Protection of Industrial Wood Products with ACZA

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Summary

As previously presented to this organization in 2013, ACZA or Ammoniacal Copper Zinc Arsenate is a metallic wood preservative solubilized in aqueous ammonia with water as the carrier. It was originally developed at the University of California at Berkeley as ACA or Ammoniacal Copper Arsenate. It was reformulated into its current state of ACZA in the early 1980's. It is registered with both the PMRA for Canadian use and the EPA for US use, ACZA is currently approved in CSA and AWPA standards for the protection of wood products, particularly those used in industrial applications such as utility poles, railroad material and marine piling. Testing of its various properties were presented in the 2013 paper, this is an update on its performance and use in industrial applications.

Over the years, ACZA has been subjected to a litany of testing to determine its level of efficacy. In the USDA Forest Products Laboratory stake test installed in Saucier, MS updated in 2011, ACZA treated stakes compared favorably with other industrially used wood preservatives as shown in the table below. Even at above ground retentions, the in-ground stakes had shown no failures after 30 years in Table 1 below.

Table 1 USDA Stake Data

Preservative	AWPA Required Retention	Retention Rate Tested: Comparison to AWPA Standard %	Life Expectancy based on failure rates	Notes from FPL's Stake Tests
Chemonite® ACZA	0.40 pcf	0.25 pcf 60% of Standard	Not established no failures in 30 years	From most recent December 2011 update
Creosote	7.0 pcf	4.2 pcf 60% of Standard*	Established at 17.8 years based on failure rates	*from 1971 update
		8.0 pcf 114% of Standard	Not established 90% failure rate in 60 years	December 2011 update
Copper Naphthenate in P9	0.060 pcf	0.061 pcf 100% of Standard	Established at 27.1 years based on failure rates	December 2011 update

Based on earlier testing thru UL, reported in the 2013 paper, we undertook additional testing for fire retardant properties. An internal lab Char Test was performed to compare untreated wood to that treated with ACZA and also with ACZA with Disodium Octaborate Tetrahydrate, (DOT). The results as shown below in Table 2, indicate improved fire-retardant properties from ACZA over untreated wood and further improvement with the inclusion of DOT in the treating solution.

Table 2 Char test Results:

	Retentions – pcf ACZA (% BAE)				
Species	0 (0)	0.25 (0)	0.25 (0.25)	0.40 (0)	0.40 (0.25)
SY Pine	96	65	48	52	40
D Fir	52	38	36	36	32
R Oak	60	42	39	47	32
Maple	56	55	45	45	31

Ties in Service Follow-up

Since the 2013 presentation We have visited the sites where we have ACZA and ACZA +DOT ties. Including one of the first bridges of ACZA Douglas fir bridge ties and laminated timbers in Oregon. After 8+ years the bridge showed no signs of degradations nor exceptional checking even with an aqueous preservative treatment. The same is true with the 8+ year old ACZA Douglas fir crossties and switch ties in Oregon. As seen in Figures 1 and 2 below.

Follow up inspection on the originally treated hardwood ties were done in conjunction with Mississippi State University.

Figure 3 Hardwood Ties Installations

The ties in SW Florida were installed in a "Y" Curve where not only are they getting typical pounding but also lateral stresses from the curve. The lack of ballast continued to show the ties being submerged into the area swamp. Some of the ties had been cut with by a derailment. This section of track has a seven-year life span for its hardwood creosote ties and they were pleased that after 5 years, the ACZA sand ACZA +Borate ties were holding up well.

- After evaluation the test ties at all three exposure sites it was noted that biological deterioration was not a problem at this time. All treatment and/or species combinations were showing excellent protection.

- Mechanical issues while not the focus of this research were the prevalent problems noted and none of these are attributed to the preservative treatments found in the test ties. Future inspections are planned for 2019/2020 to continue monitoring the efficacy of these test ties.

