Kovácsvölgyi Gábor

Manufacturing LVL type products based on poplar clones as raw materials

DOCTORAL (Ph.D.) thesis

University of West Hungary
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Program: **Wood Sciences (F1)**

Discipline: **Science of Material Engineering and Technology**

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1. Introduction and Research Objectives

Wood is one of the available industrial raw materials, whose yield does not cause decrease due to means of mining activity, because it grows on readily available natural resources (water, carbon-dioxide, solar energy).

Forest managing activity, that creates wood for industrial material is costly, by the way Forest services' activity has to gain profit.

It is a collective interest of all participants (forest services, furniture industry, carpenter industry, cellulose and paper industry, wood market etc.), that utilization of wood grown on the cheapest and cleanest resources, should reach the highest level of effectivity.

Inasmuch as the profit of wood utilization is taken into account, it can be stated that the highest turnout rate value of wood utilization is the veneer manufacturing and the manufacturing of veneer based products.

Volume of wood raw material, that fulfills the relatively strict specifications of veneer based panel industry, creates limitation for increasing the manufacturing of veneer based panel products.

Recent properties (range, variety of species, age, cultivation methods) of Hungarian forests are able to provide only 1.5 – 3 percent of the whole yield for veneer manufacturing.

Decorative veneer-manufacturing utilizes classic domestic wood species like oak, beech, cherry, maple, walnut etc. Rotary cut veneer manufacturing uses mostly wood material of beech, poplar, alder, and linden.

A possibility of long expected breakout point seems to be provided by the announced 10 year long forest plantation program that aims to create 150 000 ha new forested area. The program is nearing to its execution period, that will increase rate of forested area in Hungary from 19% up to 25-26%. The new forested areas will be created mostly by plantation of fast growing poplar and black locust species. By applying adequate cultivation methods, it is achievable to utilize the 40-50% of poplar wood as veneer industrial raw material.

Summarizing the introduction, it can be predicted that the raw material supply of veneer industry will differ from recent conditions.

Expectedly, veneer raw material supply will be 3-4 times more than recently available volume. This is the reason why my research activity aimed to determine the products and technologies that can be developed and produced in Hungarian factories.

Research Objectives

I. Comparison of densification rate and bending strength increase of different sort of rotary peeled domestic polar veneers after applying hot pressing.

