

A COMPARATIVE STUDY OF POLYSTYRENE MODIFIED WOOD AND CCA TREATED WOOD (BIOLOGICAL TESTS)

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A comparative study on decay resistance of pine poles treated with styrene and with copper-chrome-arsenic salt (CCA) by laboratory and field tests was carried out.

1. INTRODUCTION

In a previous paper [1] the resistance of polystyrene modified wood against fungi, insects and marine borers was determined by laboratory tests.

Since the results obtained in preliminary tests with small treated samples were very promising, a further study was carried out with samples out of 8 meter poles, industrially treated, in order to determine if the product penetrates homogeneously up to the pole core and through the whole length of the pole itself and if its effectiveness is comparable with that of copper-chrome-arsenic salts (CCA).

Moreover a comparative study of polystyrene modified wood stakes and CCA treated stakes was carried out in a test field in Florence.

2. POLES

Poles of scots pine sapwood (*Pinus silvestris* L.) were treated with styrene monomer by the full-cell process. The thermal-catalytical polymerisation was carried out accordingly to the patent technology [2]. The degree of impregnation with the polystyrene was about 85%. Next poles of scots pine were treated with copper-chrome-arsenic salt by the full-cell process. The salt retention was about 10 kg/m³, accordingly to C.T. n. 1082/1972 [4]. The wood poles were impregnated by Firm "Stella S.p.A.", Cuneo Italy. Na. 2 polystyrene modified wood poles, n. 2 CCA treated poles and n. 2 untreated poles were tested.

Sample discs were cut at height of 1 m, 1.6 m and 4 m from each pole and samples of diameter 2.5 × 2.5 × 5 cm³ were cut from each disc, in the sapwood area, which was completely impregnated. The samples were tested to determine their resistance to fungal attack. The resistance of treated wood against *Basidiomycetes* was determined accordingly to European Standard Methods [5, 6]. The test fungi are: n. 8 — *Coriolus versicolor*, n. 34 — *Gleophyllum trabeum*, n. 36 — *Coniophora puteana*.

The resistance of treated wood against soft rot fungi was determined accordingly to the method described by Savory [3]. The samples were placed in vessel contain-

ning 300 g unsterilized garden soil. In preliminary tests it was ascertained that the soil biological activity caused soft rot and that the isolated fungi belonged chiefly to the genera *Chaetomium*, *Phialophora* and *Humicola* (n. 38). The characteristics of the soil was as follow : water holding capacity 33.0%, organic matter 5.9%, pH 7.3, nitrogen total 0.31%. The results are reported in the Figs. 1, 2, 3 and 4. In our tests since samples treated with styrene showed the same resistance against

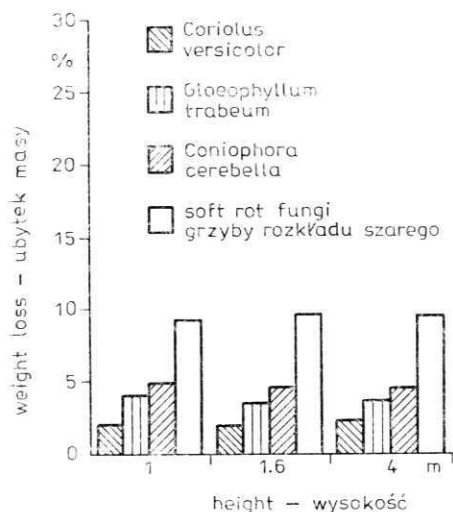


Fig. 1. Decay resistance of polystyrene modified wood at various length of the pole

Rys. 1. Odporność na rozkład drewna nasyconego polistyrenem w zależności od miejsca pobrania próbki

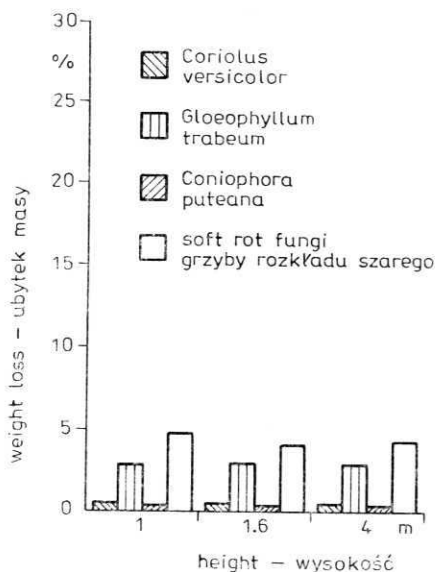


Fig. 2. Decay resistance of CCA treated wood at various length of the pole

Rys. 2. Odporność na rozkład drewna nasyconego preparatem typu CCA w zależności od miejsca pobrania próbki

fungi at any given length of the pole, the product resulted to have homogeneously penetrated through the whole length of the pole.

