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SERVICEABILITY OF COPPER NAPHTHENATE-TREATED POLES

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ABSTRACT

Copper naphthenate-treated poles in service were inspected for deterioration, penetration, retention, and serviceability. The study to date has included poles in all hazard zones in the United States. Poles installed by 12 different utilities and eight different treating companies are included in the survey. Both southern pine and Douglas-fir poles and distribution and transmission poles are included in the survey. Only two of the surveyed poles were considered failures, indicating that properly treated copper naphthenate poles are performing satisfactorily.

Keywords: southern pine, poles, performance, copper naphthenate, Douglas-fir

INTRODUCTION

The southern pine pole stubs from the original copper naphthenate (CN) trials conducted at Mississippi State University (Barnes and Hein 1988) are showing excellent performance after over 12 years of ground contact exposure in Mississippi. These steam-conditioned stubs include several methods of post treatment conditioning. Kiln-dried poles were installed in 1988 in Ohio, Virginia, and West Virginia and as of 1992 (Engdall and Baileys 1992) no observations had been made to contraindicate expectations of adequate performance. Migration of preservative was typical of oilborne systems. Thousands of CN-treated poles (CNTP) are currently in service throughout the USA, but due to

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severe premature failures a task force was formed by AWPA Subcommittee T-4 in 1996 to investigate the performance of CNTP in service. This report documents our survey of poles in service.

METHODS & MATERIALS

Test Poles--CNTP of different ages, sizes, and species from different geographical areas were identified, and the cooperation of the pole owners was secured. Individual poles were numbered, and a random number generator was used to identify which poles would be examined, depending on the wishes of the cooperating utility. If the physical location of a pre-chosen pole precluded its examination, the pole was replaced by the next number chosen.

A total of 137 Douglas-fir and 170 southern pine CNTP were examined for this report. These poles represent five different utilities and eight different treaters and include assessments for poles in all deterioration zones in the U.S. (AWPA 1997).

Pole Inspection--All poles chosen for this study were examined for signs of deterioration both above-ground and one foot below groundline by independent inspectors. Test poles were excavated to one foot below groundline, sounded from groundline to as high as the inspector could reach, examined for signs of external decay both above and below groundline, and bored three or four times near grade and once within one foot of the brand to determine internal decay and penetration. These cores were combined for assay as described below. Selected poles were bored above the brand in a spiral pattern in five-foot increments in order to more thoroughly assess the condition of the above-ground portion of the pole. These cores were assayed separately as a group. Cores were then placed in straws and shipped to the

Mississippi Forest Products Laboratory (MFPL) where each core was examined for signs of internal decay and the penetration of preservative was rechecked. Cores were then ground to pass a 30 mesh screen, and assayed using AWPA Standard A9-97 (AWPA 1997). A pictorial record was made for each pole sampled.

RESULTS

The data for Douglas-fir show the following:

- Poles have been in service for six to eight years.
- Twenty-four (18%) Douglas-fir poles failed to meet the target assay. About 71% of the poles treated to a 0.075 pcf target met retention requirements. Of those treated to a 0.095 pcf target, 94% met the retention requirements.
- The average for all 0.075 pcf target poles was 0.101 pcf or 35% greater than the specified target; for the 0.095 pcf target, retention averaged 0.157 pcf or 65% more than target.
- One penetration failure was noted.
- No insect problems were noted in any of the treated poles; a small decay pocket was present in one pole.

Retention distribution data are shown in Figures 1 and 2 for the Douglas-fir poles. The data suggests that treaters are having problems in meeting the lower (0.075 pcf) retention target. On average, however, most Douglas-fir poles are over-treated. Penetration does not seem to be a concern with only one penetration failure in the total Douglas-fir pole sample.

The southern pine pole data show the following:

- 91% of the poles treated to a 0.06 pcf target met or exceeded retention requirements. The average retention for this group was 0.096 pcf.
- 71% of the 0.08 pcf target group were treated to the target or above and the group average was identical to the group above.

- One pole in the 0.08 pcf target group had penetration problems. One additional pole failed from decay and was removed from service.

- The 0.13 pcf target group was the least well treated with 59% of the pole not meeting target. Average retention for this group was 0.119 pcf by assay.

- For the 0.13 pcf target group, one pole had spotty penetration and a second pole, which failed from decay, also had spotty penetration.

- Decay was found in five percent of the 0.06 pcf target poles. No penetration failures were noted.

- The data suggest that treaters are having difficulty in meeting the 0.13 pcf target.

