Effect of Preservative Type and Gaff Style on Gaff Penetration into Wood Poles

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ABSTRACT

This study is part of an ongoing investigation to better understand the relationship between wood preservative formulation and gaff impregnation. In this laboratory study, a mechanical clamped jig was used to emulate the force required by a typical utility pole lineman to climb wooden utility poles that were manufactured from either Southern Yellow Pine or Douglas-fir. Included in this study is a series of popular commercial pressure applied preservative treatments to also investigate if the treating chemicals or treating processes employed to achieve adequate penetration and retention, to meet or exceed AWPA Standards, altered the gaff penetration properties of the wood. This is the fourth of a wood pole basic research program to gain insight into wood properties that can influence use and purchase and specification decisions.

BACKGROUND

One of the common complaints from utility pole linemen is that certain preservative formulations result in poles that have a hard outer shell and are difficult to climb. A number of measures have been taken by the preservative industry over the years as a means to increase climbability while also maintaining structural integrity of the poles (Cary 2010; Engdahl et al. 1992; Fox et al. 1987; McIntyre and Fox 1990; Zahora and Rector 1990). Most of these problems are associated with CCA-C, which is considered by some utilities to be a preferred preservative due to its cost factor and surface cleanliness. In the mid 1980s a CCA-C form formulation was modified by adding a plasticizer/lubricant in the form of polyethylene glycol with a specific molecular weight (Trumble and Messina 1985) or later adding an emulsified oil treatment only to the wood pole surface (McIntyre and Pasek 1990). A gaff design has also been patented by Koppers (Demers 1985). A comprehensive study on gaff penetration of CCA-PEG poles found that twice as much force is needed to drive a gaff into wood when the outer shell moisture contents drops from 35 to 10%. Four years of pole aging resulted in a 62% increase in force needed to achieve a set gaff penetration depth (Gilbert et al. 1997).

MATERIALS AND METHODS

Three commercial gaff types were selected after interviewing roughly several linemen during the annual pesticide training courses hosted by the LSU AgCenter. These linemen also supplied contacts within their utility in the specifications and purchasing departments which later informed us of the gaff types they used, specified, and purchased for their company storeroom. All of these gaff types were tested and evaluated on pole stubs of Douglas-fir and Southern Yellow Pine (SYP), which were commercially pressure treated with either CuNap, ACZA (Douglas-fir only), Penta, Creosote, and CCA (Southern pine only). An untreated pole of each species was also tested and evaluated. Each pole was penetrated twenty times, in different, non-repeated locations with each gaff at a depth of 0.475 inches. Gaffs were deemed very sharp at start of study and were not re-sharpened during the study. Gaffs were reevaluated at study end and were deemed very sharp at study end as well.

The crosshead speed of the Instron testing machine was set at 50 mm/minute and the drive was terminated once the gaff reached the desired depth of 0.475 inches. The load cell/strain gauge was reset to a ground condition of 0.00 pounds after each gaff penetration trial and after the pole was slightly rotated to yield a new, fresh pole surface, Great care was taken to ensure the gaff was not inserted into any split or check, especially on the Douglas-fir poles which had a much larger check pattern than did the SYP.

DATA

An Instron electronic mechanical stress-strain universal testing apparatus, calibrated one week prior to the study, was used as the evaluation tool.

All load cells on the device were calibrated to read in pounds +/- 0.10 pounds by an ISO 17020 accredited agency and the calibration certificate was present on the device during testing. The LSU Wood Durability Lab is also an ISO 17025 accredited Testing and Evaluation.

The Southern Pine Poles and the Douglas-fir poles was assayed to AWPA Standards and inspected by Timber Products Inspection Company (Conyers, GA). All poles in the study meet with minimum penetration requirements for assay and all poles meet the minimum AWPA requirements for preservative penetration.

Figure 1. Assay results from Timber Products Inspection.

Species	Preservative	Target Retention	Actual Retention
S. Pine	CCA-Type C	0.60	0.61
S. Pine	Creosote	7.50	7.6
S. Pine	Penta	0.45	0.45
S. Pine	Copper Nap.	0.08	0.082
D. Fir	Copper Nap.	0.095	0.097
D. Fir	Creosote	12.0	11.2
D. Fir	Penta	0.60	0.62
D. Fir	ACZA (Chemonite II)	0.60	0.65

Figure 2. Summarized data of force needed to reach 0.475 in. penetration for three different gaff types, two species, and four preservatives.

