Creosote Posts 50 Years Later

Final Inspection Of The 1958 Cooperative Test After 50 Years Of Exposure As A Ground Contact Preservative

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This paper presents data from the 50-year final field inspection of southern pine posts. This post study was the only remaining part of the 1958 Cooperative Project that was originally initiated to compare service life performance of several different types of creosotes and creosote preservative solutions.

Data from the field inspection indicates creosotes described by the American Wood Protection Association (AWPA) Standards for Creosote P1/P13 and Creosote Solution P2 can and will continue to provide excellent service life when wood products are treated to the retention levels recommended in the appropriate AWPA Use Category Standards.

INTRODUCTION

This study with creosote-treated wood products is the longest continuous field inspection project that has been solely conducted by industry sponsors. The study was located at the Blessing Plantation—a former Koppers Company field test site—about 20 miles north of Charleston, S.C. This site is classified as a severe deterioration zone as defined in AWPA Standard U1-08.

The original test program included laboratory, marine and land exposure tests for various creosote distillates and solutions. Data and information on these 11 creosotes are given in Table 1. There were six different study areas for the project, and these are listed in Table 2.

There were originally four cooperators in the project: Allied Chemical Corporation, United States Steel Corporation, Koppers Company Inc. and Bernuth Lembcke Company. Of these four, only two—Koppers Company Inc. and KMG-Bernuth Inc.—currently hold registrations for the use of creosote as a wood preservative.

Additional information on this project can be found in previously published papers (see references). This paper is the 16th published paper in a series on the 1958 Cooperative Creosote Project. To be consistent with previous inspections at the Blessing site, an Index of Condition was used to grade/evaluate each of the creosote-treated southern pine posts during the inspection. The scale used is given in Table 3.

Of the original six study areas (Table 2), only the seven-foot post test is currently active. The average nominal retention levels of four, six and eight pounds per cubic foot (pcf) for each of the 11 creosote preservatives were grouped together and compared as to their service-life performance. The information given in this paper is a summary of the data from the most recent inspection, which was performed the third week in November 2008 by the three authors. For comparative purposes, a summary of the five neat creosote "Index of Condition" data from previous inspections are also given in Table 6. Unfortunately, a number of posts have been missing, lost or stolen over the years. Also, Hurricane Hugo

Table 1
1958 Cooperative Creosote Project Types of Creosotes Used in the Test Evaluation

Four basic types of creosote preservative solutions:

- Creosotes A, C, D, F and G were straight-run distillates.
- Creosotes B and E contained 2% pentachlorophenol 4.
- Creosote Solutions H and I were 70/30 solutions meeting the 1958, P2 Solution Standard (note that coal tar was added to this mixture).
- Creosote Solutions J and K were 50/50 solutions meeting the AWPA, P3 Creosote/PetroleumStandard.

Physical property descriptions for the 11 creosote preservatives:

- A - Creosote, 41% distillate to 270 degrees C.; 17% residue at 355 degrees C.;
- B - Creosote A with an addition of 2% pentachlorophenol;
- C - Creosote, 26% distillate to 270 degrees C.; 19% residue at 355 degrees C.;
- D - Creosote, 13% distillate to 270 degrees C.; 17% residue at 355 degrees C.;
- E - Creosote D with an addition of 2% pentachlorophenol;
- F - Creosote, 4% distillate to 270 degrees C.; 28% residue at 355 degrees C. (note of specific importance is that this material would meet the current AWPA Standard for P2 Solution);
- G - Creosote, 15% distillate to 270 degrees C.; 22% residue at 355 degrees C. (note that this material was close to the current AWPA requirements for P1/P13 being 1% off on the residue);
- H - 70/30 blend of Creosote A and coal tar; current production methods do not use coal tar for preparing the AWPA, P2 Solution;
- I - 70/30 blend of Creosote D and coal tar; same statement as above;
- J - 50/50 blended mixture of creosote/petroleum made with Creosote A and 50% petroleum oil meeting AWPA, Standard P4 (minimum specific gravity of 0.96);
- K - 50/50 blended mixture of creosote/petroleum made with Creosote D and 50% petroleum oil meeting the P4 Standard.

