

**THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE
(C.C.I.T.T.)**

**PRESERVATION OF WOODEN POLES
CARRYING OVERHEAD
TELECOMMUNICATION LINES**

Published by
THE INTERNATIONAL TELECOMMUNICATIONS UNION
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FOREWORD

A first edition of this booklet was prepared during 1956-1958 with a view to drawing attention to the importance of preserving the wooden poles carrying overhead telecommunication lines, and to provide Administrations developing their networks with some information on impregnation processes.

At the IVth C.C.I.T.T. Plenary Assembly (Mar del Plata, 1968) it was decided that a complete revision of the booklet was required and this second edition is the result of work done mainly by the Argentine Administration, in association with C.C.I.T.T. Study Group VI and including also information supplied by the Administrations of Australia, Austria, Chili, France, Federal Republic of Germany, Italy, Norway, Switzerland and by the United Kingdom Post Office.

In presenting their first draft of the revised text, the Argentine Administration made the following comments:

“No work of this kind can claim to be exhaustive. We have tried to produce a coordinated text containing the basic concepts making it as clearly understandable as possible and excluding controversial matters, as is desirable in dealing with such specialized subjects as this.

Chapter II can probably be extended in later editions to include additional information from other Administrations and provision should be made for bringing the material up to date, say, every five years. The same observation applies to Annexes 1, 2 and 3 which are intended to serve simply as background information.”

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THE PRESERVATION OF WOODEN POLES CARRYING OVERHEAD TELECOMMUNICATION LINES

CHAPTER I

GENERAL CONSIDERATIONS

1.1 Purpose of this publication

Since the problems of preserving wood against biological agents depend on the region and are of interest to other enterprises besides telegraph and telephone companies, they have to be studied mainly in a regional context by joint groups of technicians, producers and users of poles.

It is not the intention of the C.C.I.T.T. to usurp the role of such groups and the aims of this booklet are therefore as follows:

- to draw the attention of telecommunication Administrations to the economic advantages of giving the poles they use preservative treatment;
- to describe, for general information, the considerations to be borne in mind in applying this treatment and the planning and organization required;
- to provide a reference work—which would otherwise be difficult to assemble—for judging the behaviour and efficacy of the various treatments, according to the different species, requirements, destructive biological agents and climates;
- to indicate to telecommunication Administrations the regional research institutes best able to advise them and to provide a list of selected publications for more detailed study.

This publication deals with wooden poles only. Such poles are in widespread use for carrying overhead lines (open-wire and cable) being cheap, light and of high mechanical strength.

The poles should be inspected at regular intervals after they are erected and as a safety measure before they are climbed. The soundness of the poles can be tested by various methods, ranging from visual inspection to the use of electronics devices. An experienced worker can generally assess the state of a pole by tapping it with a hammer and listening to the sound emitted. The most vulnerable part of the pole lies between points about 30 cm above and 30 cm below the ground level.

The present publication does not deal with other means of prolonging the life of poles such as precautions in siting them or the use of waterproof substances to protect the foot of the pole from damp.

1.2 Basic concepts

1.2.1 *Regional character of preservation problems*

The chief function of a wood preservative is to protect the pole from attacks by different biological organisms. The conditions in which the pole is to be used may imply a greater risk from a particular organism. However, there may also be a combined effect, the presence of one organism either helping or being necessary for another to get a hold, each seemingly thriving from the presence of the other. On the other hand, the destructive process may quite simply be due to the action of different biological agents acting independently in time and place.

Regions often have their own peculiarities which need to be studied, especially when considering the introduction of new preservatives or techniques developed in other parts of the world to meet local require-

ments there. Preservation requirements in a tropical region, for example, obviously cannot be equated with those of a temperate zone.

It is evidently of importance to treat the problem in a regional context. This is the basic approach designed to prevent the automatic transfer of techniques and standards to an environment for which they are not at all suited, or to which they need to be adapted. The whole purpose of treatment is to modify the relationship between the wood and the destructive agent, which is governed by very complex factors. The climate, the preservative, the mode of treatment, forestry practices and local customs together create a set of conditions within a given country such that complete techniques cannot be transferred from one area to another. Economic factors should also be considered.

1.2.2 *Species used for poles*

Only timber that has sufficient natural durability to make its use worth while, or which lends itself to preservative treatment, is used for poles.

It is common mistake to assume that because the wood of a particular species is hard or very dense, it must be durable. In fact, not many woods in the world are suitable for poles and have sufficient durability without the addition of a preservative. Natural durability depends on the quantity of natural preservative substances present in the wood, particularly tannin and phenolic compounds.

Particular mention may be made of Western red cedar (*Thuya plicata*) among the conifers¹ and the following species among broad-leaved trees¹: the chestnut (*Castanea* spp.), ironbark (*Eucalyptus siderophloia*, *E. siderozylon*, *E. crebra*), red quebracho (*Schinopsis* spp.), white oaks (*Quercus* spp.), urunday and urundel (*Astronium* spp.) and teak (*Tectona grandis*).

There is no point in mentioning the different types of wood used for impregnated poles since they vary according to the region or even according to the country. However, it may be mentioned that in the Northern Hemisphere conifers are normally used, especially those of the *Pinus* genus in America and of the *Abies*, *Pinus*, *Picea*, *Pseudotsuga* and *Larix* genera in Europe, while various species of eucalyptus are often used in the Southern Hemisphere.

1.2.3 *Destructive agents*

Deterioration and destruction of wood are chiefly due to biological agents. In the case of poles, the main organisms responsible for damage are xylophagous fungi and xylophagous and lignicolous insects (chiefly coleoptera and isoptera; this latter group includes termites) which feed on them or destroy them by boring.