- The oldest poles in the southern pine survey group were installed in 1988.

Retention distribution data are shown in Figures 3-5 for southern pine poles. Considerably more variation was shown in the southern pine poles tested to date. Most non-conforming poles failed to meet the specified assay requirement. Only two seriously decayed southern pine poles were found, and they were removed from service after 7-8 years in service. One pole had a break below the bottom conductor in the decayed area near the crossarm. The other had a large decay pocket containing some preservative at groundline. In both instances, decay appeared to result from conditioning problems (wet pockets), or inadequate sterilization. Several southern pine poles were severely under-treated, with one being only 40% of the target retention specified. These poles are candidates for early failure. It was noted that some poles had bleached tops, but this observation did not correlate with under-treatment, decay, or other defects.

Data comparing assays from pole tops (above brand) to those taken from the brand down are shown in Table 1. This was done since some have

indicated that differential treatment may contribute to early failure in service. There was no consistent trend with respect to assay location, with half of the poles having higher retentions in the top portion and half with higher retentions in the bottom portion. All but eight poles show bottom to top differences within ± 0.025 pcf Cu. For Douglas-fir, the average retention in pole tops was 92% of the target retention. Southern pine tops averaged 128% of target. For the most part, these comparisons fall within what might be expected and do not seem to indicate differential treatment.

CONCLUSIONS

This study has shown copper naphthenate to be a very effective preservative when properly applied to wood poles. The failure rate in this study (<1%) is well below the 5% exclusion limit found in a normal distribution of samples. Some difficulties in meeting some of the target retentions are indicated, but performance does not seem to be impacted so long as proper penetration is achieved. Failure of poles in this study seemed to arise from conditioning problems and/or inadequate sterilization.

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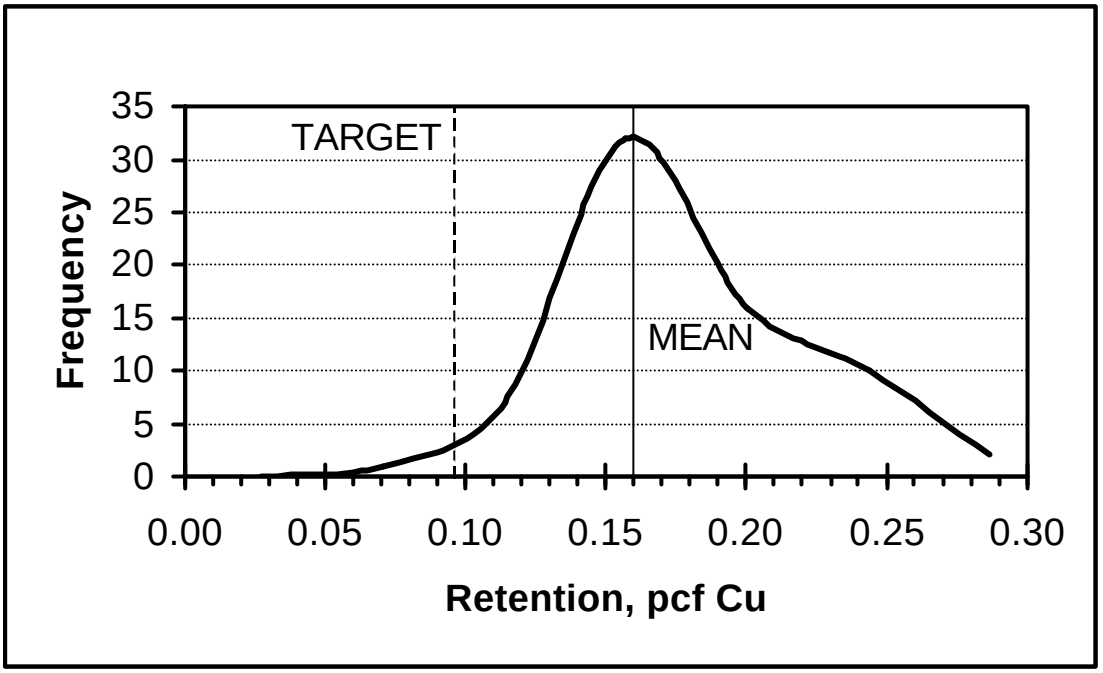

Figure 1. Retention distribution for Douglas-fir poles treated to a 0.075 pcf target.

