RESULTS OF FIELD TEST IN THE AMAZON ENVIRONMENT OF DURABILITY OF EUCALYPTUS WOOD (*Eucalyptus* sp.) TREATED WITH CCA BY VACUUM-PRESSURE PROCESS

Henrique José Borges de ARAUJO[1] **Luis Cláudio de OLIVEIRA**[1]

[1]Forester, M.Sc., Researcher of EMBRAPA - Empresa Brasileira de Pesquisa Agropecuária
Rodovia BR 364, km 14, CEP 69908-970, Rio Branco, Acre, Brazil
henrique@cpafac.embrapa.br; lclaudio@cpafac.embrapa.br

SUMMARY

The intense economic exploration have caused a decrease of the original stock of Amazon woody species, including those of high natural durability used in soil contact. The lack of those species results in increased price that make economically unfeasible of the use, an alternative is the replacement by planted species of fast-growing treated with preservatives. Another advantage of to use species planted to replace the traditional species is environmental, because this will reduce the exploratory pressure on these species. The objective of this study is to evaluate the degree of biological degradation of eucalyptus wood (*Eucalyptus* sp.) treated with CCA under vacuum and pressure process and exposed in field experiment in Rio Branco, state of Acre, Brazilian Amazon. The experiment was implemented in May 2005 and its variables were: 1) treatment with CCA, 2) no treatment, 3) degradation by fungi, 4) degradation by termites, and 5) region or part of the piece. The results show that after the 3rd evaluation (47 months), 100% of the specimens without treated were classified with the maximum degree of degradation and, in contrast, 100% of the specimens treated with CCA, after 60 months of test, were classified with the minimum degree of degradation. The parties of the pieces without treatment with the higher and the lesser degrees of decay were, respectively, the under top and the aerial part above 10 cm of soil. The degradation caused by fungi was slightly lower than that of termites. The field experiment has shown that is technically feasible the use of eucalyptus wood to replace the traditional species of the Amazon.

Key words: Eucalyptus wood, Durability of wood, Wood treatment preservative, CCA, Amazon wood species.

INTRODUCTION

The most of the Amazon tree species considered traditional and best know in the timber market, thus had been heavily exploited in the last years has greatly reduced their natural occurrence and are in the increasing process of shortages, and in some cases, even under threat extinction. Among these species are listed the used to rustic application in rural land like as fence posts, stakes, poles and bridges, especially in uses where the wood is in permanent contact with the soil, environment with a high degree of degradation. Examples of species from Amazonian traditionally used in soil contact: maçaranduba (*Manilkara surinamensis* (Miq.) Dub.), itaúba (*Mezilaurus itauba* (Meissn.) Taub.), aroeira (*Astronium Lecointei* Ducke), acariquara (*Minquartia guianensis* Aubl.) and pequi (*Caryocar villosum* (Aubl.) Pers.). These species have high natural durability and can be resisting for many years in good condition of use in unfavorable environments.

In: CONGRESO FORESTAL DE CUBA, 5.; SIMPOSIO INTERNACIONAL SOBRE SISTEMAS AGRO FORESTALES, 6.; ENCUENTRO INTERNACIONAL DE JÓVENES INVESTIGADORES, 5., 2011, Havana. Memórias ... Edición Especial de la Revista Forestal Baracoa, n. 1/2011. 1 CD-ROM.

The scarcity of native timber with high natural durability in managed forests results in increased your value in the timber market. The price of their products is very high, which has prevented its economic use. By the way, the replacement of those species by other fast growing, like as eucalyptus (*Eucalyptus* sp.) properly treated with chemical preservatives, presents itself as an excellent alternative to the problem.

Beyond the economic aspect, another advantage of using treated wood from planted forest in substitution of the marketable wood is the environmental form, since the exploratory pressure on native species will be reduced, which is very positive in terms of conservation and restoration of stocks.

Amongst the methods of wood preservation used in worldwide the most efficient are those applied under vacuum and pressure conditions, and the most important among these is the "full cell", also known as Bethell process, which aims to fill most cells of the wood preservative product (CTFT, 1970; Cockcroft, 1971; Déon, 1978). One of the main products used to treat the wood preservative is chromated copper arsenate, also known as CCA, preservative based soluble copper (Cu), chromium (Cr) and arsenic (As) (Moreschi, 1985; Velizarova *et al.* 2004; Galvão *et al.*, 2004). Although the CCA is a preservative widely accepted, there is a restriction of toxicity to humans, due to the element arsenic, and low efficiency in wood with low retention (Richardson, 1993; Ramos *et al.*, 2006).

