

## Compression strength of pine wood (*Pinus sylvestris* L.) degraded by ozonization

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**Abstract:** *Compression strength of pine wood (*Pinus sylvestris* L.) degraded by ozonization.* Ozonization is one of the common sterilization methods, used also for wood. Mentioned method is effective, but dangerous to wood. Under influence of ozone wood degradation process occurs, lowering wood mechanical properties. Following work describes influence of ozone ageing on compression strength along the fibers of pine wood.

*keywords:* pine wood, ozone, accelerated ageing, compression strength

### INTRODUCTION

Attempts of disinfection with ozone of wooden objects were reported in Poland. These are dangerous treatments, not only because of ozone toxic properties, but also irreversible damages to wood. Ozone, being very powerful oxidant, even with low solution strength (1-3%), is able to quickly decompose wood constituents – cellulose, lignin and hemicelluloses. Wood darkens under ozone influence, surface finish is also damaged (French polish, polychrome, gilding). Because of chemical decomposition of wood, its strength properties are also affected.

Chemical research of wood treated with ozone was performed by Kobayashi. Scientist states, that in wood treated with ozone cellulose decomposition occurs [Kobayashi and Asano 2005]. Trials of fungi killing with ozone, also are being undertaken [Taylor and Morrell 2009]. In museums worldwide, special equipment is installed, cleaning ozone from the air, which prevents damage of coatings [Cass et al. 2010]. In natural environment, ozone content in the air levels at 0,003%.

The aim of these studies was to examine the impact of ozone on compression strength along the fibers of pine wood.

### MATERIALS AND METHODS

In these studies material from hardwood zone of about 90-year-old pine (*Pinus sylvestris* L.) was used. For the testing purposes, samples for compression strength measurement were used (PN-79/D-04102). Batch of 100 samples was selected. Density of wood was determined in accordance to PN-77/D-04101 standard. Batch was separated into 2 groups. First one was aged in the ozone, second was used as a control samples.

Ageing was made in closed desiccator, in closed loop (continuous ozone feed). For ozone production A2Z Ozone Systems ozone generator was used, as an input gas air was used. During ozonization, gas flow (air/O<sub>3</sub>) reached 1dm<sup>3</sup>/min. Ageing time in ozone was set at 7 days. Samples were turned over each 24 hours.

After ageing, compression strength test along the fibers was made. Measurements were performed on Instron 3382 testing machine.

## RESULTS AND DISCUSSION

After 7 days of aging in ozone, decrease of wood compression strength along the fibers was observed. Strength drop occurs in all tested wood density range. In samples with higher density, described decrease is insignificantly higher (Fig. 1.).

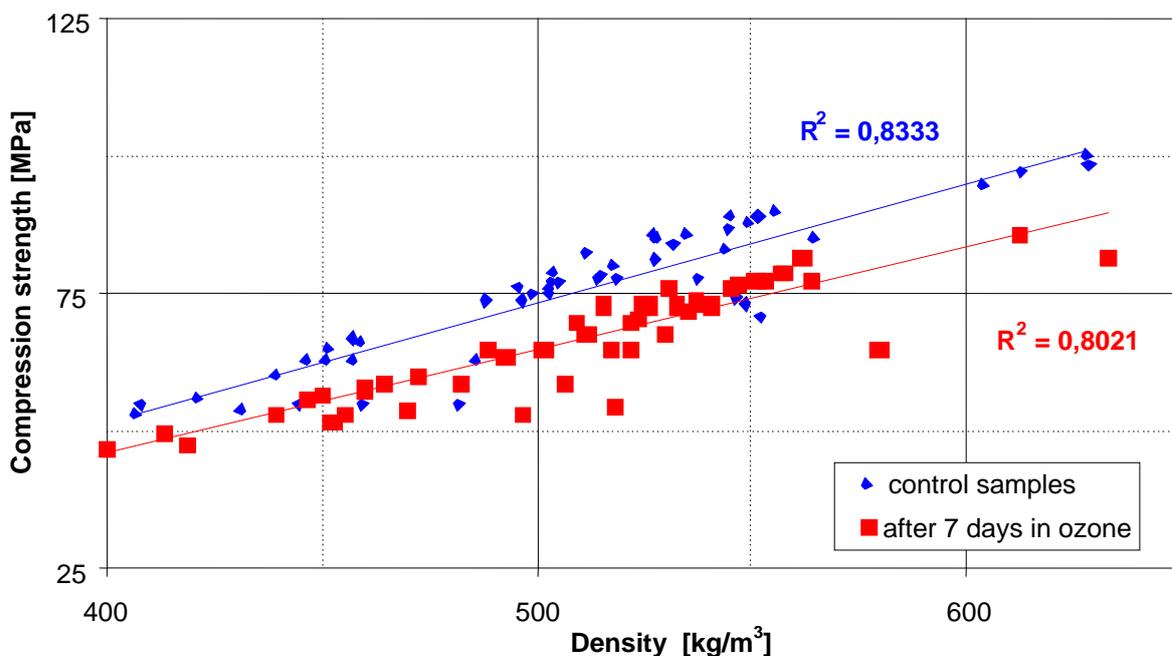


Fig. 1. Dependence between density and compression strength of natural pine wood and pine wood aged in ozone.

Decrease of average compression strength along the fibers reaches about 12%. Higher dispersion of results is observed for aged batch (Table 1).

Table 1. Characteristics of tested samples

	Density [kg/m <sup>3</sup> ]		Strength [MPa]	
	control	7 days	control	7 days
Minimal	408	401	54	48
Average	510	513	76	67
Maximal	628	633	100	87
Standard deviation	50	51	12	10

The results of wood strength are consistent with chemical studies presented in second publication [Antczak et al. 2011]. Significant increase of substances soluble in 1% NaOH after wood ozonization was observed. In natural pine wood, content of substances soluble in 1% NaOH reaches 12%, which is in agreement with literature [Prosiński 1984]. In degraded wood by ozone, these substances content reaches 30%. Moreover, decrease of polymerization degree of cellulose in wood degraded by ozone was observed. Presented the changes are certainly responsible for the decrease in the strength properties of pine wood.

## CONCLUSIONS

- \* under influence of ozone wood degradation process occurs
- \* decrease of compression strength along the fibers (by about 12%) is certainly caused by depolymerization reaction of structural substances in ozone treated wood

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**Streszczenie:** *Wytrzymałość na ściskanie drewna sosnowego starzonego ozonem.* Drewno sosnowe poddano starzeniu w atmosferze ozonu. Następnie porównano wytrzymałość na ściskanie wzdłuż włókien przed i po starzeniu. W wyniku 7-dniowego starzenia w atmosferze ozonu zaobserwowano spadek wytrzymałości na ściskanie wzdłuż włókien o ok. 12%.

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