QUALITY OF LAMINATED VENEER LUMBER (LVL) PRODUCED FROM TWO HARDWOODS AS AFFECTED BY VENEER THICKNESS AND NUMBER OF PLIES

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By

Gaber Refai El-Sayed Kayad

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ABSTRACT

This work was initiated to study the quality of laminated veneer lumber (LVL) produced from veneer of two hardwoods, namely, casuarinas (Casuarina glauca) and poplar (Populus sp.) and their mixture, as affected by number of plies, veneer thickness and combination of different veneer thickness.

Veneer of three thickness 1, 2 and 3 mm were prepared from each species. These veneer were used for producing LVL panels from one thickness, from mixture of two thickness (1 and 2 mm or 1 and 3 mm) and from the three thickness together. Commercial urea-formaldehyde (U.F) was used as adhesive by applying hot pressure of 12 kg/cm^2 at 100^{o}C for 20 minutes.

Three combinations were made from veneer of homogenous thickness (1 or 2 or 3 mm veneer thickness). Three arrangements were made from mixing 1 and 2 mm and four arrangements from mixing 1 and 3 mm. meanwhile, four arrangements were made from mixing 1, 2 and 3 mm and one arrangement from mixing 2 and 3 mm veneer.

For this study, five panels were produced for each arrangement from each species and from their mixtures. The nominal dimensions of produced panels were 18 mm in thick by 300 mm for both width and length.

The mechanical properties of the panels were evaluated in flatwise bending properties (MOR_f, MOE_f), edgewise bending properties (MOR_e, MOE_e), maximum crushing strength parallel to board axis (C_{max}) and gluing shear strength (SH). In addition, water absorption (aWA), thickness

swelling (TS), compressibility ratio ($COMP_{ratio}$) and specific gravity (G) were determined.

A completely randomized design with five repetitions was used to estimate the role of each factor. The significant differences between the means of each studied parameter were determined depending on the least significant differences method ($L.S.D_{0.05}$).

The results indicated that veneer type (Species) significantly affects the mechanical and physical properties of LVL panels. Each species behaved differently according to the thickness and number of plies and methodology of mixing the different thickness for producing LVL panels.

LVL panels made from poplar veneer showed higher bending properties either in the flatwise or edgewise than LVL panels made from casuarinas. The three LVL types exhibited weaker strength in edgewise bending (MOR_e) than in flatwise bending (MOR_f) and stiffer strength in edgewise bending (MOE_e) than in flatwise bending (MOE_f). The results indicated that variability in edgewise bending properties was less than variability in flatwise bending, except for modulus of elasticity of poplar LVL.

The results of the mechanical testing indicated that panels produced from homogenous veneer thickness with 1 mm were more suitable for casuarinas LVL than panels made from 2 or 3 mm veneer thickness. However, poplar panels made from 2 or 3 mm veneer thickness were more suitable than panels made form 1 mm veneer thickness. The mixing between 1 and 3 mm veneer thickness mostly gave higher means than mixing between 1 and 2 mm veneer thickness. The arrangements with high number of plies recorded higher mean values of mechanical properties than the arrangements of lower number of plies.

The results showed that casuarinas LVL properties were affected by changes in number of plies and veneer thickness combinations, whereas poplar and mixed LVL were mostly affected by changes in number of plies than changes in veneer thickness combinations.

As for dimensional stability properties, results indicated that poplar LVL have higher mean values of water absorption (WA), thickness swelling (TS), compressibility ratio ($COMP_{ratio}$) than casuarinas LVL, whereas casuarinas LVL had higher specific gravity than poplar LVL. Moreover, it is obvious from the results of homogenous panels that WA and TS increase by increasing veneer thickness, while $COMP_{ratio}$ and G decrease by increasing veneer thickness. The physical parameters studied were more sensitive to the changes in number of plies than changes in veneer thickness combinations. Also, mixing veneer of the two species in manufacturing LVL panels gave some improvement to WA and TS for the product than panels produced from poplar veneer only.

In general, the results showed that most mechanical properties and dimensional stability treatments are in range of these values in the available specifications.

From these results, it can be concluded that LVL can be produced in Egypt with proper properties by using veneer from timber alone or mixed with veneer waste of poplar.