Eucalypt wood treated with CCA, to be used in contact with soil (such poles, stacks and fence posts), have the average durability of 15 years in service (technical specifications from fabricant) and can be extended in practice from 20 to 30 years (Galvão, 1972; Sales *et al.*, 2004).

OBJECTIVE

This study aims to assess the degree of decay caused by xylophagous, fungi and termites, of eucalyptus treated and untreated in vacuum and pressure conditions with CCA preservative and exposed for 60 months in a graveyard test at the experimental farm of Embrapa Acre.

MATERIALS AND METHODS

The graveyard test is located in the farm of Embrapa Acre, with geographic coordinates S10°01'30.7" e W067°42'23.6", city of Rio Branco, state of Acre, Brazilian Amazon. In this area the climate is Aw (Kopp), with three months of drought, annual rainfall between 1,800 mm to 2,000 mm and average annual temperature of 24 ° C; the soil is sandy loam with high clay content and good drainage; the topography is flat and the existing vegetation is basically composed of grasses, and cover the original Amazon rainforest; the diversity of wood decay organisms is high, especially in fungi and insects (BRAZIL, 1976; Jesus *et al.*, 1998).

The graveyard test consists of 30 samples of eucalyptus (*Eucalyptus* sp.), shelled, from the state of Paraná (southern Brazil), with 1.10 m in length and diameter of 7.0 cm, with half (15 stacks) treated with CCA preservative method "full cell" (Bethell Process) and half without preservative treatment.

Since the established of the graveyard test in May 2005, were made four annual measures at October 2006, November 2007, May 2009 and May 2010. The interval between the first and last assessment amounted to 60 months (5 years).

The samples were evaluated for the action of the xylophagous organisms on the following variables: a) treated with CCA, b) untreated; c) degradation by fungi d) degradation by termites, and e) region or part of the piece. The evaluation of different regions of the separately aimed to verify, in a comparative way, the varying degrees of degradation that is between them, since these regions are exposed to environmental degradation and unequal levels.

The parts of the samples evaluated were: a) general state - considered the degree of degradation of the piece as a whole, b) part in contact with the soil - region of the between 10 cm above and 10 cm below the line contact with the soil, c) aerial part - region of the stack above 10 cm from the line of contact with the soil, d) underground part - the region's stack below 10 cm from the line of contact with the soil, e) the upper top - face transverse on over top (aerial) of the stack, and f) the under top - face transverse lower (soil) of the stack (Figure 1).

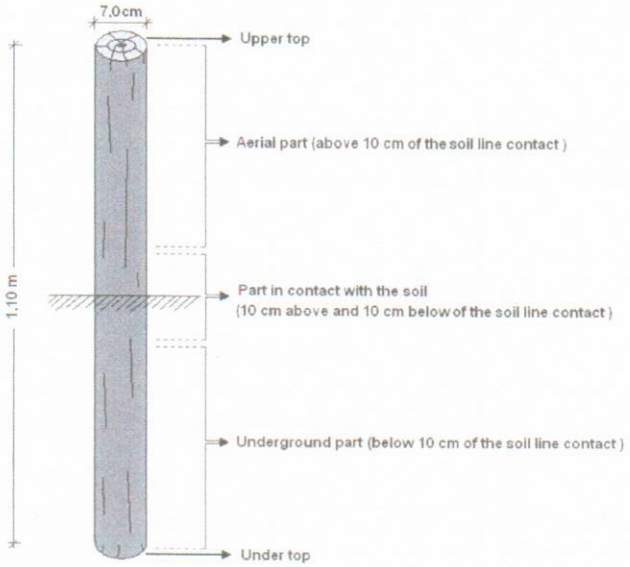

Figure 1. Evaluated parts of stackwood with regard to decay by xylophagous organisms.

Evaluation of graveyard test consisted of a visual inspection of each sample by removing of the ground and attributing a score, separately for the infestation of termites and fungi and their different parts (Figure 1), according to the classification of biological degradation shown in Table 1, which is based on the method of the International Union of Forest Research Organizations (IUFRO), described by Lepage (1970).

