

Creosote Posts – Final Inspection of the 1958 Cooperative Test After 50 Years of Exposure as a Ground Contact Preservative

David A. Webb
Creosote Council
Valencia, Pennsylvania

Roger F. Fox
Arch Wood Protection, Inc.
Conley, Georgia

Russel G. Pfeiffer
Koppers, Inc.
Harmarville, Pennsylvania

ABSTRACT

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 twenty miles north of Charleston, South Carolina. 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 eleven (11) creosotes are given in Table 1. There were six (6) 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 sixteenth (16) 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 7 foot post test is currently active. The average nominal retention levels of four (4), six (6) and eight (8) pounds per cubic foot (pcf) for each of the eleven (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 of 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 during the later 1980's 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% 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% 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 AWWA 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 AWWA, 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.

RESULTS OF THE INSPECTION

Before further discussing this long-standing project and the results of the recent 50-year inspection conducted in November of 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 AWWA 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 (3) retention groups were 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 7-foot posts and had previously been indicated by a similar trend with test data from both the soil-block and ¾-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 post were predominately from retention levels below that recommended by AWWA. Thus indicating excellent performance for these two creosotes.
- As given in Table 5 the data shows the "average index of condition" for all the test 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 (3) different test protocols that have been used to evaluate wood preservatives – the soil-block, ¾-inch stake (empty cell treatment) and posts when using a six (6) pound per cubic foot (pcf) creosote retention. The ranking has been relatively consistent with the three tests for each of the creosotes.



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 AWWA, Standard P1/P13 type creosote and Creosote F represents AWWA, 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 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.

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

- Creosote Solutions H and I were 70/30 solutions meeting the then 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/Petroleum Standard.
 - Physical Property Descriptions for the Eleven (11) Creosote Preservatives are listed as follows:
 - 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.

1. 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.
2. 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.

Table 2. Study Areas 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 4 and ½ - 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 produces in the 1958 Cooperative Study.

Table 3. Index of Condition Used to Rate the Posts During the Inspection

| <u>Description of Condition</u> | <u>Rating</u> |
|---|---------------|
| Sound | 10 |
| Surface Softness to 1/8-inch Depth | 9 |
| General Surface Decay, Pocket Up to 1/4-inch Depth | 7 |
| Surface Decay 1/2-inch and Deeper | 4 |
| Failure – posts broken with a hard push | 0 |

Table 4. Number of Posts Remaining in the Test at the Time of the 50-Year Inspection

| Oil | Original 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 Retention (pcf)

| Creosote | <5.0 | 5.0 to 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 |

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 | 3/4 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.

REFERENCES

1. Baileys, R. T. and R. F. Fox. 1989. 1958 Cooperative Creosote Project – XIII: An Update After 30 Years of Field Test with Posts. AWPA Proceedings 85: 244.
2. Baileys, R. T. and D. A. Webb. 1987. 1958 Cooperative Creosote Project – XII: An Analysis of Creosotes from Posts after 26 Years in Test. AWPA Proceedings 83: 163.
3. Colley, R. H. 1972. 1958 Cooperative Creosote Project – VII: Field Test for Posts: A Progress. AWPA Proceedings 68: 186.
4. Colley, R. H., H. J. Fry, W. T. Henry and D. A. Webb. 1980. 1959 Cooperative Creosote Project – X: Field Tests with Stakes and Posts after 20 Years in Test. AWPA Proceedings 76: 290.
5. Leach, C. W. 1964. 1958 Cooperative Creosote Project – I: Laboratory Soil-Block Tests. AWPA Proceedings 60: 165.
6. Stasse, H. L. 1958 Cooperative Project V. Field Tests with Stakes and Posts: Laboratory Evaporation Test. AWPA Proceedings 64: 17.
7. Webb, D. A., R. H. Colley, R. F. Fox and W. T. Henry. 1984. 1958 Cooperative Creosote Project – XI: Field Tests with Posts after 25 Years in Test. AWPA Proceedings 80: 171.
8. Webb, D. A. and R. T. Baileys. 1995. 1958 Cooperative Creosote Project – XIV: 35 Years of Field Exposure with Posts. AWPA Proceedings 91: 120.
9. Webb, D. A., R. T. Baileys, G. P. Merrick and R. G. Pfeiffer. 2002. Creosote – 43 Years of Experience as a Ground Contact Preservative. AWPA Proceedings 98: 125.