Two important points to consider concerning the test creosote preservative solution with coal tar and petroleum:

- The current practice used in manufacturing the P2 preservative does not use coal tar in the blend. Thus, posts treated with Creosotes H and I do not represent the type of product currently being produced.
- With regard to the creosote/petroleum blends, both Creosotes A and D were low residue materials and do not represent the type of creosote currently being produced.

during 1989 caused some additional casualties. Despite all this, after 50-years of ground contact exposure, a significant number of the creosote posts remain in excellent condition.

The reader should also give consideration to the following overall comments concerning the types of creosotes and solutions that were used in the test:

1. Creosotes designated B and E both contain 2 percent pentachlorophenol. These preservative systems, although an excellent treatment for commercial wood products, are not registered wood preservatives under the Environmental Protection Agency (EPA) pesticide program. Nor is it conceivable that they ever will become registered wood preservatives. There were plant-operating problems with the 2 percent addition of pentachlorophenol to creosote and there would be significant expense to complete all the testing required to meet the EPA registration of this preservative.

2. With regard to the test creosote solutions H, I, J and K, it must be considered that creosotes A and D had the lowest residue at 355 degrees C, with A being the most volatile. In addition, both creosotes A and D have been the poorest performers and neither met the AWPA Standards for P1/P13 and P2.

3. Finally, with a focus on creosote solutions H and I, it must be considered that these test creosote solutions were prepared in a ratio of 70/30 creosote to coal tar. Coal tar was added, but it has very limited pesticide activity. Because of air emission limitations at coke plants and the high amounts of water present within coal tar, it is impossible to use any coal tar in the making of AWPA, P2 Standard Creosote Solution. Thus, the current P2 solution being produced does not contain any coal tar and would be similar to the test creosote F.

Table 2
Study Area For The 1958 Cooperative Test

- Marine-block bioassay
- Soil-block bioassay
- Accelerated field exposure:
- ¾ inch by ¾ inch by 18-inch stakes for land exposure,
- ¾ inch by 3 by 14-inch for marine waters,
  - Evaporation Studies – 3 to 4 inch by 18-inch post sections,
  - Simulated service test with 4½ - foot posts for marine exposure,
  - Simulated service test with 7-foot posts for land exposure.

It should be noted that the 7-foot posts were the only remaining creosote-treated wood produced in the 1958 Cooperative Study.

Table 3
Index Of Condition Used To Rate The Posts During The Inspection

Description Of Condition	Rating
Sound	10
Surface softness to 1/8-inch depth	9
General surface decay, pocket up to ¼-inch depth	7
Surface decay ½-inch and deeper	4
Failure – posts broken with a hard push	0

RESULTS OF THE INSPECTION

Before further discussing this long-standing project and the results of the recent 50-year inspection conducted in November 2008, it needs to be stated that the information that follows does not deviate significantly from the results reported following the 43-year inspection. This information was published to the AWPA Proceedings in 2002. For example, the number of creosote-treated posts that "failed" (Table 4) had increased somewhat, and the "average index of condition" (Table 5) for the three retention groups was somewhat reduced. However, "ranking" of the various creosotes remained the same—with the exception that creosotes F and G attained the same ranking with an "average index of condition" of 63.

The following is a summary of the most recent inspection results along with appropriate comparison with previous inspections of the 1958 Cooperative Posts. The discussion focuses on the straight or neat creosotes (A, C, D, F and G) as the other formulations contain pentachlorophenol, coal tar and heavy petroleum oil and are not representative of the creosote preservatives currently being produced.

