

THE INTERNATIONAL RESEARCH GROUP ON WOOD PRESERVATION

WORKING GROUP I

BIOLOGICAL PROBLEMS

DECAY PATTERNS OBSERVED IN BUTYLENE OXIDE MODIFIED PONDEROSA PINE
ATTACKED BY FOMITOPSIS PINICOLA

by

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Summary

Small blocks of ponderosa pine chemically modified by butylene oxide to three different weight percent gains (WPG) were decayed for 2 months with the brown rot fungus Fomitopsis pinicola. Wood substance loss and the type of decay pattern recognised were fairly similar both for control and blocks treated to 8 and 15 WPG. No difference in attack was observed between radial or tangential walls in latewood tracheids. Microscopical examination of undecayed wood blocks treated to 23.7 WPG revealed numerous cracks in both the middle lamella regions of radial walls and in cell corners of latewood tracheids. The fungus had gained entry to the cracks, possibly via bordered pits and rays. Attack started from the cracks and progressed along the middle lamella and towards the cell lumen.

Introduction

The micromorphology of soft rot and bacterial attack which occurred in butylene oxide modified ponderosa pine after burial in unsterile soil was described in a previous report (Nilsson and Rowell, 1982). It was noted that soft rot cavities occurred exclusively in the radial walls of latewood tracheids in samples treated to 8 WPG. Improper penetration of the modifying agents into the outer parts of the radial walls of the latewood tracheids was considered responsible for the localised distribution of the soft rot cavities.

Very few cavities occurred at 15 WPG and no signs of attack were observed in wood blocks treated to 23.7 WPG.

The present report deals with decay patterns observed in butylene oxide modified ponderosa pine after exposure to a pure culture of the brown rot fungus Fomitopsis pinicola.

Material and methods

The butylene oxide modified ponderosa pine (Pinus ponderosa) wood samples were taken from the same treatment batch reported earlier (Nilsson and Rowell, 1982). The following weight percent gains (WPG) were tested: 8, 15 and 23.7. Untreated control blocks were also employed. The size of the test wood blocks used was 5 x 5 x 10 mm.

Unleached wood blocks were dried (105°C), weighed, and then placed in glass flasks containing vermiculite to which a malt extract solution was added. (Approx. 7 g vermiculite + 25 ml 2 % malt extract solution). The flasks were autoclaved and subsequently inoculated with a culture of the brown rot fungus Fomitopsis pinicola.

The flasks were incubated for 2 months at 25°C . Two blocks from each treatment level were used for the microscopical studies. Transverse and longitudinal sections were cut with a razor blade and examined in a light microscope. The sections were stained with either safranin or Chlorazol Skye Blue in lactophenol. The remainder of wood blocks were dried at 105°C, weighed and the wood substance losses calculated.

Results and Discussion

The wood substance losses are shown in Table I.

Table 1. Wood substance losses after 2 months' decay.

<u>WPG</u>	<u>Number of blocks</u>	<u>Percent wood substance loss</u>
0	9	72.8
8	4	59.4
15	4	63.5
23.7	4	4.5

The results show that the modified wood is not completely resistant to brown rot decay, not even at a WPG of 23.7. This agrees with earlier results by Rowell (1982), who reported losses of 2.0 - 3.8 % at 23 WPG in a soil-block test with the brown rot fungus Gloeophyllum trabeum. The white rot fungus Coriolus versicolor was reported to be inhibited at 17.3 WPG while soft rot appears to be prevented at approximately 15 WPG (Nilsson and Rowell, 1982).

Microscopical examination of the wood blocks showed both the control blocks and blocks treated to 8 and 15 WPG had been attacked by the fungus in a manner typical for brown rot decay, i.e. the hyphae grew in the cell lumina where they caused a breakdown of the cellulose in the wood fibre walls. A total loss of birefringence was observed when polarised light was employed. The S₂ layer was seemingly intact even in late stages of decay but probably consisted of a lignin matrix (Fig. 1). Drying caused an irreversible collapse of the wall. The S₂ layer was often seen to have separated from the rest of the wall probably at the S₁ - S₂ interface (Fig. 1).