    - Michael Sanders, Senior Research Associate, Mississippi Forest Products Lab, Mississippi State University

Figure 4 SW Florida Site:

International Studies and Expanded Applications

Australian Bridge Studies

Figure 5 and 6 below shows the bridge at the test site and the working bridge at Mt. Mee.

In 2016 Dr. Jeff Morrell of Oregon State University inspected some of the bridge installations in Queensland, Australia.

- The stress deck bridges are 22-year-old ACZA treated Douglas fir
- One bridge is on the South Johnstone test site to monitor performance
- Another working bridge at Mt. Mee was also observed

Material and the Environment:

- Material: 2”x12” lumber
- 66 layers of lumber held together by three tensioned rods
- Target retention: 0.60 pcf
- Minimum penetration: 0.4”
- Ave. Daily Temp.: 75° - 88°
- Ave. annual rainfall: 11.5’ (68 years in OR)
- Climate: tropical

Cores were taken from each board located at the test site and the results were as follows:

- Results of treatment
- Penetration from 116 cores taken:
- Ave. 1.2” far exceeding the 0.4” required
- Only 4 cores had penetration of less than 0.4”
- No visible signs of decay on any of the boards
- Retention cores were taken from the upper edge surface of the boards only and were at 54.2% of the required retention
- The retention was above the threshold of 0.15 pcf

OSU Conclusions were:

- The ACZA treated Douglas-fir in the stressed deck assemblies at both South Johnstone and Mt. Mee were both sound and free of visible decay.
- No decay fungi were isolated from the materials at South Johnstone while preservative retentions were lower on the upper deck surfaces, but well above the protective threshold after 20+ years of field exposure.
- The results illustrate the benefits of pre-fabrication coupled with proper treatment for producing long term performance under harsh environmental conditions.

ACZA +DOT Douglas Fir Poles

- This study is based on the documented improvement in life expectancy and treatment of ties with the use of borates.
- With ACZA borates can be included in the treating solution, providing a better distribution of the boron than dipping, spraying or pretreating with boron.
- Poles were treated and put into test and use on the Oregon State University campus.
- The poles were unincised Douglas fir for a Marine Corps Training Course and the OSU test area.

The poles were sampled as soon as they were cool enough to core, no extended time was used to allow for boron diffusion. Figure 7 below shows the copper penetration indicator used for ACZA. These poles were not incised, radial drilled or through bored due to their use on the obstacle course.