■ Using the residue data (percent distillate above 355 degrees C.) as a comparison, those creosotes with a higher residue (less volatile distillate) have consistently had a longer service life. This performance difference had been noted with the recent inspection of the seven-foot posts and had previously been indicated by a similar trend with test data from both the soil-block and three-quarter-inch stake tests.

■ Table 4 lists the number of posts that have been lost or stolen from the test plot. Also of importance is the number of posts that have failed. Creosotes F and G have the fewest number of failed posts. It needs to be considered that the failed posts were predominately from retention levels below that recommended by AWPA, thus indicating excellent performance for these two creosotes.

■ As given in Table 5, the data show the "average index of condition" for all the test ▶

Table 4
Number Of Posts Remaining In The Test At The Time Of The 50-Year Inspection

Oil	Originial Total	Number Missing	Number Failures
A	53	6	42
B	58	5	27
C	60	5	22
D	59	2	36
E	60	3	11
F	59	5	18
G	60	7	17
H	58	14	39
I	58	13	27
J	60	10	23
K	58	4	37

Table 5
Average Index Of Condition For Posts After 50 Years In Service

Creosote	<5.0	5.0-6	>7.0
A	2	0	2
B	10	40	65
C	4	51	77
D	12	23	52
E	35	61	94
F	46	63	87
G	20	63	92
H	0	6	33
I	0	15	64
J	8	31	79
K	5	22	70

creosotes. Of significance is the excellent performance of creosotes F and G.

■ Data given in Table 6 is significant because it gives a comparative ranking of the straight-run/neat creosotes in three different test protocols that have been used to evaluate wood preservatives—the soil-block, three-quarter-inch stake (empty cell treatment) and posts when using a six-pound per cubic foot (pcf) creosote retention. The ranking has been relatively consistent with the three tests for each of the creosotes.

Table 6
Comparative Rank Of Creosotes In Soil-block Stakes (Empty Cell) and 7-ft. Posts At 6 PCF Creosote Retention

Rank	Soil Block	Stakes 20 Years	¾ Inch Posts 25 Years	Posts 30 Years	Posts 35 Years	Posts 43 Years	Posts 50 Years
1	F	F(57)	G (96)	G (92)	G (94)	G (81)	F-G (63)
2	G	D-G (30)	C-F (91)	F (90)	F (89)	F (78)	--
3	D	--	--	C (85)	C (88)	C (73)	C (51)
4	C	C (22)	D (76)	D (63)	D (54)	D (31)	D (23)
5	A	A (20)	A (29)	A (16)	A (3)	A (0)	A (0)

() Indicates average index of condition in the 5.0 to 6.9 creosote retention range.

CONCLUSIONS

There are several conclusions that can be drawn for creosote as a wood preservative based on data gathered from the 1958 cooperative study:

■ The service life of creosote-treated wood products is increased with the use of a higher residue, less volatile type of creosote. As shown by creosotes F and G, which have given excellent performance throughout the duration of this 50-year service test. For all practical purposes, Creosote G represents AWPA, Standard P1/P13 type creosote, and Creosote F represents AWPA, Standard P2 type creosote solution without the addition of coal tar.

■ There is a significant conclusion that can be reached from this long-term test on creosote. Based on short-term soil-block test results, one can conclude that creosote formulations F and G would give improved service life as compared to high volatile creosotes such as creosote A. It is thus possible to establish, in this instance with creosote, that the short-term soil-block test could predict the long-term perform once of creosote-treated wood products.

This inspection yielded valuable data on the long-term performance of creosote as a wood preservative in direct contact with the ground. This inspection after 50 years is the conclusion of the study. Several samples from posts treated with creosotes F and G were taken for further testing for retention and gas chromatograph analyses.

The authors wish to acknowledge the assistance of all the original companies who had the foresight to initiate this study on creosote. In addition, we thank Jim Gauntt and the Railway Tie Association (RTA) for their sponsorship of the study during the 43-year inspection. §

See references and author biographies online at www.rta.org.