

THE PRESERVATION OF FENCE STAKES, POLES, SLEEPERS AND CONSTRUCTION TIMBERS FOR HOUSING IN BRAZIL*

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RESUMO

A situação da preservação de madeiras de estacas, postes, dormentes e madeira para construção na confecção de casa no Brasil, será descrita e seus efeitos serão discutidos. A maior ênfase na preservação de madeira nacional é dada na impregnação de postes e dormentes. Um futuro mercado no campo da confecção de casas pré-fabricadas poderá surgir.

Existem normas nacionais para preservação de madeira e sua impregnação, para a administração pública, seja para o transporte, serviços de correios ou eletricidade, elas são prescritas por lei.

O processo de pressão de caldeira apesar de introduzido há aproximadamente 40 anos e legalizado há 13 anos até o presente não colaborou na promoção e ampliação da preservação da madeira no Brasil. Quase não verificou-se nenhuma melhoria técnica de adaptação às condições locais. É recomendado dar maior importância aos métodos de preservativos de madeira através de canalização natural da água na madeira, os quais deveriam ser de mais fácil adaptação quando introduzidos corretamente.

1. GENERALITIES

This paper aims to contribute to the dialogue on the possibilities of wood preservation in tropical countries and the necessities of research in these regions. Brazil was taken as an example, because it is one of the main powers in South America and it is interpreted as a threshold country with fast increasing economic and political influence. The brazilian infrastructure is developing with amazing speed and it's local market for forest products and timber can be seen as one of the biggest in the third world. The increase in living standards during the recent years has been followed by higher demands for modern products of high quality, as i. e. in the furniture industry. The production of prefabricated housing which was started some years ago is developing rapidly.

In many industrial countries it is tradition to apply preservatives to timber to extend its service life for as long as possible. A multitude of laws, regulations and technical standards oblige producers and consumers to use wood pre-

servation on many timber products. Governmental and private institutions, boards and others supervise and further develop the chemicals and their methods of application thus propagating their use. Supply and demand extensively presume the application of wood preservation.

In most tropical countries wood preservation often only gains importance when new and less durable secondary wood species are introduced to the market to replace highly resistant hardwoods. The initiative for wood preservation generally comes from the producer, who has to guarantee the same service life as for the naturally more resistant species replaced. Also the introduction of mass production methods of new timber products from light timbers of fast growing plantation wood often includes the application of wood preservation, again mostly due to decisions taken by the producer. There seldom being sufficient support from the government or influential local private institutions or boards. The consumer rarely and the public even less have any imagination

* Paper presented at the IUFRO-Meeting in Xalapa, Veracruz, México, on July 18-21, on "Actual Trends of the Wood Preservation Research in Tropical America". Subject Group S. 5.03 Wood Preservation.

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about the necessity or possibilities of preservation.

The manufacturers of timber products look to the industrialized world when trying to gain information and experience in the application of wood preservation. But the imitation of these practices has not always been successful, because the regional conditions and local peculiarities were not fully considered. Apart from need for local theoretical and practical knowledge there is one more point that has to be taken into consideration when trying to improve the reputation of wood preservation in these countries and that is the interpretation of the profitability often follows other conformities than in the industrial world.

The information given in this paper is based on an inquiry which was recently undertaken by the Department of Wood Technology of the Federal University of Paraná, Curitiba. It took into account the central and southern part of Brazil including the following states: Rio Grande do Sul, Santa Catarina, Paraná, São Paulo, Rio de Janeiro, Minas Gerais and Espírito Santo, representing the areas with the highest national distribution of income and the greatest aquisitive power. More than 60% of the Brazilian population lives in these states (1). The population of Brazil was estimated to be 113.208.500 at the end of 1977.

2. BODIES RESPONSIBLE FOR WOOD PRESERVATION

On 20th October 1965 by the law No. 4797, the use of impregnated timber was made compulsory for wood in service for the public and exploited by governmental enterprises for governmental and private units bound to transport by road and railway, telegraph- and telephone service as well as for the transmission of electricity. The regulations of this are defined by the decree No. 58.016 of 18th of March 1966. The former Department of Natural Renewable Resources which is now the "Brazilian Institute of Forestry Development" (IBDF) is responsible for the enforcement of this law as well as registration of wood preservation plants and the apportioning of contract work to various companies.