The styrene improved the decay resistance of wood, but the protection against various fungi was not uniform. Styrene was observed to be best successful against *Coriulus versicolor* (weight loss <3%, accepted in EN 113 [5]), and rather efficient

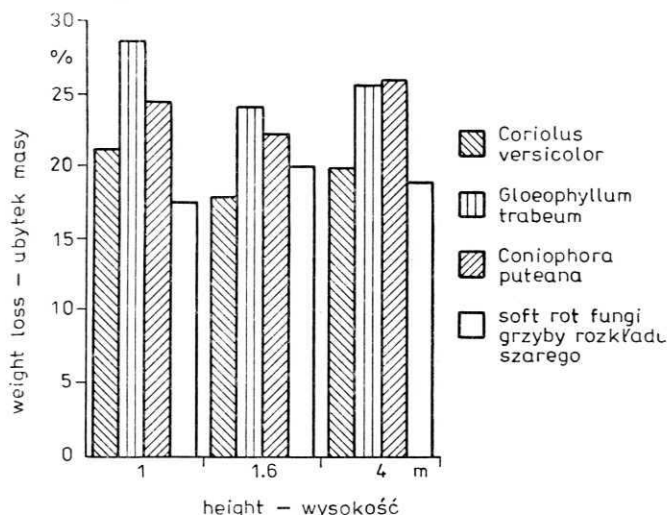


Fig. 3. Decay resistance of untreated wood at various length of the pole

Rys. 3. Odporność na rozkład drewna w zależności od miejsca pobrania próbki

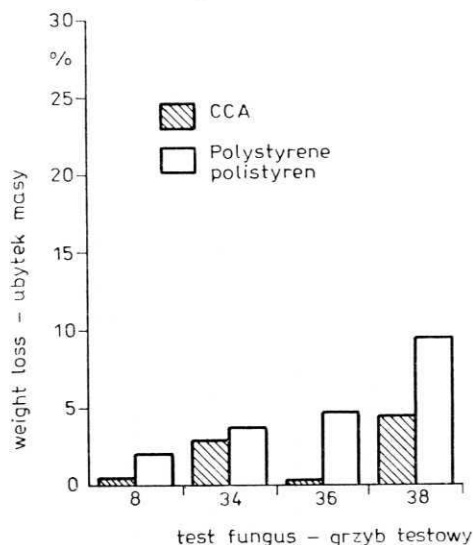


Fig. 4. Decay resistance comparison between polystyrene modified wood and CCA treated wood

Rys. 4. Porównanie odporności na rozkład drewna nasyconego polistyrenem i preparatem typu CCA

against *Coniophora puteana* and *Gleophyllum trabeum* (weight loss <5%). For the soft rot fungi results were not quite satisfactory, although a higher resistance was obtained (weight loss about 10%) in comparison with untreated wood (weight loss about 20%). The CCA treated samples showed that the product penetrated homogeneously through the whole length of the pole and the product is effective against tested Basidiomycetes (weight loss <3%) and rather efficient against soft rot fungi (weight loss <5%).

3. FIELD TESTS

Stakes of scots pine sapwood of diameter $2.5 \times 2.5 \times 50$ cm³ were treated with styrene and with CCA salt. The treatments were carried out accordingly to the methods described in paragraph 2. The treated stakes were buried to approximately half their length in a test field in Florence. Untreated stakes were buried in the same field.

The stakes were inspected twice a year. The inspection starts with a light push on the upper end of each stake when still in the ground, to find out whether its strength has been so reduced by severe decay that it breaks. If the stake does not break, it is cautiously drawn out of the ground and the condition is estimated accordingly to the following rating system:

- 0 — not decay,
- 1 — slight and superficial decay,
- 2 — evident but moderate decay,
- 3 — severe decay,
- 4 — failure.

The results are reported in the table 1 and 2.