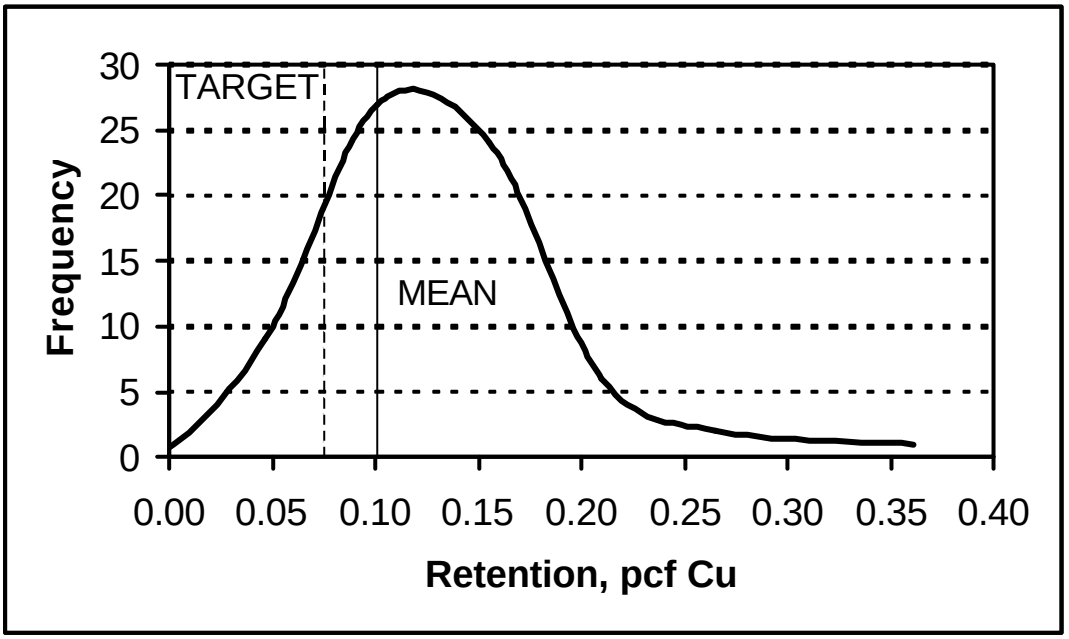

Figure 2. Retention distribution for Douglas-fir poles treated to a 0.095 pcf target.

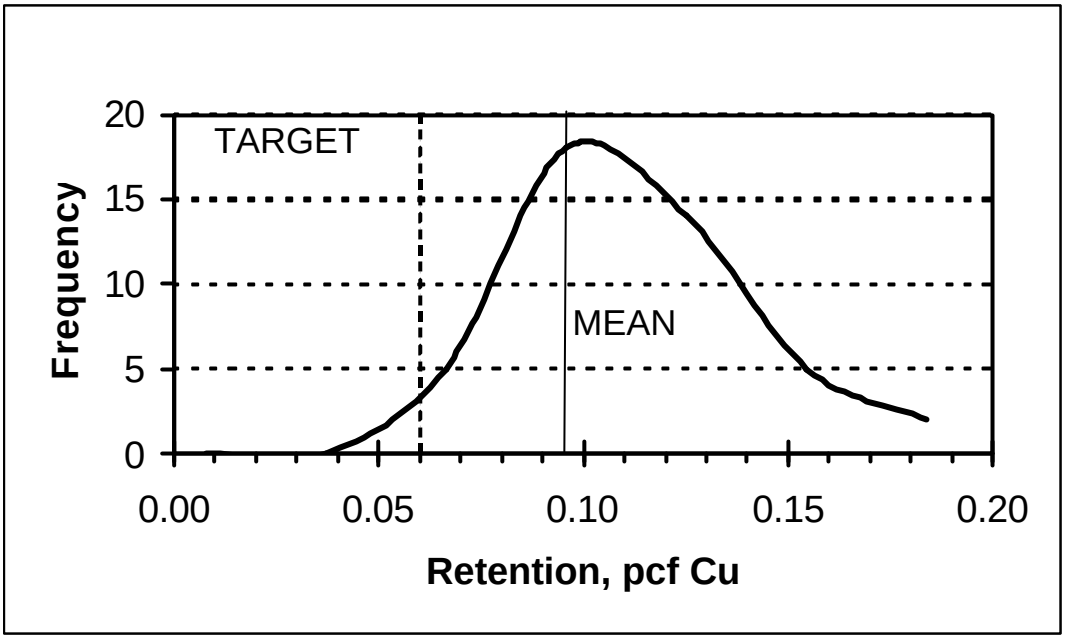

Figure 3. Southern pine retention distribution for poles treated to a 0.06 pcf target.