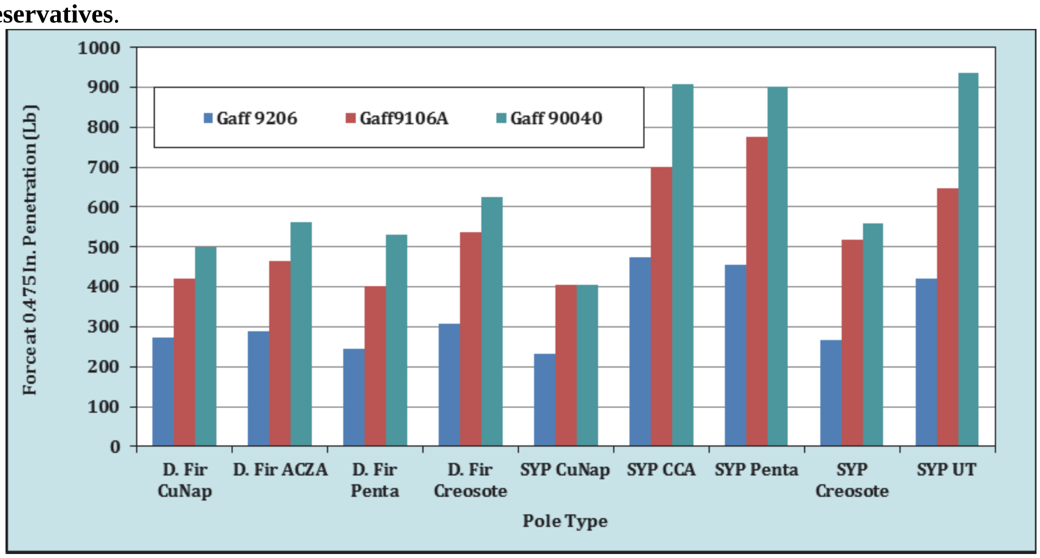

Figure 3. Summary of LSD statistical analysis for each gaff types. Means with similar letters for each gaff type are not significantly different at alpha = 0.05.

Gaff 9206

Treatments	lbf. Avg.	LSD
SYP CuNap	232.03	A
Douglas Fir Penta	243.56	AB
SYP Creosote	265.89	BC
Douglas Fir CuNap	272.06	C
Douglas Fir ACZA	290.24	CD
Douglas Fir Creosote	307.07	D
SYP Untreated	421.69	E
SYP Penta	454.22	F
SYP CCA	474.62	F

Gaff 9106A

Treatments	lbf. Avg.	LSD
Douglas Fir Penta	400.40	A
SYP CuNap	403.50	A
Douglas Fir CuNap	420.52	AB
Douglas Fir ACZA	464.35	B
SYP Creosote	517.59	C
Douglas Fir Creosote	537.74	C
SYP Untreated	647.81	D
SYP CCA	698.93	D
SYP Penta	774.64	E

Gaff 90040

Treatments	lbf. Avg.	LSD
SYP CuNap	405.68	A
Douglas Fir CuNap	500.87	B
Douglas Fir Penta	530.18	BC
SYP Creosote	557.77	C
Douglas Fir ACZA	562.99	C
Douglas Fir Creosote	623.82	D
SYP Penta	901.47	E
SYP CCA	908.51	E
SYP Untreated	937.66	E

Figure 4. Digital images of the three experimental gaff types.

SUMMARY AND CONCLUSIONS

Overall, Penta- and CCA-treated Southern pine required the greatest force to penetrate wood pole surfaces with all three gaff types, including the one designed especially for CCA Poles. The untreated Southern pine was statistically similar to both the CCA and the Penta treated poles of SYP, indicating no significant level of 'hardening' existed over that of untreated, kiln-dried SYP. Douglas-fir was somewhat easier to penetrate using these gaff types than SYP. It is acknowledged that linemen climb all these poles daily, but have historically complained the most about climbing waterborne treatments due to the lack of lubricity that oil-borne or oil type preservatives give to the pole after pressure treatment. Overall, in this study, copper naphthenate pressure treated poles yielded the easiest to penetrate wood pole surfaces and thereby are deemed by these researchers to be the "easiest to climb" wood pole in this evaluation series.

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REFERENCES CITED

1. Cary, T. 2010. A climbing evaluation of pine poles treated with a CCA/oil emulsion system - A 20-year update. In: (H.M. Barnes, ed.). Proceedings Southeastern utility pole conference and trade show. Forest Products Society. Madison, WI. pp. 175-176.
2. Demers, H. 1985. Gaff. United States Patent 4,679,658. U.S. Patent Office. Washington, DC.
3. Engdahl, E.K., R.F. Fox, T.O. Geiser, and D.A. Werr. 1992. A climbing evaluation of pine poles treated with a CCA/oil emulsion system. In: Proceedings of American Wood Preservers' Association Annual Meeting. (88):57-70.
4. Fox, R.F., H.J. Demers, T.O. Geiser, and J.E. Pennefeather. 1987. Improved climbability of CCA-treated poles through modification of GAFF design. In: Proceedings of American Wood Preservers' Association Annual Meeting. (83):191-213.
5. Gilbert, R., A. Besner, and P. Octeau. 1997. Effect of aging and temperature on the resistance to spur penetration in red pine poles treated with CCA-PEG 1000. Forest Products Journal. 47(3):81-88.
6. McIntyre, C.R. and R.F. Fox. 1990. Update on Wolman ET a new CCA/oil treating system. In: Proceedings of American Wood Preservers' Association Annual Meeting. (86):63-77.
7. McIntyre, C.R. and E.A. Pasek. 1990. United States Patent 4,950,329. Wood preservative composition and method of treating wood with same. U.S. Patent Office. Washington, DC.
8. Trumble, W.P. and E.E. Messina. 1985. CCA-PEG pole preservative research. In: Proceedings of American Wood Preservers' Association Annual Meeting. (81):203-211.
9. Zahora, A.R. and C.M. Rector. 1990. Water-repellent additives for pressure treatments. In: Proceedings of Canadian Wood Preservative Association. 11:22-42.