

Visualization of wood humidity using cobalt chloride during microwave drying

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Abstract. *Visualization of wood humidity using cobalt chloride during microwave drying.* Wood is a heterogeneous material with various local moisture content. During microwave drying some parts of timber dry faster than others. We visualize the heterogeneity using cobalt chloride which changes color while drying. Results of drying visualization may be helpful for theoretical modeling of wood microwave drying process.

Key words: wood, drying, cobalt chloride, kinetics, microwaves

INTRODUCTION

The process of wood microwave drying is the subject of many articles (Aichholzer, Arthaber, Schuberth, Mayer, 2013; Antti, 1995; Du, Wang, Cai, 2005; Hansson, Antti, 2003; Ratanawilai, Nuntadusit, Promtong, 2015; Yu, Guo, Nan, Sun, 2011; Zielonka, Dołowy, 1998; Zielonka, Gierlik, Matejak, Dołowy, 1997). It is known that insulating material can be heated delivering electromagnetic energy to it in the form of high frequency electromagnetic field (Metaxas & Meredith, 1983). The process of determining the electromagnetic field and the temperature distribution in heated sample of wood is not a simple one. As the microwave energy is absorbed its temperature increases, depending upon many parameters, for instance the moisture content. Wood is a heterogeneous material with various local moisture content. To visualize these differences infrared pyrometers have been commonly used. We propose a new qualitative, simple method using cobalt chloride solution which upon drying is changing its color from transparency through light pink up to deep blue, which allows for visualization of moisture content in wood sample.

MATERIAL AND METHODS

The spruce samples 300x170x60mm were cut in half to obtain 2 elements of a 300x170x30mm. The two corresponding surfaces were painted with saturated solution of cobalt chloride i.e. 52.9 grams of CoCl_2 per 100ml of water or 97.0 grams of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$. The spruce color has not changed. Two half samples were combined and tightly pressed against each other. The sample was then put to microwave chamber. Microwaves (600 W) fell on upper surface of combined elements (300x170x60mm) penetrating the sample. Every 3 minutes the samples were taken from the microwave chamber and photographed.

RESULTS AND DISCUSSION

The kinetics of the drying process is visualized in Figure 1. The more blue color the less moisture. As can be seen after 6 minutes the blue color (marked with the black line on the on the black and white pictures) appears 10mm below the wood surface exposed to microwaves. The blue color is spreading down in time. One can notice the lack of a blue color in the vicinity of the knag, which indicates a slower drying surrounding the resin containing part of timber.

CONSLUSION

Water solution of cobalt chloride is a useful tool for the visualization of the kinetics of microwave wood drying.

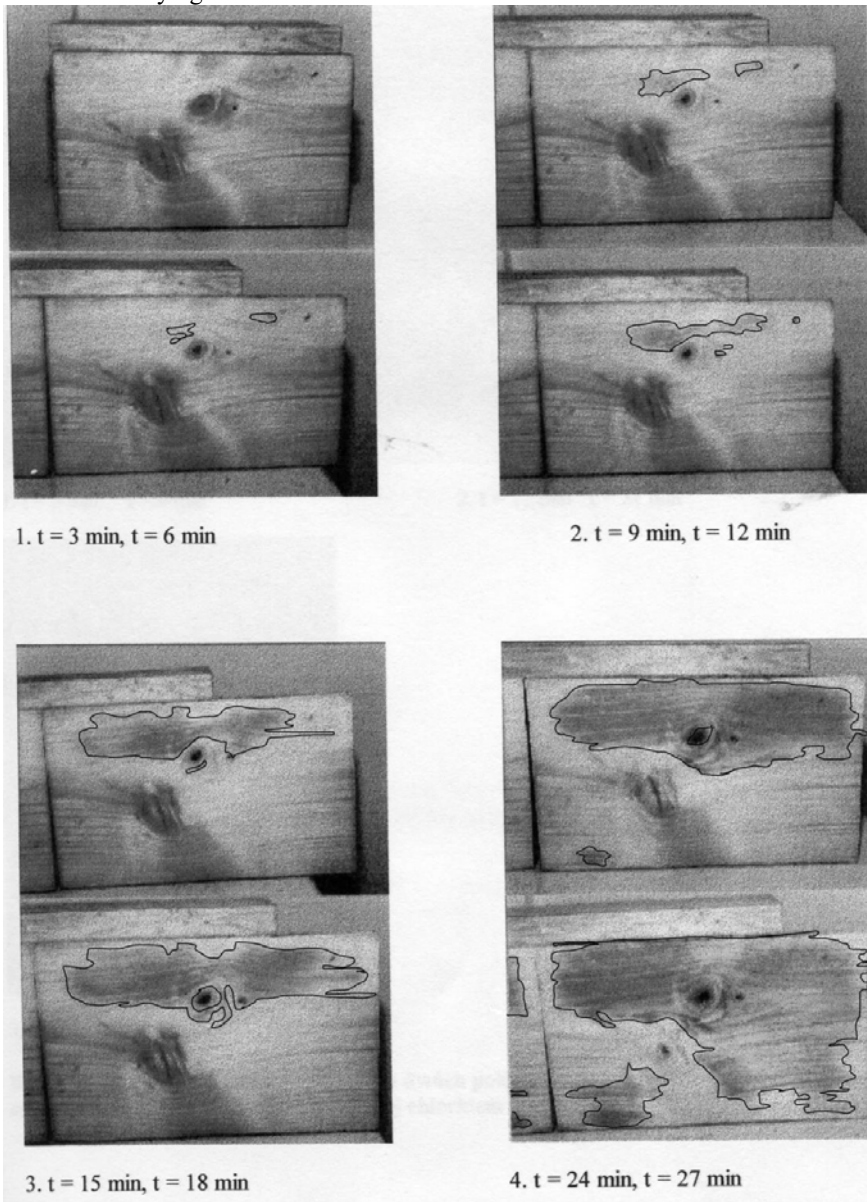


Fig.1. Visualization of wood humidity content by means of cobalt chloride during microwave drying. The dried area is enclosed with the black line. Eight consecutive photograph taken each 3 minutes.

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Streszczenie: *Wizualizacja rozkładu wilgotności drewna za pomocą chlorku kobaltu podczas suszenia mikrofalowego.* Drewno jest materiałem heterogenicznym o różnych wartościach lokalnej wilgotności. Podczas suszenia mikrofalowego pewne części próbki drewna schną szybciej niż inne. Zastosowaliśmy roztwór chlorku kobaltu, który zmienia zabarwienie podczas suszenia z bezbarwnego poprzez różowy aż do ciemno niebieskiego. Obrazowanie zmian wilgotności podczas mikrofalowego suszenia drewna mogą być pomocne przy teoretycznym modelowaniu procesu suszenia drewna.

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