The Brazilian Association for Wood Preservation (ABPM) represents the interest of the private promoters of wood preservation. The governmental Institute of Technological Research (IPT) is well equipped for all kinds of tests for the control of wood preservation and offers its services to the industry. There exists an agreement between all these institutions on the orientation, supervision and improvement of the quality of wood preservation as well as the development of further utilization of impregnated timber. The Brazilian Association for Technical Norms (ABNT) has published standards for treatment and the three organs mentioned previously assist in the promotion of these norms. All institutes have their headquarters located in São Paulo.

There does not exist any other legislature on timber preservation and the private sector not being bound by any governmental contracts is free to act according to its own concepts. For them standards of the ABNT are only recommendations. Quality control in these factories is not common and the consumer generally is not capable of determining the quality of the impregnation.

A new initiative, which might perhaps promote wood preservation, could have been started by the official government bank for housing (Banco Nacional de Habitação — BNH) in the field of civil construction. The BNH's plans for popular housing includes houses made from timber and requires a service life of 25-30 years.

3. FENCE STAKES

For the State of São Paulo, the most densely populated in Brazil, it is known, that in 1977 around 12.000.000 fence stakes were used (unofficial information given by the Agricultural Secretary of the State of São Paulo). About 60% of them were still made from durable hardwoods *Schinus* sp. (Arueira), *Ocotea* sp. (Imbuia), *Tabebuia longiflora* (Ipê), *Aspidosperma polyneuron* (Peroba) and others.

Treated stakes did not exceed 0,1% of the whole demand, and this is not due to economic reasons. A dozen treated stakes are sold for about Cr\$ 360,00

while the same quantity of Arueira-stakes comes to Cr\$ 500,00. The producers themselves calculate only Cr\$ 4,00 for bought stakes to be treated. When calculating that 60 stakes make 1 m³ which corresponds to 3 poles of 10 m length, the net profits for preserved stakes amount to 86,6%, compared with 75,5% for poles, which are bought for about Cr\$ 220,00 and sold for Cr\$ 900,00 each. The costs for wood preservation are not taken into account, as they are in both cases more or less the same. Both products are only treated by vacuum-pressure in an autoclave.

This apparently higher profit for fence stakes compared with poles, and the lower price for the consumer in comparison with untreated poles still has no effect on promoting the use of impregnated stakes. The reasons for this unusual position seem to be the following:

— The market for stakes is not organized. Its extensive disunity complicates the mechanism of buying and selling.

— Only big preservation units impregnate fence stakes and apply the same method of impregnation as they do for poles.

— There is only limited confidence in the service life of treated stakes. They often fail due to incorrect preservation techniques or improper handling of the timber before the treatment. The timber is often not seasoned and is attacked by fungi and/or insects before treatment takes place.

— Simple and highly efficient preservation methods locally applicable on fresh timber are unknown, or there is no confidence in them.

— Little or no knowledge exists of differences in the permeability of wood species and its consequences on the application of wood preservatives.

— Wood preservatives available are often sold without any technical advice. Wrong application, such as the use of PCP as an insecticide, leads to distrust and creates a bad reputation.

— Wood preservation products available are often antiquated and do not fulfill the modern needs of the market.

— There is only limited interest in

and knowledge on the use of norms for seasoning and maturing timber for the preservation process. Storage of timber is interpreted as loss of time and money.

4. POLES

Statistics on the production of poles in Brazil during the last 8 years are given in table 1. No perceptable increase in production can be noted, making an average of 527.340 units per year, which represents a volume of about 86.000 m³. Nearly all of them are sold to governmental and municipal customers. All registered poles are from *Eucalyptus* sp. plantations.

TABLE 1
The production of poles in Brazil from 1970 until 1977.

year	Pole production (units)
1970	224.475
1971	232.359
1972	231.376
1973	258.465
1974	363.214
1975	290.626
1976	233.624
1977	244.645 (until September)
Total	2.058.684

Lit.: Brazilian Association of Wood Impregnators.

TABLE 2
Volume of wood preservation plants per State (1)

State	Volume of autoclaves (m ³)
Espirito Santo	33,91
Minas Gerais	66,91
Paraná	14,45
Rio Grande do Sul	125,59
Santa Catarina	39,42
São Paulo	387,50
Total	667,19

(1) Situation in March 1978.

They are all impregnated in autoclave by the vacuum-pressure method. Altogether 20 factories for pole preservation have been registered giving a total volume for impregnation of about 667 m³ (table 2) and representing an annual capacity of 400.800 m³ (2 operation per day; 300 working days per year). This exceeds the production figure about 4,7 fold. At present only four of the twenty factories impregnate an average of more than 3.500 poles per month.

