

MODELLING OF ENERGY CONSUMPTION NEEDED FOR MELTING FROZEN BOUND WATER IN WOOD CHIPS

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ABSTRACT

A mathematical model and an engineering approach for calculation of the specific mass energy consumption, which is needed for melting frozen bound water in wood chips above the hygroscopic diapason, $q_{\text{bwm}}^{\text{m/t}}$, have been suggested.

An equation for easy calculation of $q_{\text{bwm}}^{\text{m/t}}$ has been derived, depending on the wood moisture content u , on the fiber saturation point at 20 °C (i.e. at 293.15 K), $u_{\text{fsp}}^{293.15}$, and on the initial temperature T_0 of the frozen chips. According to this equation, the values of $q_{\text{bwm}}^{\text{m/t}}$ increase with increase of $u_{\text{fsp}}^{293.15}$ and of the difference $271.15 - T_0$, then they decrease when u or T_0 increase. For calculation of the $q_{\text{bwm}}^{\text{m/t}}$ according to the suggested model, a software program has been prepared in MS Excel 2010. By means of this program, calculations have been carried out to determine $q_{\text{bwm}}^{\text{m/t}}$ for oak, acacia, beech, and poplar frozen chips with moisture content in the range from $u = 0.4 \text{ kg}\cdot\text{kg}^{-1}$ to $u = 1.0 \text{ kg}\cdot\text{kg}^{-1}$ and at a temperature range from $t_0 = -40 \text{ °C}$ to $t_0 = -2 \text{ °C}$. At $t_0 = -2 \text{ °C}$ the melting of frozen bound water in wood chips has been completed.

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