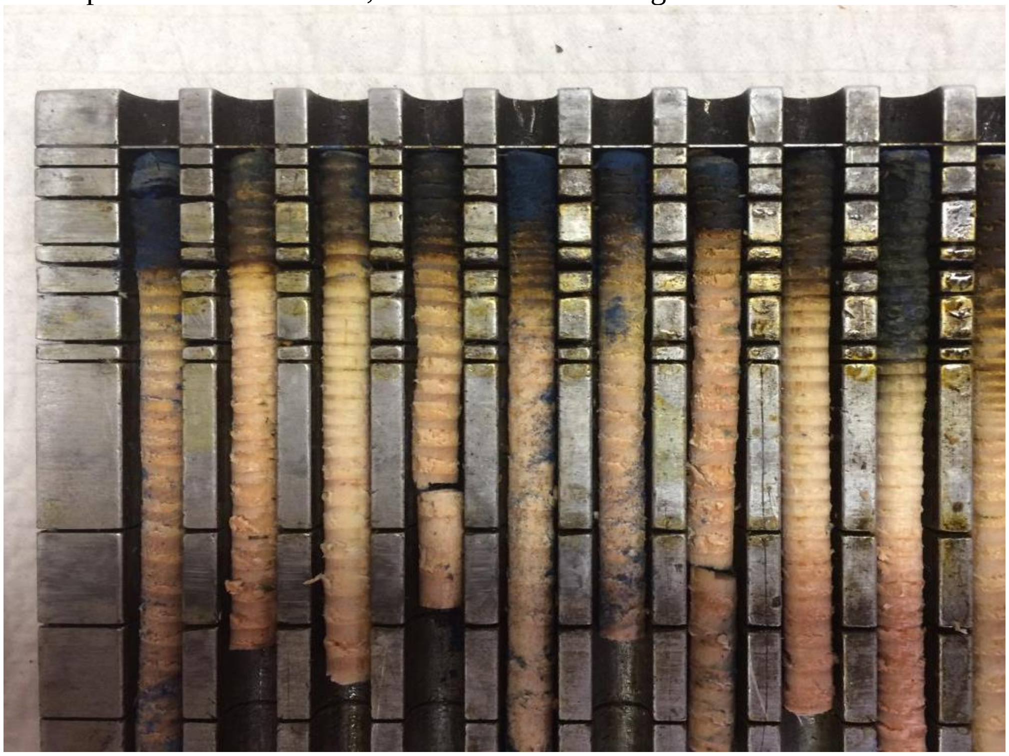
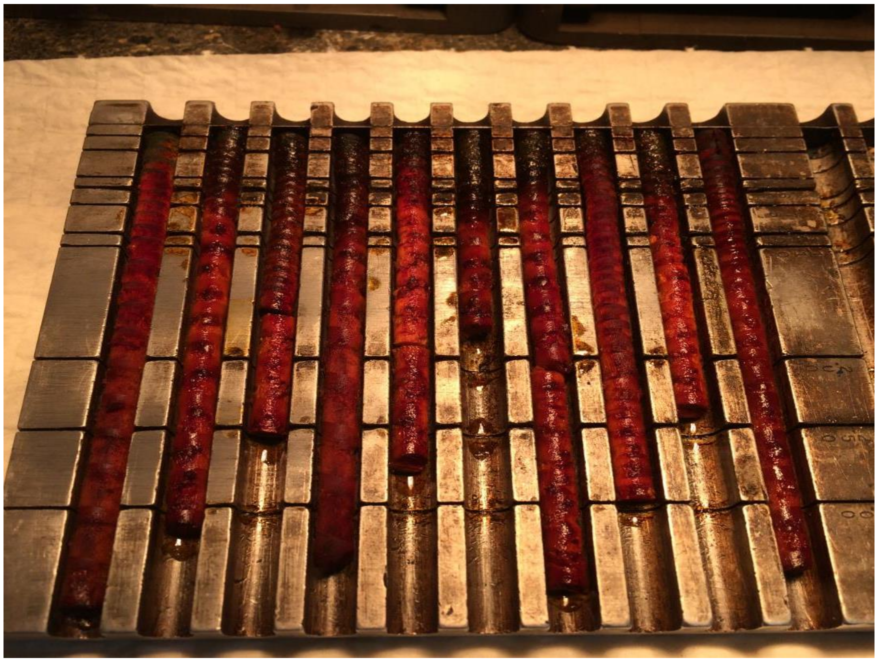


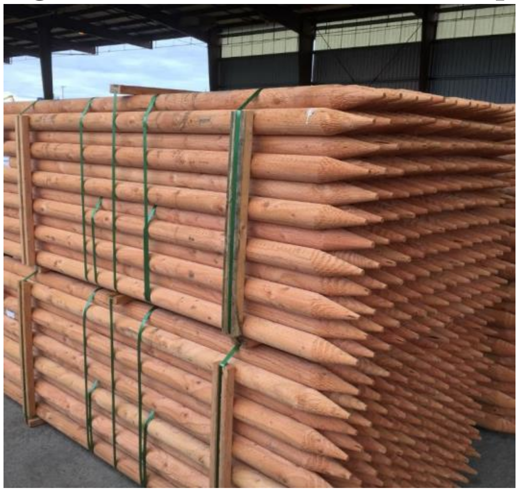
Figure 8 shows complete boron penetration with the use of boron indicator.

