ORGANIZATION OF WOOD ELEMENTS IN PARTIALLY ORIENTED FLAKEBOARD MATS

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ABSTRACT

Partially oriented flakeboard mats play a significant role in commercial flake-based products, such as three-layered oriented strand board (OSB). The study presented in this thesis mathematically investigates the structure of partially oriented flakeboard mats.

To better understand the nature of the structures of flakeboard mats, a simulation program ***Winmat***©, based on the Monte Carlo technique, has been written to compute the horizontal distribution of overlap and density, free flake length and its distribution, number of flake crossings, the location and distribution of void sizes, the autocorrelation function, variance function and the degree of orientation of flakes in both simulated mats and experimental mats. This program can also determine the effect of sampling zone sizes on the density/overlap distribution.

In the model development, flake position was considered to be random. The orientation angle of the flake was assumed to be random following either the Von Mises distribution or the uniform distribution. A mathematical model based on these distributions was developed. The autocorrelation function and variance function of the horizontal density distribution were investigated at different k values and q angles. The characteristic area concept from random field theory was first introduced to evaluate the degree of orientation of the flakes in a mat.

In the process of estimating the degree of orientation of a flakeboard, the horizontal density distribution is needed to compute the autocorrelation function and the characteristic area. A non-destructive method, X-ray scanning technique, was used to determine the density profiles from experimental flakeboard mats. A model that maps X-ray voltage levels to

overlaps and/or density was presented and discussed. The density and overlap were found to be a logarithm function of the X-ray intensity ratio (I_0/I: the intensity of the incident radiation to the intensity of radiation at location (x, y) in a mat).

A study of the relationships between thickness swelling and mat structure in robot-formed flakeboard mats made without wax was conducted under 95% and 90% relative humidity conditions and 24-hour water soaking tests. A model describing such relationships was established for two relative humidity conditions. With this model the thickness swelling of flakeboard mats (without wax) can be predicted, provided that the amount of moisture absorbed and the density distribution of the mat are known.

Finally, a case study was presented to demonstrate the application of the models developed in the thesis. Two kinds of mats, partially oriented flakeboard mats and OSB mats, of size 2440 mm $\times$ 1220 mm were simulated and characterized. Their density/overlap profiles and degree of orientations were then compared with a commercial OSB panel whose density profile was obtained by X-ray scanning technique. The thickness swelling values of these simulated mats were predicted and the degree of orientation of the commercial OSB panel was presented.

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