It was determined, that in 1975 55,75% of the poles were treated with oil soluble preservatives (PCP and Creosote) and 44,25% with water soluble salts (CCA and CCB). From 1976 these figures changed in favour of water soluble impregnation. This method already accounted for 59,46% in 1977 as compared with only 40,04% oil soluble preservatives. Table 3 shows the number of factories using the different types of preservatives.

TABLE 3

Distribution of kinds of preservatives on number of existing factories in December 1977

Kind of preservatives	Number of factories
CCA	14 (1)*
CCB	1 (1)
Creosote	2
PCP	2
Total	19 (21)

(*) to be installed in 1978.

According to information received, the treated poles have an average service life of 6 to 12 years, guarantees of up to 30 years are challenged by the consumer, but until now the manufacturers are not obliged to service and repair poles after determinate periods of service life. It is obvious that this situation discredits the use of wooden poles. The substitution of wooden poles by cement is increasing. The treatment of poles without sufficient technical knowledge, the manufacturers

apparent policy of highest profit for lowest investment and the negligence of the public service in controlling quality and efficiency of the treatment are only some facts to be mentioned, and these problems are not only restricted to Brazil.

The future of the wooden pole in Brazil seems to be dependent on the governmental efforts to supply rural areas with electricity. The IInd. National Plan for Rural Electrification considers for the next 30 years an annual amount of 1.100.000 poles to be installed.

The commission for Rural Electrification compared the costs of wooden poles with those made from cement and concluded, that stipulating a minimum service life of 20 years wooden poles will be cheaper by 39,5% (figure not yet published). But not only this fact speaks in favour of wooden poles. Considering the great distances to be overcome in electrification, the better availability of raw material for poles, and the lower level of technical know-how in these areas still give the wooden pole some advantages. The rural municipals generally are poorer and therefore unable to buy the more expensive cement poles.

It is the opinion of the majority of the Brazilian pole producers, that a faultless technical performance of the treatment by autoclave could solve the problem. Local authorities presuppose that only poles of *Eucalyptus* (*E. saligna*, *E. citridora*, *E. alba*, *E. paniculata* a. o.) from plantations are to be used to guarantee homogenous poles.

The main destroyers of wooden poles in Brazil are termites and fungi. It is known for the area of Tupá, SP that termites even attack well treated *Eucalyptus* poles by leaving untouched the immunized sapwood and just destroying completely the heartwood, and this within 2 to 3 years after installation. In other regions of São Paulo with rather humid climatic conditions the heartwood of *Eucalyptus* is regularly destroyed by *Basidiomycetae* causing considerable loss of confidence in wood poles, and demonstrating the limits of the efficacy of preservation by autoclave.

It surely will be easy to increase the capacity of autoclave-impregnation in

the country, but most of it is concentrated in areas with a high population close to the cities. The increasing costs for long distance transport (which can amount to much more than 1.000 km) to the rural place of installation not only lessens the economical advantages of wooden poles in comparison to cement poles also influences the guarantee for a steady supply. An other limiting factor is the location of *Eucalyptus* spp. — plantations, they are not found all over the country, but mainly in the States São Paulo and Minas Gerais. Therefore to guarantee the accomplishment of the ambitious plan of rural electrification and to assure the capability of competition of the wooden poles with poles from other material it seems to be necessary to follow a new strategy.

Under these extreme tropical and subtropical conditions with particularly aggressive wood destroyers standard chemicals and wood preservation methods are often inadequate. It seems, that more efficient chemicals have to be discovered and applied with extreme capability of penetration into the timber and even into the heartwood and good fixation abilities.

Much more emphasis has to be placed on, applying methods for preservation which follow the law of natural liquid penetration into wood. Particularly for poles which do not need to pass through any wood processing, a further developed diffusion treatment, to be applied directly after felling would be most adequate.

The local application of wood preservation in the rural area by known or further developed simple methods, would not only considerable drop the investments for impregnation equipment, it also would help mobilize the population in the rural municipals to do the preserving treatment of the poles in their region themselves.

Considering the huge rural area of the country to receive electrification and the lot of straight growing wood species there available it seems difficult to understand why poles from *Eucalyptus* should be installed. It shows the insecurity in methods of overcoming the problem of low resistance of national wood

species. As there are several research institutes for forest products in the country one would think it possible to test the permeability and technological qualifications of species which could be recommended for use in the national plan of rural electrification.