The distribution and importance of these agents depend, generally speaking, on the local environment. Consequently, apart from a few cosmopolitan types, the species of fungi, coleoptera and termites differ according to the place. This means that the efficacy of the preservation treatment depends largely on a knowledge of the destructive agents of economic importance at work in the region where the poles are erected. Since deterioration is faster in wet regions and may be slower in dry ones, a given preserving treatment is generally less effective in wet regions.

1.2.4 *Climatic conditions*

From the time a pole is erected it is exposed not only to the action of biological agents but also to the weather: it may be subjected to hot sun, rain and humidity according to the local climate. These factors may impair the effect of the preserving agent by reducing the time during which it remains in the wood.

Furthermore, climatic conditions affect physical behaviour of poles, particularly as regards splitting of the wood. In the species in which preservation depends exclusively on the treatment of a narrow band of sap-wood, as with species of the *eucalyptus* genus, for example, the cracking may extend beyond that area, facilitating the action of organisms in the untreated heart-wood.

¹ In English, the broad-leaved species are also distinguished from the conifers by calling them "hardwoods" and "softwoods" respectively. These two terms have no mechanical significance, the range of mechanical properties in each group being very broad.

When choosing the impregnation process to be applied and the composition and quantity of the preservative to be used, both the climate and the risk of biological attack must be taken into account.

1.2.5 *Economic conditions*

A preserved pole is a piece of timber that has absorbed in the course of treatment a certain amount of a substance which will prevent or retard biological attacks on the ligneous tissue. Assuming that the mechanical strength requirement is fully satisfied, any significant differences in effectiveness are to be attributed to two basic variables—*retention* and *penetration*. The *retention* is the amount of active substance expressed in pounds or kilogrammes incorporated in one cubic foot or one cubic metre of wood respectively, while the *penetration* is the depth to which the wood is permeated.

Nevertheless, when the preservative is dissolved in a liquid, as is the case for instance with the water-borne substances, and when as a result the solution absorbed by the timber contains only the proportion of preservative components determined by the concentration of the solution, the degree of concentration must be taken into account, and it must be an essential condition that the quantity of liquid absorbed is the maximum compatible with the permeability of the timber (refusal treatment).

This is in accordance with the way in which research institutes test the effectiveness of their products. They make solutions of different strengths which are used totally to impregnate samples of sap-wood and these are first tested for resistance to leaching, and then exposed to attack by destructive agents that may be of importance in the region concerned.

From these results the requisite quantities in kg per cubic metre can be determined, these are then multiplied by a given factor corresponding to the maximum amount of solution absorbed normally by the sap-wood of the species in given humidity conditions. Furthermore, experience shows that in preservation treatments, at the end of the process the absorption of a solution and the retention of a product in the impregnated timber differs from one pole to another even with the same species, and regardless of the method used. These differences in similar types of wood are due to the proportion of sap-wood, for example, and to the differential distribution of the substances in the preservative through the ligneous tissue. As these well-known phenomena cannot be evaluated precisely in advance it is necessary to inject the maximum volume of solution at a concentration corresponding to the desired protection or retention.

It is important to fix a retention value or, when applicable, the degree of concentration for each preservative depending on the biological action expected in a given region and on the planned service life of the overhead route. The relationship between the retention and the effectiveness in years of service also depends on the preservation method chosen.

Not all types of treatment give results that meet the specified requirements. Industrial processing is the most reliable as regards homogeneity, which is a desirable characteristic of the preserving operation. This calls for extensive equipment and investment, especially in the case of vacuum-pressure processes which are advisable when large quantities of correctly impregnated poles are required.

In areas of difficult access, transporting the poles before and after impregnation may be impossible or account for a large part of the total costs, or there may be other technical and economic factors, often varying from one country to another or from one area to another within the same country. In such cases, if there are local forestry resources, it may be wise to choose a method enabling the poles to be preserved on the spot (sap replacement and diffusion treatment), and the Boucherie process seems to be particularly indicated as it provides a large number of poles with high-quality treatment because it uses the maximum absorption capacity of each pole. However, some species (*Abies*, *Picea*, etc.) are difficult to impregnate under pressure but, when fresh, are easily impregnated by the Boucherie process.

The merits of a preserving treatment have to be defined in terms of the substance used, the retention and the penetration. It is also necessary to determine which of the various merits is best suited to the proposed installation programme and what would be the real economy to be expected from the choice made.

The comparative cost of the various types of impregnated wooden poles can be estimated by calculating the present value of the annual charges over the required life of the plant. The annual charges should

include all economic factors. The frequency of periodical inspections and the cost involved may depend on the preservation process used.

When a decision is reached on the types(s) of timber and most suitable methods of impregnation, specifications should be drawn up and they should be observed to the letter.

1.2.6 *Customers of the wood-preserving industry*

Telecommunication Administrations are not the sole customers of the wood-preserving industry; electric power companies also use vast numbers of wooden poles requiring preservative treatment for their low and medium voltage lines and even for their high voltage lines. Nor is the industry solely concerned with poles; railway sleepers, mine-timbers, lumber, beams, ties and other timbers need treating, too.

However, in view of the characteristics of the components, the way in which they are used, and the type of deterioration, it is impossible to conclude that the results of all these different treatments are interchangeable, since the various practices cater for different specialized technologies.

1.2.7 *Statistics and controls*

It is important for telecommunication Administrations to know the average useful life of their wooden poles because the amounts allotted annually for renewals and depreciation will depend on this. Statistics should be kept concerning poles and these might include the species, preservative, impregnation process, year of erection and date of replacement. Every pole should bear suitable marking identifying some or all of these factors. The study and control of the behaviour of the protective products and the efficacy of preservation processes should be carried out systematically and regularly on experimental sites and lines.

These duties, and the specialized nature of control tests and studies of new systems and substances, make it desirable to have specialist technicians on the staff.