Relationship of Longitudinal Permeability to Treatability of Wood

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Keywords
Permeability
Treatability
Sapwood
Heartwood
Copper Sulfate
Creosote
Softwood
Hardwood

Summary

The permeabilities of sapwood and heartwood of twelve species representing different kinds of wood were determined using
1. water on never-dried/saturated and on previously-dried/resaturated specimens, and
2. nitrogen gas at mean pressure of 2.5 atm and at infinite pressure.
Also, their effective permeabilities to water were determined. These specimens were subsequently treated with copper sulfate, and their matched specimens with creosote.
The sapwood showed much higher mean permeability and treatability values than the heartwood. The permeability to water was found to be much higher with specimens which had been previously-dried/resaturated than with those which had not been dried. High degrees of correlation between various permeability and treatability values were obtained. When the relationship between permeability and treatability was analysed by species group, higher correlations were obtained in the hardwoods than in the softwoods. Among the hardwoods, the semi-ring porous woods show no correlation, probably because they were all moderately permeable.

Schlüsselwörter (Sachgebiete)
Aufnahmefähigkeit
Permeabilität
Splintholz
Kernholz
Kupfersulfat
Kreosot
Nadelhölzer
Laubhölzer

Beziehung zwischen Längs-Permeabilität und Aufnahmefähigkeit des Holzes

Zusammenfassung

Der Permeabilität des Splint- und Kernholzes von 12 Holzarten wurde an folgendermaßen vorbehandelten Proben bestimmt:
1. Proben im biologischen Quellungszustand bzw. vorgetrocknet und wiedergequollen,
2. Proben bei 2,5 atm Stickstoff sowie bei unendlichem Druck.
Die für Wasser wirksamen Permeabilitäten wurden bestimmt. Anschließend wurden die Proben mit Kupfersulfat — Kontrollen mit Kreosot — behandelt.
Splintholz besitzt eine höhere Permeabilität und Aufnahmefähigkeit als Kernholz. Die Permeabilität für Wasser ist bei Proben, die getrocknet und wieder gequollen waren, viel höher als bei niemals getrockneten Proben. Zwischen den verschiedenen, jeweils gemessenen Permeabilitäten und Aufnahmewerten bestand ein hohes Maß von Korrelation. Analysiert man die Beziehung zwischen Permeabilität und Aufnahmefähigkeit gruppenweise, so ergibt sich bei Laubhölzern eine bessere Korrelation als bei Nadelhölzern. Unter den Laubhölzern zeigten die halbringporigen Hölzer keine Korrelation, wahrscheinlich weil sie eine mittelmäßige Permeabilität besitzen.

Introduction

During the last decade numerous studies have been made to evaluate the various factors affecting the treatability of wood by preservatives. It has been established that sapwood treats better than heartwood and that fluids move much faster in the longitudinal than in the transverse direction. Associated with these phenomena is the permeability of wood. The literature (Tesoro et al. 1966, Arganbright and Wilcox 1969, Erickson and Estep 1962, Siau 1970, Choong et al. 1972) revealed contradictory results on this property with treatability, although these studies predominantly indicate that highly permeable wood treats better than those woods of low permeability.

This paper reports on the relationship between various permeability and treatability values among different groups of wood species and wood types.

Experimental

Materials and Preparation

Twelve species were selected for study. These included nine hardwoods and three softwoods. Of the hardwoods, four were ring porous: black locust (*Robinia pseudoacacia* L.), American elm (*Ulmus americana* L.), white oak (*Quercus* spp.), and hackberry (*Celtis occidentalis* L.); three were diffuse porous: sycamore (*Platanus occidentalis* L.), sweetgum (*Liquidambar styraciflua* L.), and soft maple (*Acer* spp.); and two were semi-ring porous: black willow (*Salix nigra* Marsh.) and cottonwood (*Populus deltoides* Bartr.). The softwoods were: southern pine (*Pinus* spp.), baldcypress (*Taxodium distichum* (L.) Rich.), and redwood (*Sequoia sempervirens* (D. Don) Endl.).

For each species, one two-inch disc was obtained from a green log. Only discs with centrally located pith were selected. Dowel-size specimens about 7/8-inch in diameter were cut in the longitudinal direction with the use of a plug cutter. Two tangentially matched specimens in the sapwood portion were cut at equal distances from the bark for each quadrant. The corresponding heartwood specimens were simillary matched and cut at equal distances from the pith. One set of specimens was used for permeability determination and subsequent treatment with copper sulfate. The other set was treated with creosote.

The specimens selected for permeability measurements were cut into three sections with the central portion about 1.2 inches long and the other two about 0.6 inches long. The two shorter sections were necessary accessories for relative permeability measurements. The specimens for treatment with creosote were also cut to 1.2 inches long.

Methods

Liquid Permeability Measurement. The permeability specimens were first measured for liquid (water) permeability using a technique described by Choong and Kimbler (1971). The specimens were saturated using deaerated water obtained by cavitation. Impregnation of the water was done in a small pressure chamber similar to an empty-cell process, i. e. an initial vacuum was applied, then pressure of 100 psig for an hour using CO_2 gas (which dissolved in the liquid). Later, frequent vacuum-and-atmospheric pressure treatments were applied until air bubbles failed to appear from the specimens. Liquid permeability measurements were performed with a displacement pump whose flow rates could be regulated from