4. RAILWAY SLEEPERS

The impregnation of railway sleepers in Brazil is predominantly done by autoclave treatment, and it is all in the hands of the governmental "Federal Railway Co. S. A.", which controls and operates the national railway system. There is at present no private working in this highly potential field for wood preservation, because the railway company is working on a base of no profit which seems to make it impossible for the private industry to compete.

Due to information by the federal company the annual demand for sleepers since years has been around 6.000.000 units for maintenance of the about 33.000 km national railway network, but there does exist at the moment only a capacity for treatment of 3.150.000 units (table 4). Since March 77 a further extension of the impregnation capacity for 2.100.000 sleepers is being considered (table 5), but this will take sometime.

Until now there does not exist any production of cement sleepers in the country.

The sleepers are treated with PCP or creosote and their service life is around 12 to 15 years as compared with untreated sleepers, which have an average service life of only 6,5 years. The sleepers for treatment are made like the poles from *Eucalyptus* spp., while the untreated sleepers in use are composed decreasingly of different national timbers. The sleepers are partly exploited from forests owned by the railway and partly bought from others.

The applied creosote is of national production and shows some variations in its composition and viscosity, obviously reflecting on the quality of the impregnation. The technical performance of the treatment also includes some irregularities, which, due to various local peculiarities have not been overcome until now.

The federal company's standards for seasoning and maturing the sleepers for impregnation are not known exactly, but in some way seem to follow the general behaviour of wood handling before processing or treatment in the country, i.e. insufficient control of the water-contents and seasoning of wood. This attitude is common in many tropical countries and information and demonstration on how to improve the process still often have little influence on practical behaviour.

The treatment of sleepers in Brazil can be taken as one more example of highly expensive equipment in huge quantities being used in wood preservation following foreign standards of impregnation with sophisticated technical procedure, but showing insufficient results. After several years of efforts it still is not possible to adopt the treatment by autoclave in such a manner, as to satisfy regional necessities.

Therefore wood preservation, if it wants to be come more reliable and popular in Brazil, has to be adapted to local circumstances. Changing the local conditions for making wood preservation possible has already been proved impossible many times.

5. CONSTRUCTION TIMBERS FOR HOUSING

The house made from wood has tradition in the rural areas of Brazil, particularly in the south of the country, where the wellknown parana pine (*Araucaria angustifolia*) has also been used for this purpose. On the other hand in the majority of brazilian cities, and in the so-called better municipalities wooden houses are often still not accepted for "esthetic" reasons.

TABLE 4

Plants for the impregnation of sleepers and their annual capacity in Brazil ¹

Place	State	Process	Annual capacity
Fortaleza	CE	vacuum-pressure	300.000 units
João Amaro	BA	vacuum-pressure	300.000 "
Goiania	GO	vacuum-pressure	300.000 "
Azurita	MG	vacuum-pressure	300.000 "
Corinto	MG	warm/cold imersion	50.000 "
F. Bernardino	MG	vacuum-pressure	50.000 "
Avelar	RJ	warm/cold imersion	50.000 "
Rocha Leão	RJ	vacuum-pressure	300.000 "
Aquidauana	MT	vacuum-pressure	300.000 "
Cará-Cará	PR	vacuum-pressure	300.000 "
Tubarão	SC	vacuum-pressure	300.000 "
Benjamin Not	RS	vacuum-pressure	300.000 "
TOTAL			3.150.000 units

TABLE 5

Projects for extension of the capacity for the impregnation of sleepers in Brazil
(March 1977)¹

Place	State	Process	Annual capacity
Codó	MA	vacuum-pressure	300.000 units
Bitencourt	AL	vacuum-pressure	300.000 "
Goiania	GO	vacuum-pressure	300.000 (extention) units
Yapurã	RJ	vacuum-pressure	300.000 units
Rocha Leão	RJ	vacuum-pressure	300.000 (estention) units
Aquidauana	MT	vacuum-pressure	300.000 " "
Cará-Cará	PR	vacuum-pressure	300.000 " "
TOTAL			2.100.000 units

(1) Information given by the Federal Railway.

The application of preservatives to extend the service life of construction timber was and is still not common in Brazil. The wood is rarely even seasoned adequately. Only sometimes paints protect wall surface from weathering.

Perhaps new perspectives can be expected in future as the market for pre-fabricated housing develops and it seems that local producers of wood preservatives have started to discover the possibilities for introduction and application of modern products in this sector.