In contrast to the soft rot attack previously reported (Nilsson and Rowell, 1982) no differences in the strength, or mode of attack could be observed between latewood and earlywood tracheids nor between radial and tangential walls in latewood tracheids. The wood substance losses were of the same order for both control and those blocks treated to 8 and 15 WPG. This suggests that butylene oxide modification at these levels only effects brown rot attack to a very limited extent. Thus any differences in treatment between radial and tangential walls in latewood tracheids will not be easily detected using light microscopy. It can not be excluded, however, that differences may have been found in earlier decay stages.

The attack in wood blocks treated to 23.7 WPG was quite different. No attack was observed in earlywood tracheids while decay in the latewood tracheids was not caused by hyphae growing in the cell lumina. Instead, the attack occurred in the middle lamella region of the radial walls and some times in cell corners (Fig. 2). Hyphae were observed in holes, which on impressions were reminiscent of soft rot cavities. The attack was observed to proceed both along the middle lamella and towards the cell lumina. The fungus seemed to remove all wood substances leaving a hole in the wood cell wall. This contrasts to the normal type of brown rot where a lignin skeleton remains after decay. The explanation for this unusual decay pattern was found when transverse sections from undecayed wood blocks treated to 23.7 WPG were examined under the microscope. It was observed that cracks occurred very regularly in the middle lamella region in the radial walls (Fig. 3). The cracks

were situated approximately halfway between the two cell corners of almost every latewood tracheid. Cracks were frequently observed also in the cell corners. Cracking has been reported earlier (Rowell, 1982) and is considered a direct result of a high chemical add-on.

No bore holes were observed in the tracheid walls so the hyphae could not have gained entry to the cracks by growing from the cell lumina. Examination of longitudinal sections indicated that the fungus had gained entry via rays and bordered pits that were in contact with cracks in the middle lamella region.

The results show that butylene oxide modification is fairly effective in preventing brown rot at 23.7 WPG for an incubation period of 2 months. But cracks resulting from the treatment made it possible for the fungus to initiate attack in the outermost parts of the radial walls, which apparently are the regions of the tracheids which receive least chemical during treatment.

References

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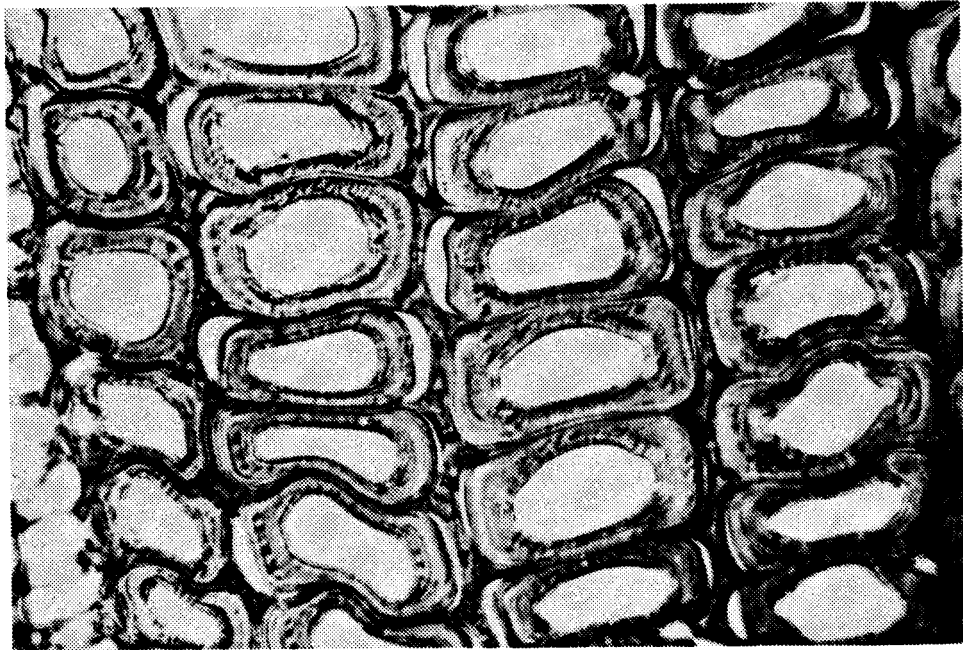


Figure 1. Ponderosa pine modified with butylene oxide to 15 WPG. Typical brown rot attack in latewood tracheids.