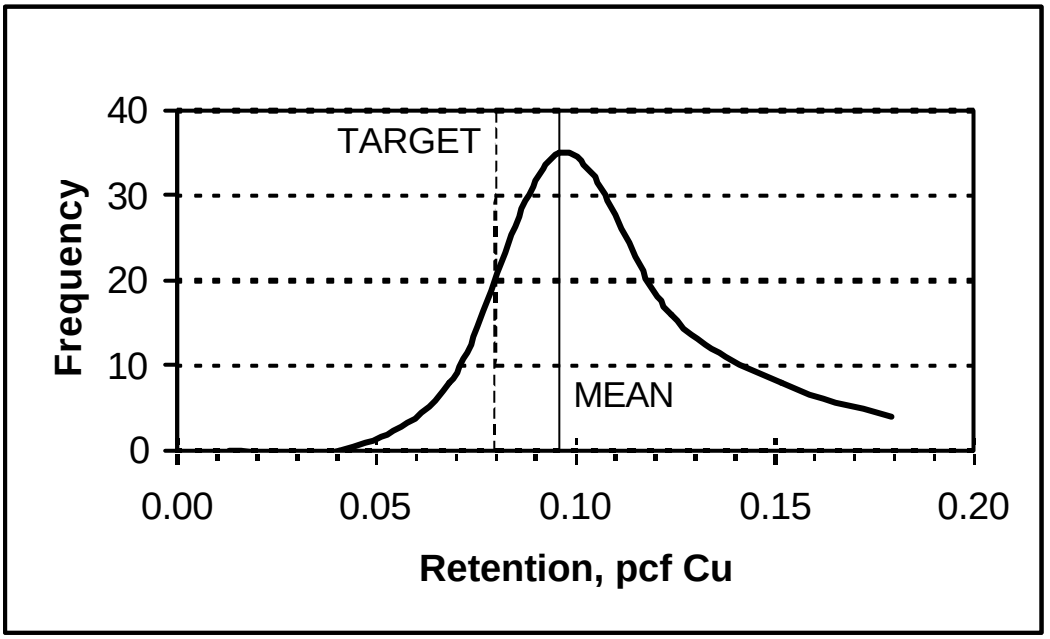

Figure 4. Retention distribution for southern pine poles treated to a 0.08 pcf target.

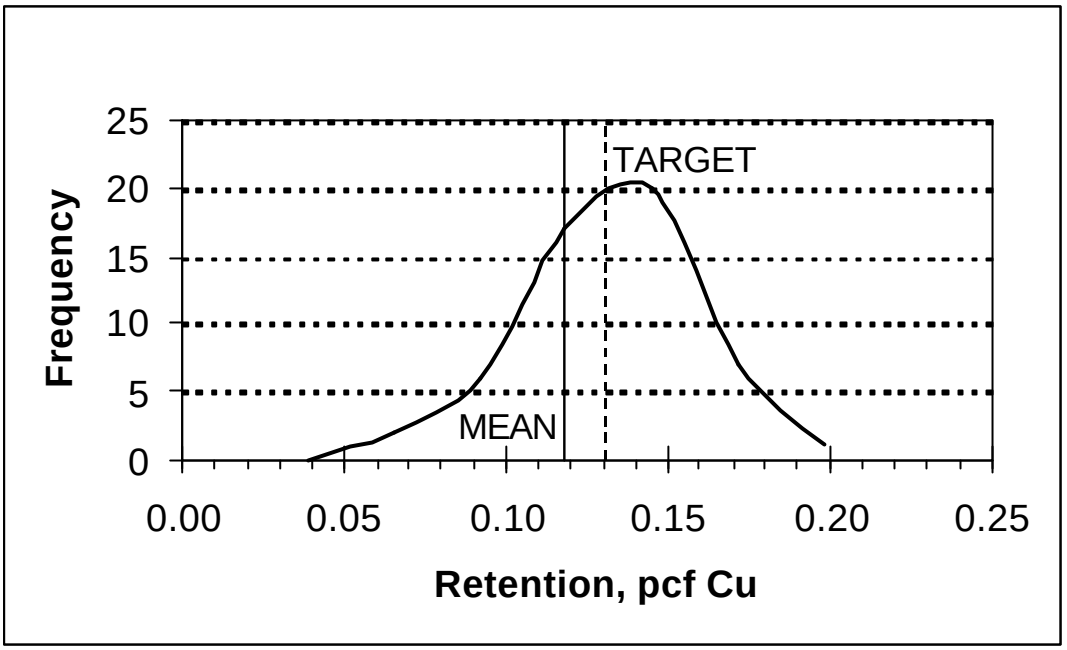

Figure 5. Retention distribution for southern pine poles treated to a 0.13 pcf target retention.