The inquiry, showed, that also in the industry of wooden house constructions it is only the producer who encourages the use of wood preservation, but at the same time it was demonstrated, that many of them have no knowledge of the causes of deterioration of timber and the possibilities for adequate protection. According to the answers received until the end of April, less than 50% of the companies apply wood preservation. None apply the autoclave-treatment. Wood preservation is restricted to brushing or immersion of boards to be located at the outer parts of the construction and exposed to weathering. The preservatives applied are based on PCP and boron-components.

There are some factories in Brazil, which produce wooden houses of high quality, but even in those, wood preservation is not adequate. The manufacturers argue, that due to rivalry on the limited market the costs for additional

wood preservation would make them unable to compete. As long as available at reasonable prices they prefer to continue using nice looking and rather durable wood species like *Ocotea porosa* (Imbuia).

On the market of cheaper housing which seems to have big future in the country, the Governmental Bank of Housing (BNH) only recently also admitted house constructions made of timber. The challenge to guarantee a service life of 25-30 years might help to promote the application of adequate wood preservation in this kind of construction.

But even more than on the market of high quality housing there will be high rivalry between the manufacturers, and strong competition between timber and other construction material. Higher costs or bad reputation rapidly leads to substitution. Again the perspectives for wood preservation will depend on how the industry is able to adapt to its technical and economical requirements. This can be facilitated if the chemicals to be applied are highly effective, easy to handle and do not require long preparation of the timber for maturing or high technical knowhow for its application.

6. CONCLUSION

In Brazil wood preservation is being applied to poles and sleepers. It is also applied to fence stakes in some plants which treat poles in order to get utiliza-

tion of the existing units capacity. Only one treatment method is used: the sophisticated and most expensive vacuum-pressure treatment in autoclave. Other methods i. e. treatment based on the diffusion phenomenon are not considered. In the housing sector wood preservation is nearly nonexistent.

In all fields the efficacy of wood preservation is not sufficiently satisfactory, and the substitution of wood poles by cement poles is increasing. Due to inadequate technical procedures and the extremely aggressive wood destroyers, like termites and fungi, the service life of impregnated material amounts to only 6-15 years in comparison to 25 and 30 years in none tropical countries. Wood preservation is performed, because of governmental action and law for governmental purposes, and guided by national standards, which generally follow recommendations and experiences from abroad. The government is supported by institution representing those interested in promoting wood preservation, but nation wide there is a complete lack of experience on development of self-reliant performances in qualified wood preservation, taking into consideration the local conditions of felling, seasoning and manipulation of wood. The private sector not bound by government contracts, and, even more, the public still often think of wood preservation as a handicap for rational and economical production with only limited practical effect.

The development of a new market for prefabricated housing perhaps will in future motivate formation of new laws which will oblige the industry to apply preservation on the wooden parts of constructions. This initiative would be most welcome, but it might hit a technically and psychologically unprepared branch. Introduced inefficient chemicals or unqualified methods rapidly lead to distrust and substitution of timber by other materials.

By adapting the methods of preservation to local conditions and simplifying them rather than insisting on complicated systems like the autoclave treatment in an unfavourable environment, wood preservation should assert itself. The necessary maturing of wood for treat-

ment i. e. the controlled drying down to around 20% U and storage after treatment for fixation require time and accurate work which in many places cannot be guaranteed. Furthermore the autoclaves' ability to penetrate tropical timbers is not always satisfactory.

Wood preservation will have to adapt more to local conditions and in this field a lot of research still has to be done. It is furthermore concluded that simple methods, directly applicable in the forest or at the place of processing green wood, and which follow the laws of natural penetration of liquids into the wood, should receive much more emphasis because they are adaptable, generally not requiring much investment and give immunization directly after felling or processing, thus avoiding any further damage during storage and transport from which timber suffers a lot in tropical countries.

7. SUMMARY

The situation of preservation of fence stakes, poles, sleepers and construction timbers for housing in Brazil is described and its efficiency interpreted. The main emphasis of national wood preservation is put on poles and sleepers. Prefabricated housing might become a new market for preservatives.

There do exist national bearers of wood preservation. The impregnation of wood for use in public works such as transport by road and railway, telegraph and telephone services and the transmission of electricity is ratified by law.

The preservation by autoclave was introduced about 40 years ago and 13 years legislation has existed making its use compulsory in some areas, but it did not lead to a further promotion and extension of wood preservation and did not sufficiently develop technical maturity for the various realities in the country. It is recommended to put more emphasis on methods which follow the laws of natural penetration of liquids into the wood and which possibly adapt more easily to local conditions, once they are well introduced.

8. LITERATURE

1. Instituto Brasileiro de Geografia e Estatística: Censo: de 1970, S. Paulo.