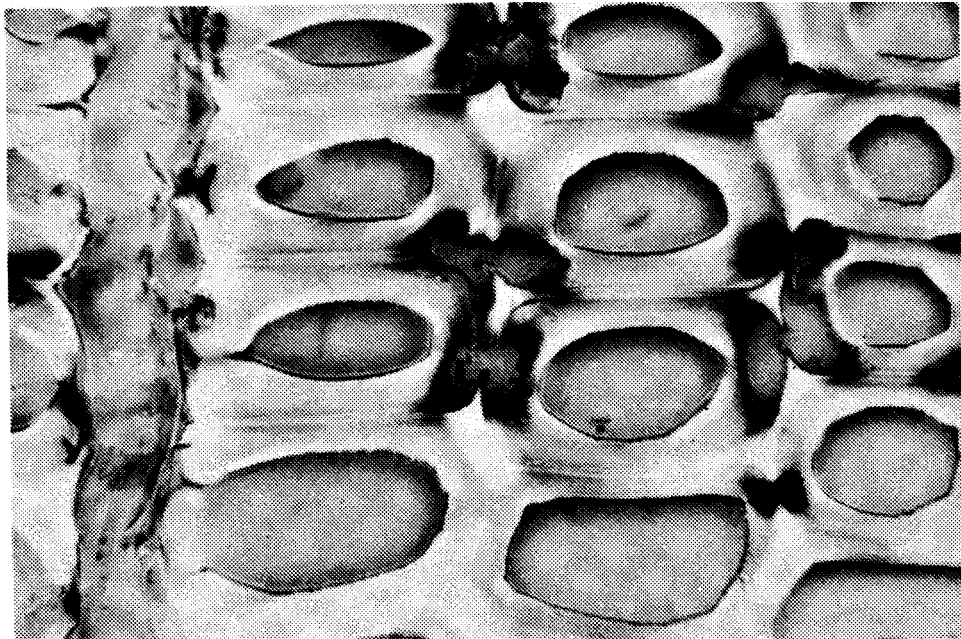


Figure 2. Decay pattern caused by Fomitopsis pinicola in ponderosa pine modified with butylene oxide to 23.7 WPG.

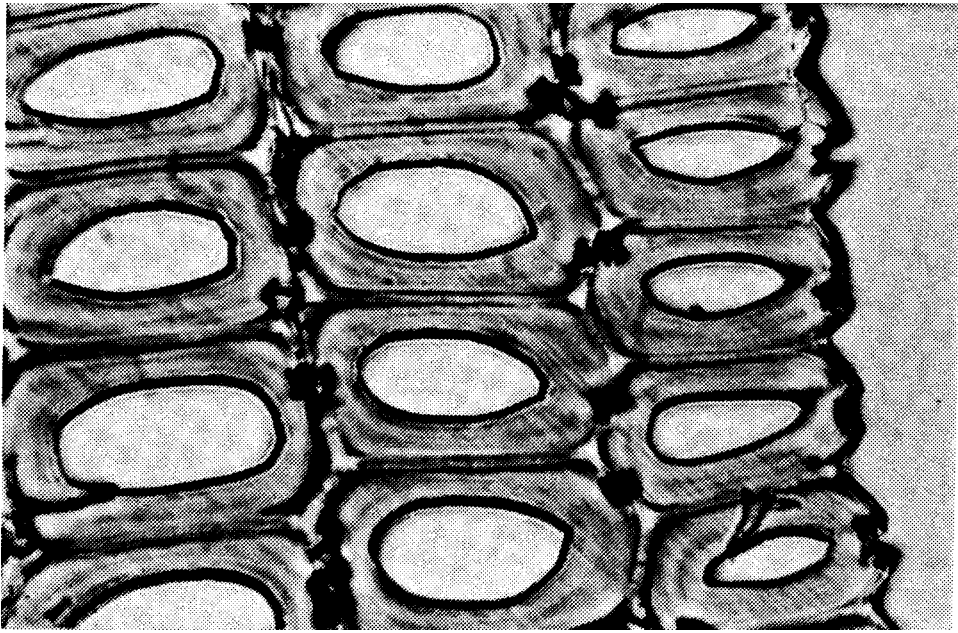


Figure 3. Cracks in the middle lamella region resulting from high chemical add-on. Ponderosa pine treated to 23.7 WPG