Table 1. Comparison of retentions for pole tops (above brand) and bottoms (brand down).

TREATED MO	TREATED YR	POLE CLASS	LENGTH (ft)	TARGET RETENTION (pcf Cu)	ZONE	ASSAY (pcf Cu) BOTTOM	ASSAY (pcf Cu) TOP	DIFFERENCE [BOT-TOP] (pcf Cu)	RATIO [TOP:TARGET]
Douglas-fir									
7	91	3	45	0.075	1	0.054	0.103	-0.049	137%
7	91	3	45	0.075	1	0.094	0.066	0.028	88%
7	91	3	45	0.075	1	0.024	0.039	-0.015	52%
							AVG	-0.012	92%
							STD DEV	0.039	43%
Southern pine									
4	90	5	40	0.06	2	0.090	0.141	-0.051	235%
9	93	4	40	0.08	2	0.092	0.117	-0.025	146%
5	91	5	40	0.08	4	0.054	0.078	-0.024	98%
5	91	5	40	0.08	4	0.075	0.098	-0.023	123%
9	93	4	40	0.08	2	0.070	0.089	-0.019	111%
4	88	4	40	0.08	4	0.070	0.083	-0.013	104%
4	90	5	40	0.06	2	0.081	0.094	-0.013	157%
4	88	5	40	0.08	4	0.071	0.083	-0.012	104%
4	88	5	40	0.08	4	0.123	0.135	-0.012	169%
4	90	5	40	0.06	2	0.086	0.097	-0.011	162%
8	96	5	30	0.13	5	0.105	0.116	-0.011	89%
4	90	5	40	0.06	2	0.083	0.094	-0.011	157%

Table 1. Comparison of retentions for pole tops (above brand) and bottoms (brand down).

TREATED		POLE	LENGTH	TARGET		ASSAY (pcf Cu)		DIFFERENCE	RATIO
MO	YR	CLASS	(ft)	RETENTION (pcf Cu)	ZONE	BOTTOM	TOP	[BOT-TOP] (pcf Cu)	[TOP:TARGET]
9	93	4	40	0.08	2	0.061	0.069	-0.008	86%
4	90	5	40	0.06	2	0.084	0.092	-0.008	153%
6	92	5	40	0.06	1	0.040	0.047	-0.007	78%
10	92	5	35	0.06	1	0.064	0.071	-0.007	118%
4	96	5	30	0.13	5	0.096	0.102	-0.006	78%
4	90	5	40	0.06	2	0.118	0.120	-0.002	200%
4	88	5	40	0.08	4	0.080	0.081	-0.001	101%
4	90	5	40	0.06	2	0.122	0.123	-0.001	205%
4	90	5	40	0.06	2	0.101	0.100	0.001	167%
4	90	5	40	0.06	2	0.120	0.116	0.004	193%
4	90	5	40	0.06	2	0.110	0.106	0.004	177%
4	88	5	40	0.08	4	0.082	0.076	0.006	95%
4	88	5	40	0.08	4	0.100	0.094	0.006	118%
4	90	5	40	0.06	2	0.079	0.073	0.006	122%
5	91	5	40	0.08	4	0.101	0.095	0.006	119%
6	93	3	45	0.08	2	0.119	0.112	0.007	140%
4	90	5	40	0.06	2	0.072	0.061	0.011	102%
4	90	5	40	0.06	2	0.102	0.089	0.013	148%
10	92	5	35	0.06	1	0.075	0.056	0.019	93%
4	90	5	40	0.06	2	0.111	0.092	0.019	153%
9	93	4	40	0.08	2	0.112	0.092	0.020	115%
3	94	5	30	0.13	5	0.115	0.095	0.020	73%
5	94	5	35	0.13	5	0.093	0.07	0.023	54%
6	93	4	40	0.06	1	0.132	0.102	0.030	170%
5	93	5	35	0.06	1	0.093	0.062	0.031	103%
5	91	5	40	0.08	4	0.098	0.063	0.035	79%
4	90	5	40	0.06	2	0.157	0.104	0.053	173%
5	91	5	40	0.08	4	0.149	0.056	0.093	70%
							AVG	0.004	128%
							STD DEV	0.024	43%