Table 1. Classification of degradation of samples (stack) by xylophagous organisms.

Score	Classification
10	Clear wood
9	Slightly attacked
7	Moderately attacked
4	Heavily attacked
0	Destroyed or broken

Source: Lepage (1970).

RESULTS

As expected, due to the recognized low natural durability, the stacks of eucalyptus without preservative treatment were rapidly degraded and infested by termites and fungi, as the stacks treated with CCA preservative remained intact with no signs of attack the termites and fungi.

The results shows that from the 3rd evaluation occurred after 47 months (3 years, 11 months) after implantation of the graveyard test to all regions or parts of the samples evaluated, 100% of the stacks not treated were classified with the degree of degradation maximum, ie, destroyed or broken, and virtually disappeared from the test, leaving only fragments. On the other hand, all the samples treated with CCA, 60 months after implantation of the test, remained free of attack, classified with the minimum degree of degradation, clear wood.

The sum (amount) of the scores assigned by the evaluation method the IUFRO allowed to verifying the ranking of the parties of the stacks in relationship with the degree of degradation. The total score on the assessments are showed in the Table 2.

Table 2. Total score obtained by stacks treated (CCA) and untreated by the parties and by wood decay xylophagous organism.

Part evaluated	TRT	1ª evaluation		2ª evaluation		3ª evaluation		4ª evaluation		Total
		Termite	Fungi	Termite	Fungi	Termite	Fungi	Termite	Fungi	
General state	Treated	150	150	150	150	150	150	150	150	1.200
	Untreated	36	44	28	35	0	0	0	0	143
Contact with the soil (10 cm above and 10 cm below)	Treated	150	150	150	150	150	150	150	150	1.200
	Untreated	47	47	36	32	0	0	0	0	162
Aerial part (above 10 cm of the soil)	Treated	150	150	150	150	150	150	150	150	1.200
	Untreated	65	89	47	79	0	0	0	0	280
Underground part (10 cm below of the soil)	Treated	150	150	150	150	150	150	150	150	1.200
	Untreated	40	40	32	28	0	0	0	0	140
Upper top	Treated	150	150	150	150	150	150	150	150	1.200
	Untreated	45	48	31	34	0	0	0	0	158
Under top	Treated	150	150	150	150	150	150	150	150	1.200
	Untreated	24	24	12	16	0	0	0	0	76
Total	Treated	900	900	900	900	900	900	900	900	-
	Untreated	257	292	186	224	0	0	0	0	-

TRT = Treatment (treated with CCA and untreated).

The untreated parties that presented higher and lower degree of degradation (higher and lower score in scores) to termites and fungi in the four evaluations were, respectively, under top, with a total of 76 points and aerial part (above 10 cm of the soil), with a total of 280 points. Therefore, the under top of the stack is less resistant and more susceptible to degradation, while the aerial part (above 10 cm of the soil) is more resistant and less susceptible to degradation by termites and fungi.

The other parts of the untreated stacks (contact with soil - 10 cm above and 10 cm below, 162 points; part underground - 10 cm below of the soil, 140 points; the upper top, 158 points) presented a similar degree of degradation to the general state of the stack, thus reflects the average degradation of the parties and whose total score was 143 points. All the stacks treated with CCA scored highest in the four assessments (1200 points).

The degree of degradation caused by termites and fungi, the results shows a slight difference in favor of fungi, either the damage caused by fungi are smaller than those caused by termites in the test conditions in question (total of 257 and 292 and 186 points and 224 points respectively for termites and fungi in the 1st and 2nd assessments).

CONCLUSIONS

After 60 months of field-testing, were seen very promising results regarding the durability of eucalyptus wood treated with CCA, indicating the technical viability of its use in substitution of marketable species native from the Amazon. However, for ending of the research, before the recommendation to its use in rural lands areas still need, in addition to continued monitoring of the trial, further studies on the economic viability, diversity of xylophagous organisms and environmental issues, especially concerning the leaching of the preservative to the soil.

Although it has little relevance from the viewpoint of the durability of the stacks not treated, since in the first evaluation at 16 months of trial, the most were damaged and useless, the information on which parts degrade with more intensity can be useful, for example, in the case of conventional preservative product application (such as brushing with carbolineum) which recommends greater attention to those parts most susceptible to biological attack, especially in regions in direct contact with soil (under top and underground part).