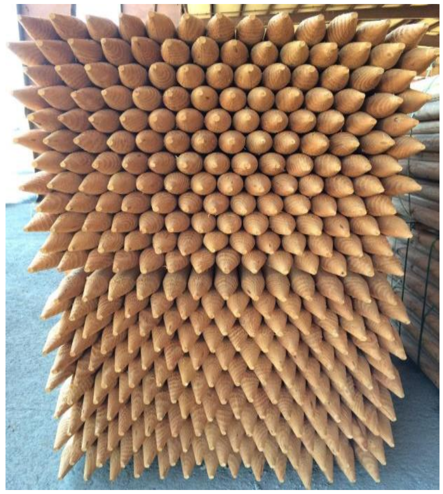


ACZA Douglas fir Agricultural Posts:

These posts are produced in on Vancouver Island in BC during the peeling of the Douglas fir logs for veneer. The posts are very straight and uniform in size. The log manufacturer has developed a process for incising these small diameter logs in the ground contact areas of the posts.

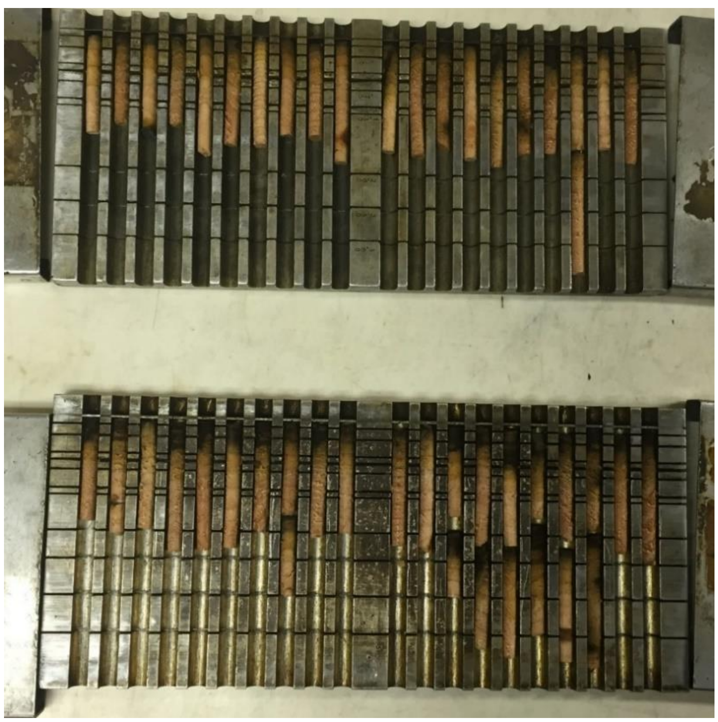
Figure 9 below shows the untreated posts:





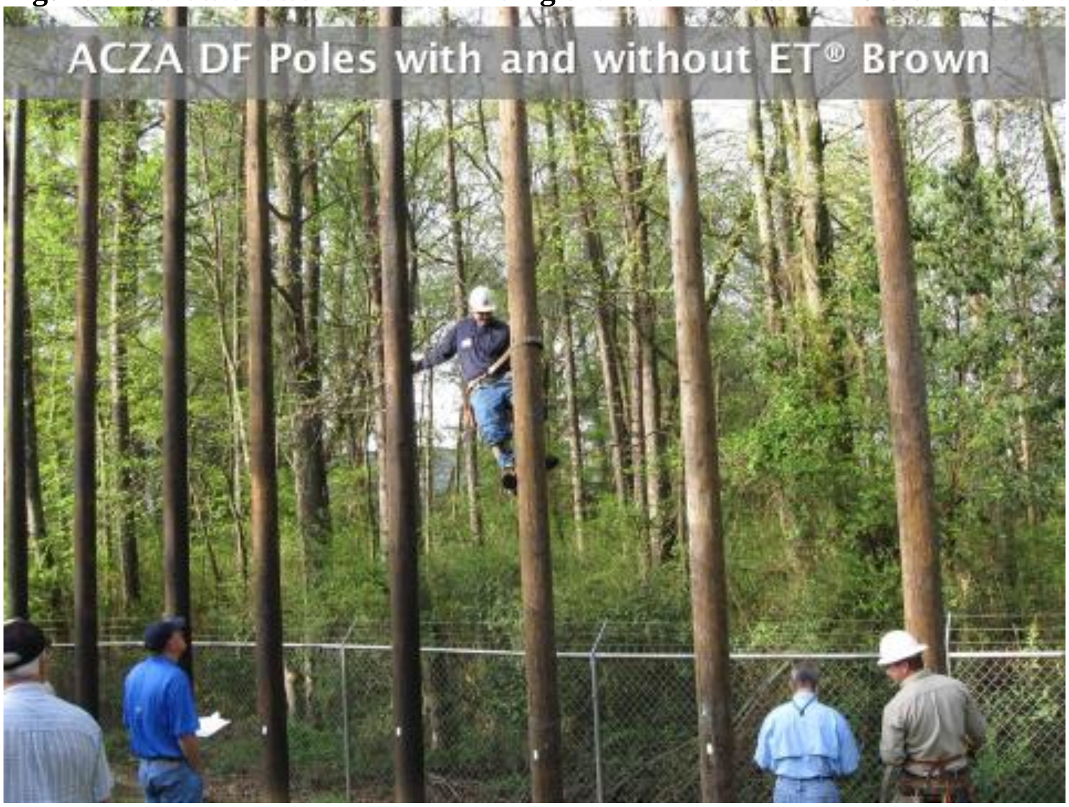
Treatment requirements for the incised area of the posts is to AWPA Standards.

Figure 10 shows the variaiton in treatment between the incicsed and unicised areas of the posts.



Climbing Trials of ACZA Douglas fir and ACZA Douglas Fir with a Brown Emulsion Treatment. Poles had been installed just over a year when the 25-year climbing trial was arranged for Penta, CCA and CCA ET poles were performed. At one year the ACZA Douglas fir poles were rated climbable and with the Emulsion treatment even easier to climb. The climbing trials are performed every 5 years to evaluate the effect of the Emulsion treatment climbing enhancer.

Figure 11 below shows linemen climbing the ACZA Brown Emulsion Treatment Pole.



Conclusion

Proper treatment with ACZA continues to provide protection and a long service life to industrial wood products in all types of exposures as has been demonstrated over the past 30 plus years. Its ability to incorporate borate formulations strengthens its ability to protect wood in additional areas of concerns with fire retardant needs as well as difficult to treat species in high hazard and Formosan termite zones. Studies and research will continue on current and potential applications.

References

USDA-FPL Research Note FPL-RN-2, Comparison of Wood Preservatives in Stake Tests, 2011 Progress Report, Bessie M. Woodward, Cherilyn A. Hartfield and Stan T. Lebow

Sanders M., Carey N., "In-track Inspection of Four Year Old ACZA Treated Hardwood Ties" AWPA Proceedings,

Jeffrey J. Morrell, Jack Norton, Michael Powell, Christophe Gerber, Scott Kleinschmidt Assessment of an ACZA Treated Douglas-fir Stressed Deck Bridge in South Johnstone, Queensland, Australia: 22 Year Report, AWPA Proceedings

Tables and Figures

Table 1 USDA-FPL Research Note FPL-RN-2, Comparison of Wood Preservatives in Stake Tests, 2011 Progress Report, Bessie M. Woodward, Cherilyn A. Hartfield and Stan T. Lebow
Table 2 W. Thomas
Figure 1, N. T. Carey
Figure 2, N. T. Carey
Figure 3, N. T. Carey
Figure 4, N. T. Carey
Figure 5, J.J. Morrell, PhD
Figure 6, J.J. Morrell, PhD
Figure 7, N.T. Carey
Figure 8, N.T. Carey
Figure 9, N.T. Carey
Figure 10, N.T. Carey
Figure 11, N.T. Carey