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The influence of sapwood and heartwood usage on the quality properties of particleboard

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Abstract: The impact of heartwood and sapwood usage on the physical, mechanical, and surface properties and formaldehyde emission of particleboard was investigated. European Larch (*Larix decidue* Mill.) trees were used as a raw material. The logs were divided into three segments: sapwood, heartwood and soundwood (heartwood and sapwood). Segments were chipped reduced into smaller particles. Urea formaldehyde was used an adhesive for the manufacturing of the test panels. Ammonium sulphate was added to the adhesive as a hardener. Mechanical properties (modulus of rupture (MOR) and modulus of elasticity (MOE), and internal bond (IB)), physical property (thickness swelling (TS)), and formaldehyde emission (FE)) of particleboards were determined according to European standards. Alcohol-benzene, hot and cold water and dilute alkali (1% NaOH) solubility's, lignin content and amount of ash were determined according to TAPPI standards. Holocellulose and cellulose contents were determined by chlorite and nitric acic methods. A Mitutoyo SJ-301surface roughness tester, a stylus type profilometer, was employed for the surface roughness tests. Contact angle (CA) measurements were performed using a CAM 101 Optical Contact Angle Meter (KSV Instruments Ltd., Helsinki). One-way analysis of variance was conducted to evaluate the effect of sapwood and heartwood usage on the quality properties of the panels. Significant differences between the mean values of the panel types were determined using Newman–Keuls's test. The highest amounts of cellulose, hemicelluloses and lignin were found in the sapwood, followed by soundwood, and the heartwood, respectively. The highest solubility values were obtained from heartwood, followed by soundwood, and the sapwood, respectively. While the lowest pH values were found in heartwood, the highest values were obtained from sapwood samples. The highest ash content and amount of condensed tannin were found in heartwood, followed by soundwood, and sapwood, respectively. The test panels manufactured from sapwood had the smoothest surface and the lowest contact angles, while the roughest surface and highest contact angle were obtained from the panels manufactured from heartwood. The panels made from sapwood had the required levels of MOR, MOE and IB for general purposes and furniture manufacturing. Particleboards made from soundwood met the required levels of MOR, MOE and IB only for general purposes. Panels made from heartwood did not have the required levels of mechanical strength properties. The test panels did not have the required level of TS property. Panels made from heartwood met the required level of FE for E_1 quality. The thickness swelling and formaldehyde emission values of the panels manufactured from heartwood significantly lower than the panels manufactured from the soundwood and sapwood. The highest mechanical strength values (modulus of rupture, modulus of elasticity and internal bond strength) were obtained from sapwood, followed by soundwood, and the heartwood, respectively. Surface smoothness and wettability of the particleboards manufactured from sapwood were better than those of soundwood and heartwood.

Keywords: Particleboard, Thickness swelling, Mechanical and chemical properties, Roughness, Contact angle, Formaldehyde emission