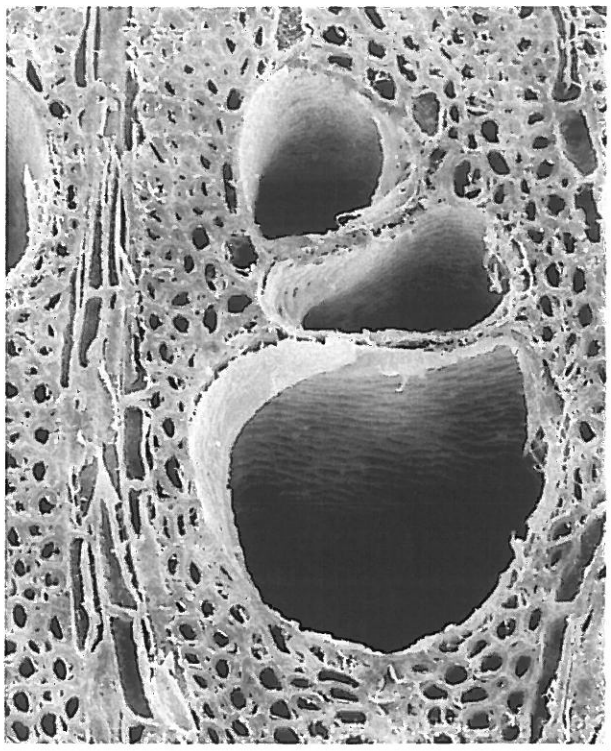
Advances in modified and functional bio-based surfaces

Proceedings



8-9 April 2015, Thessaloniki, Greece

faculty of sciences
SCHOOL OF PHYSICS

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Contents

Impact of different wood based materials treatments on surface quality assessed by contact angle and NIR spectroscopy

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Key words: hot pressing, sanding, planing, contact angle

Abstract

Among technological processes used for wood processing, planing, milling and sanding are crucial stages. Thanks to these operations, surface roughness achieves appropriate level, enabling the final finishing, such as varnishing. The quality of surface can be improved by other modification processes such as hot pressing. Beneficial effect of hot-pressing process on surface roughness was proved by Akbulut et. al for MDF panels [1].

The influence of sanding on wettabilitty of wood was analyzed by Wolkenhauer et. al [2]. Authors examined four wood variants: aged, freshly sanded, after plasma treatment and after plasma treatment and sanding. Results showed a significant increase of the polar component of total surface energy and work of adhesion in comparison to aged samples.

Cruz et al. [3] used three kinds of treatment (overdrying, extraction with water, and surface aging under light) to modify pine and eucalyptus. All these procedures result in an increase of contact angle.

According to researches of Gindl et al. [4], the changes of wettability for aged samples are caused by a decrease of oxygen to carbon ratio observed in XPS analysis. Moreover, they noticed a decrease of surface free energy with aging time. Since contact angle measurements are difficult to be implemented on-line, NIR (near infrared spectroscopy) reflectrometry is a possible technique to assess surface properties in a production line [5]

The aim of this work was to assess the impact of machining processes commonly used in industry (sanding, planing or milling) on surface properties assessed by contact angle and NIR in comparison to hot-pressing.

Six wood species (planned, sanded and hot-pressed) and MDF boards (standard, milled, milled-hot pressed, milled-sanded, milled-sanded-hot pressed, hot-pressed) were subjected to different surface treatments. During experiments, the following wood species were studied: beech (Fagus sylvatica), oak (Quercus robur L.), pine (Pinus sylvestris L.), obeche (Triplochiton scleroxylon K. Schum.), tatajuba (Bagassa Guianesis) and wenge (Millettia laurentii De Wild). All working samples were subjected to a pressure of 4 MPa at temperature of 160 °C for half an hour. Sanding was carried out in two stages (abrasive paper of grit 80 and 180).

The contact angles were assessed using a contact angle goniometer DataPhysics (see Figure 1a)). Two test liquids (water and fornamide) were used, which permitted to determine the polar and dispersive component of total surface energy according to Owens/Wendt theory. Diffuse reflectance NIR spectrometer Ocean Optics NIRQuest was used to assess changes in the surface chemistry.

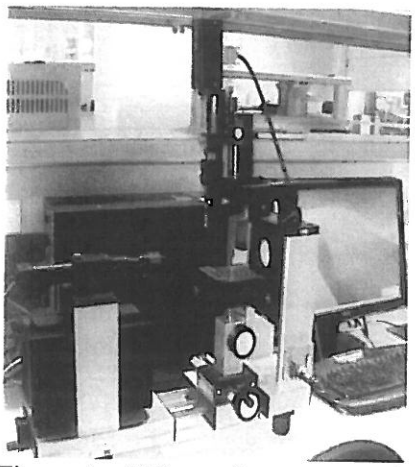
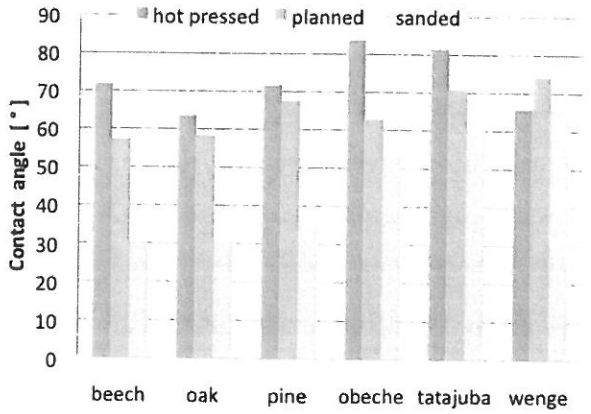


Figure 1: a)View of contact angle goniometer DataPhysics OCA 20



b) Contact angle of water for all wood species subjected to different surface treatment methods

The main conclusions of this work are:

- Contact angles for European wood species (beech, oak and pine) subjected to sanding are especially low. However, differences in contact angles are higher than for exotic wood species, Hot-pressing caused visible increase of contact angle for all wood species (except wenge). Changes of wettability are mostly due to fluctuation in the polar component of total surface energy.

- MDF boards have comparable wettability for all variants of material processing methods, but the contact angle values were above 90°. For MDF, the contribution of the polar component of total surface is much lower than for wood.
- NIR spectroscopy proved to be a promising technique to assess surface chemisty of wood and wood-based panels.

Acknowledgement: Described above researches were supported by grant of COST ACTION FP1006 (COST-STSM-ECOST-STSM-FP1006-171114-050399)

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