REFERENCES

BRASIL. 1976. Ministério das Minas e Energia. Departamento de Produção Mineral. Project Radambrasil. Page SC19. Levantamento dos Recursos Naturais. Vol. 12. Rio Branco. Rio de Janeiro, RJ. 458 pp (in Portuguese).

Cockcroft, R. 1971.Timbers preservatives and methods of treatment. Timberlab Papers Princes Risborough Laboratory, v. 46, p.1-6.

CTFT. 1970. Note on the injection of wood in an autoclave. Centre Technique Forestier Tropical, Division de Préservation. Nogent-Sur-Marne, France: CTFT. 7 pp (in French).

Déon, G. 1978. Handbook of wood preservation in tropical climate. Centre Technique Forestier Tropical, Division de Préservation. Nogent-Sur-Marne, France: CTFT. 111 pp (in French).

Galvão, A.P.M. 1972. The durability of treated wood and the efficiency of preservatives evaluated through field testing: first evaluation. IPEF, Piracicaba, n. 4, p.15-22 (in Portuguese).

Galvão, A.P.M.; Magalhães, W.L.E.; Mattos, P.P. 2004. Practical processes for preserving wood. Colombo: Embrapa Florestas, CNPF, (Embrapa Florestas. Documentos, 96). 49pp (in Portuguese).

Jesus, M.A.; Morais, J.W.; Abreu, R.L.S; Cardias, M.F.C. 1998. Natural durability of 46 Amazonian woods species in an in ground essay in a forest environment. Scienta Forestalis, 54: 81-91 (in Portuguese).

Lepage, E.S. 1970. Standard method suggested by IUFRO for field tests with wooden stakes. Preservação de madeiras, v.1, p.205-216 (in Portuguese).

Moreschi, J.C. 1985. Biological tests: a new alternative for the determination of the active ingredients of the preservative CCA and studies of interactions. Curitiba, 128p. Tese (Professor Titular) – Universidade Federal do Paraná (in Portuguese).

Ramos, I.E.C.; Paes, J.B; Farias Sobrinho, D.W.; Santos, G.J.C. 2006. Efficiency of CCB on resistance of *Prosopis juliflora* (Sw.) D.C. wood in accelerated laboratory test decay. Árvore, v.30, n. 5. Viçosa (in Portuguese).

Richardson, B.A. 1993. Wood preservation. 2. ed. London: E & FN SPON, 226p.

Sales, A. *et al.* 2004. Study of durability of eucalyptus posts treated with CCA used in southern Brazil. In: Congresso Ibérico - A Madeira na Construção, 1., Guimarães. Anais. Guimarães, Universidade do Minho, p.287-92. (in Portuguese).

Velizarova, E., Ribeiro, A.B., Mateus, E.P., Ottosen, L.O. 2004. Effect of different extracting solutions on electrodialytic remediation of CCA-treated wood waste. Part 1. Behaviour of Cu and Cr. Journal of Hazardous Materials, 107(3): 103-113.

CONGRESO FORESTAL DE CUBA

CUBAN FORESTRY CONGRESS

5TO 5TH

Palacio de Convenciones de La Habana

Havana International Conference Center

ABRIL / APRIL • 25 - 29 2011

MEMORIAS / MEMORIES

› VI SIMPOSIO INTERNACIONAL SOBRE SISTEMAS AGROFORESTALES

V ENCUENTRO INTERNACIONAL DE JÓVENES INVESTIGADORES

› 6th INTERNATIONAL SYMPOSIUM ON AGROFORESTRY SYSTEMS

5th INTERNATIONAL MEETING OF YOUNG RESEARCHERS

2710? Repitido?

Edición Especial de la **REVISTA FORESTAL BARACOA** No. 1/2011

5to CONGRESO FORESTAL DE CUBA

"BOSQUES PARA LAS PERSONAS"

AÑO INTERNACIONAL
DE LOS BOSQUES · 2011

V Encuentro Internacional de Jóvenes Investigadores

VI Simposio Internacional sobre Técnicas Agroforestales

PROGRAMA CIENTÍFICO

27 al 29 de abril de 2011

Palacio de Convenciones de La Habana, Cuba

ARTIGO
~~RESUMO~~
DE
CONGRESSO

PROJETO: 02.08.06.006.00