The stakes treated with styrene began to be slightly decayed after 42 months by average index 0.2. After 54 months all the samples showed decay from slight

Table 1

Condition of polystyrene modified wood stakes during 54 months of service
Stan próbek drewna nasyconego polistyrenem po 54 miesiącach badań poligonowych

Sample number Numer próbki	Rating after months Stopień rozkładu po upływie miesięcy								
	6	12	18	24	30	36	42	48	54
1	0	0	0	0	0	0	0	0	2
2	0	0	0	0	0	0	1	1	2
3	0	0	0	0	0	0	0	0	1
4	0	0	0	0	0	0	0	0	1
5	0	0	0	0	0	0	0	1	1
6	0	0	0	0	0	0	1	2	2
7	0	0	0	0	0	0	1	2	2
8	0	0	0	0	0	0	0	0	2
9	0	0	0	0	0	0	0	1	2
10	0	0	0	0	0	0	0	0	1
Controls* Próbki kontrolne	1	1.8	2.6	4					

* Mean of 5 stakes — Średnia dla 5 próbek

Table 2

Condition of CCA treated stakes during 54 months of service
 Stan próbek drewna nasyconego preparatem typu CCA po 54 miesiącach badań poligonowych

Sample number Numer próbki	Rating after months Stopień rozkładu po upływie miesięcy								
	6	12	18	24	30	36	42	48	54
1	1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	1	1
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	1
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	1
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
Controls* Próbki kontrolne	1	1.8	2.6	4					

* Mean of 5 stakes — Średnia dla 5 próbek

to moderate with average index 1.6. The decay was caused chiefly by soft rot fungi, as it resulted in the laboratory test.

The CCA treated stakes containing about 10 kg/m³ begin to be slightly decayed after 54 months (average index 0.3) and the decay was caused by soft rot fungi.

All the untreated stakes decayed by soft rot and Basidiomycetes fungi within 24 months.

4. CONCLUSIONS

Tests showed that styrene treatment in wood is as effective as CCA treatment against Basidiomycetes fungi, but not so effective as CCA treatment against soft rot fungi. Both laboratory and field tests underlined that situation.

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BADANIA PORÓWNAWCZE NAD DREWNEM ZMODYFIKOWANYM POLISTYRENEM ORAZ NASYCONYM PREPARATEM TYPU CCA (TESTY BIOLOGICZNE)

Streszczenie

Wykonano badania nad odpornością biologiczną drewna sosny nasyczonego w warunkach przemysłowych monomerem styrenu i spolimeryzowanego metodą termiczno-katalityczną oraz drewna sosny nasyczonego w takich samych warunkach wodnym roztworem soli impregnacyjnej zawierającej związku miedzi, chromu i arsenu (sól typu CCA). Zawartość polistyrenu w drewnie wynosiła około 85%, preparatu CCA około 10 kg/m³. Badania odporności biologicznej wykonano w skali laboratoryjnej z udziałem grzybów z klasy *Basidiomycetes* oraz grzybów powodujących rozkład szary. W pracy zawarto także wyniki badań poligonowych na przestrzeni otwartej w kontakcie z ziemią. Stwierdzono, że drewno sosny zawierające polistyren jest odporne na działanie grzybów z klasy podstawczaków, jego odporność na grzyby rozkładu szarego jest mniejsza. Wyniki badań uzyskanych w warunkach poligonowych w znacznym stopniu są zgodne z wynikami badań laboratoryjnych.

СРАВНИТЕЛЬНЫЕ ИССЛЕДОВАНИЯ ДРЕВЕСИНЫ МОДИФИЦИРОВАННОЙ ПОЛИСТИРОЛОМ И ДРЕВЕСИНЫ ПРОПИТАННОЙ ПРЕПАРАТОМ ТИПА ССА (БИОЛОГИЧЕСКИЕ ТЕСТЫ)

Резюме

Проводились сравнительные испытания биологической стойкости древесины сосны модифицированной полистиролом термо-каталическим методом в промышленных условиях и древесины пропитанной водным раствором соли содержащей соединения меди, хрома и мышьяка (соль типа ССА). Содержание полистирола в древесине составляло примерно 85%, а содержание препарата ССА — примерно 10 кг/м³. Опыты проводились в лабораторном масштабе с применением грибов класса *Basidiomycetes* и грибов мягкой гнили. В работе представлены также результаты полевых опытов на образцах в контакте с почвой. Констатируется, что древесина содержащая полистирол стойкая к действию базидиальных грибов, а в меньшей степени к действию грибов мягкой гнили. Результаты полевых опытов в основном сходные с результатами лабораторных испытаний.

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