93	82.39

Anaylsis By Oxford Lab - X			AWPA Standard	
Compound	Retention	% Balance	Min	Max
CRO3	0.301 pcf	50.1	43.00%	51.00%
CUO	0.192 pcf	18.1	12.00%	21.00%
AS205	0.602 pcf	31.9	30.00%	43.00%
Total	0.602 pcf	100		

FIGURES

Figure 1. Test site in Ascension Parish, La.

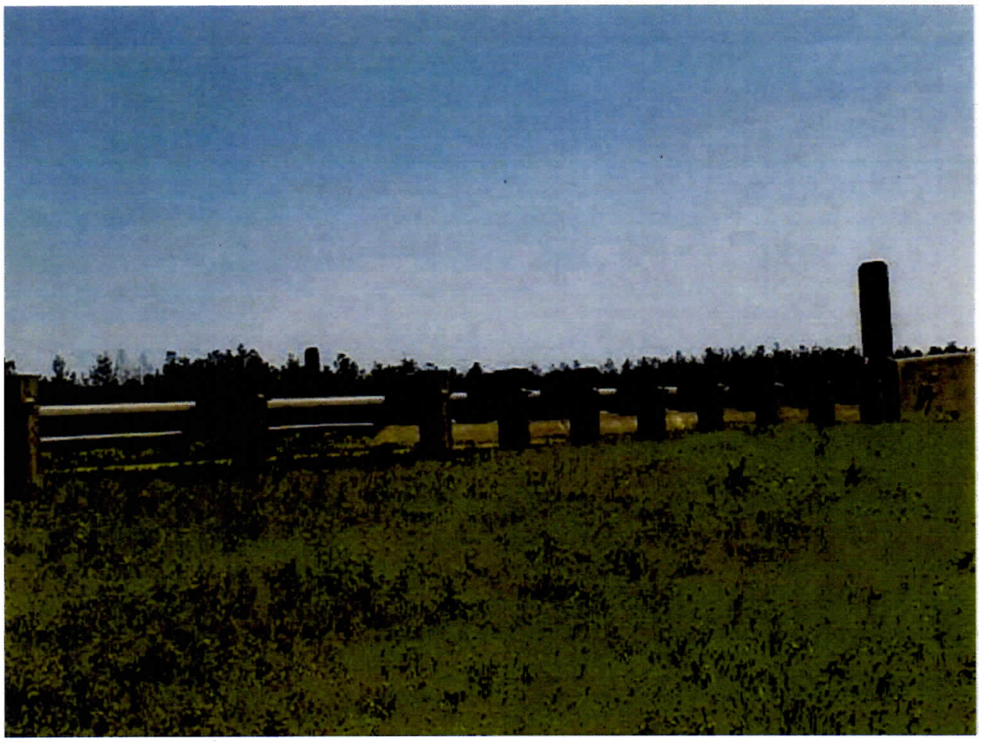

Figure 2a. Test site in DeSoto Parish, La.

Figure 2b. Test site in DeSoto Parish, La.

PRINCIPAL INVESTIGATOR

Todd Shupe is a Professor at the Louisiana Forest Products Development Center, School of Renewable Natural Resources at the Louisiana State University AgCenter. He received a B.S. with honors and M.S. in forestry and wood science, respectively, from the University of Illinois and a Ph.D. in wood science from Louisiana State University. He has been on the faculty at LSU since 1996.

Todd has published over 120 articles in refereed outlets and garnered over $2 million in grants and contracts. His principal areas of research interest includes recycling of preservative treated wood into value-added products, novel chemical extraction procedures for decommissioned preservative-treated wood, and development of organic wood preservatives. He has been awarded two patents and another is pending. He has been recognized as a merit award winner for outstanding research by the LSU Chapter of Gamma Sigma Delta. He has taught courses in treated wood recycling, introduction to wood science, and wood identification and has directed 11 graduate students, including two past FPS Wood Award winners.

Todd has been honored as a Fellow in both the International Academy of Wood Science and the Institute of Wood Science. He currently serves as President of the Society of Wood Science and Technology. He has also served as a member of the SWST Board of Directors and as FPS MidSouth Chapter Chair.

Todd is currently the Director of the Wood Durability Lab, which is an ISO/IEC 17025:2005 accredited lab by International Accreditation Service (IAS). He is active in several professional organizations including SWST, Forest Products Society, International Association of Wood Anatomists, Japan Wood Research Society, Southern Pressure Treaters Association, IUFRO, American Wood Protection Association, International Research Group on Wood Protection, Association of Natural Resources Extension Professionals, and International Network of Bamboo and Rattan, and Society of American Foresters. Todd also is an active participant of several honor societies including Phi Kappa Phi (past LSU chapter president), Xi Sigma Pi, Gamma Sigma Delta, and Alpha Zeta.