II. Bending test of experimental LVL boards by using selected poplar species

III. Bending test of poplar-beech and poplar-oak

IV. Bending test of semi-industrial experimental LVL specimens

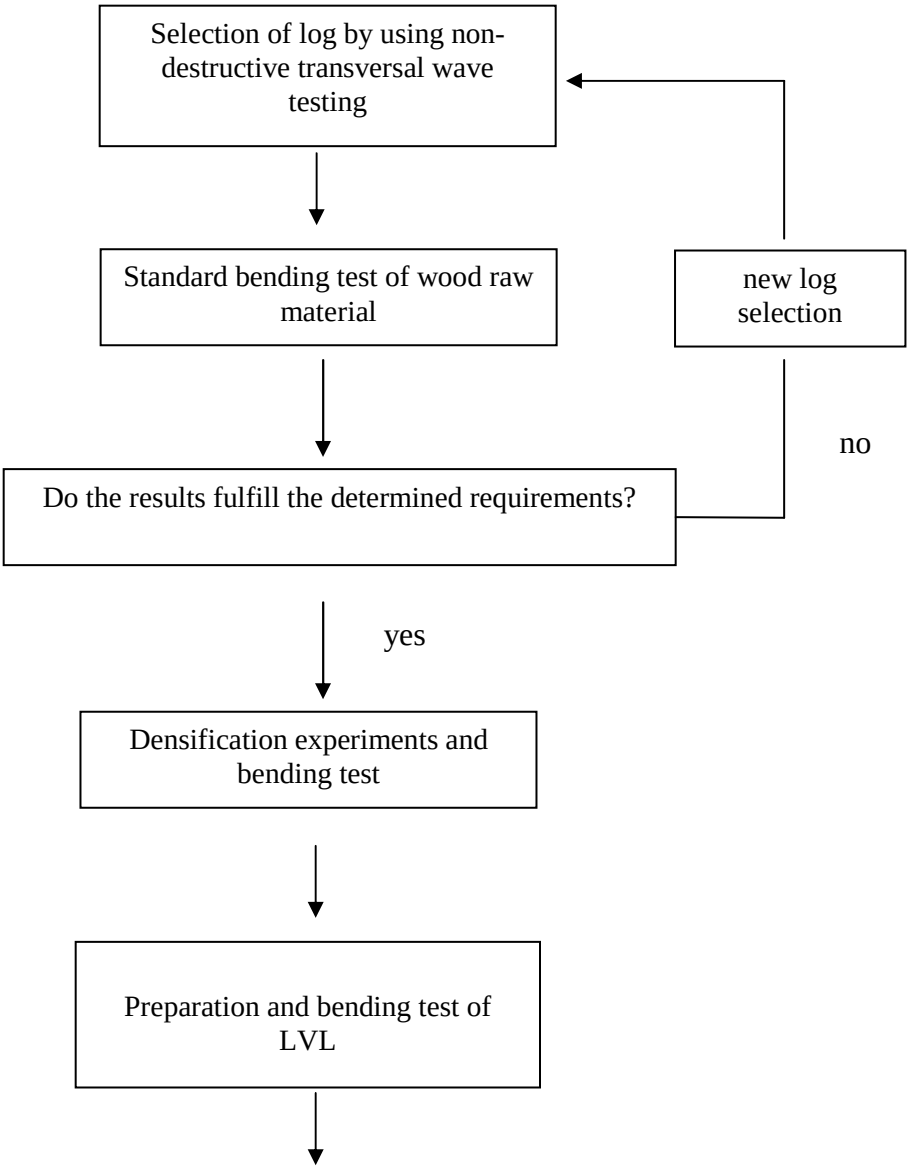
V. Design the proposed technology

2. Experimental Methods and Goals

The primary hypothesis of the present research is to see if it is possible to manufacture high strength veneer based composite products (presently LVL) under Hungarian conditions not receiving adequate funding.
After the chosen research method, it is necessary to select the adequate raw material, to determine the densification and strength properties of veneer raw material, to produce experimental boards to measure its bending strength.
If the results of the laboratory experiments are positive it is necessary to do further semi-industrial investigations to support the hypothesis of the present research and to achieve its goal.

The hypothesis of present research has to be verified twice during the entire research process (after the laboratory and after the semi-industrial experiments).

The detailed research process is summarized as below (Figure 1.):


Selection of log by using non-destructive transversal wave testing
Standard bending test of wood raw material
new log selection
no
Do the results fulfill the determined requirements?
yes
Densification experiments and bending test
Preparation and bending test of LVL

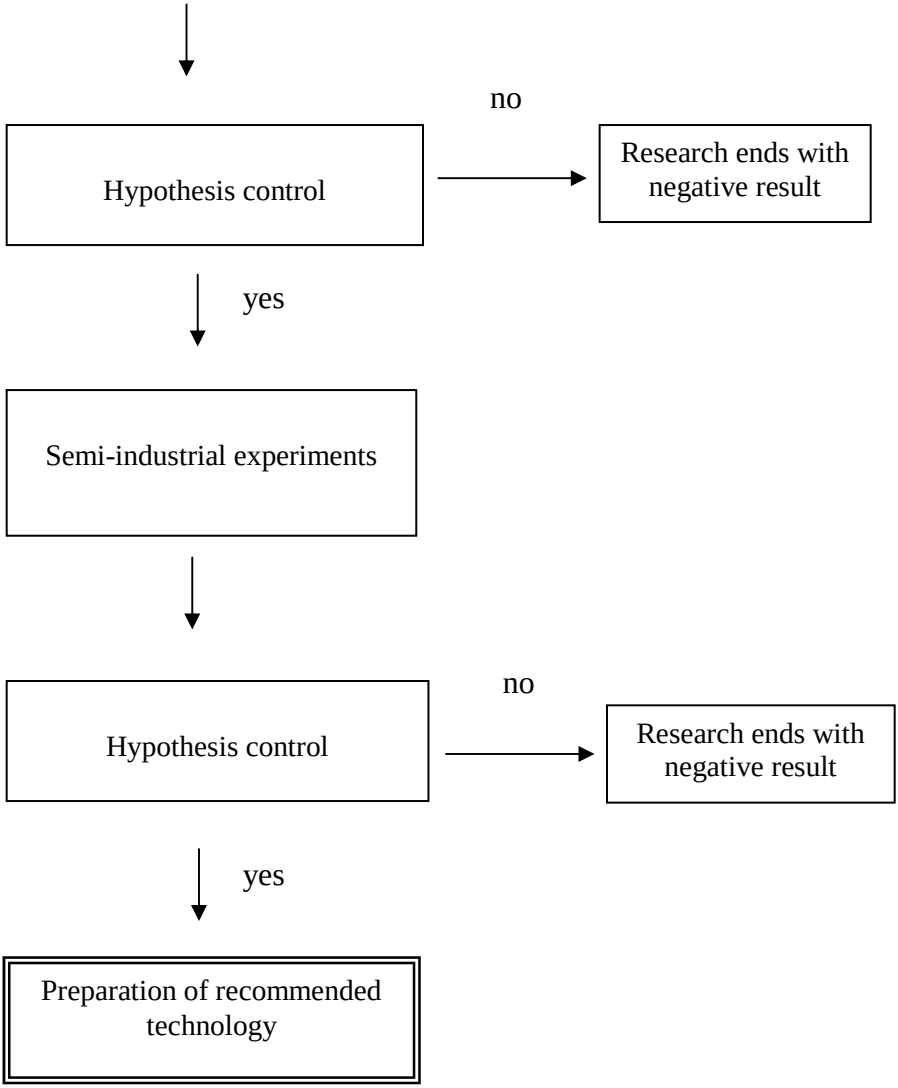


Figure 1. Research process

Scientific Results

I determined and compared the densification properties of I214 and Marylandyca poplar clones and effect of densification on change in strength and elasticity properties

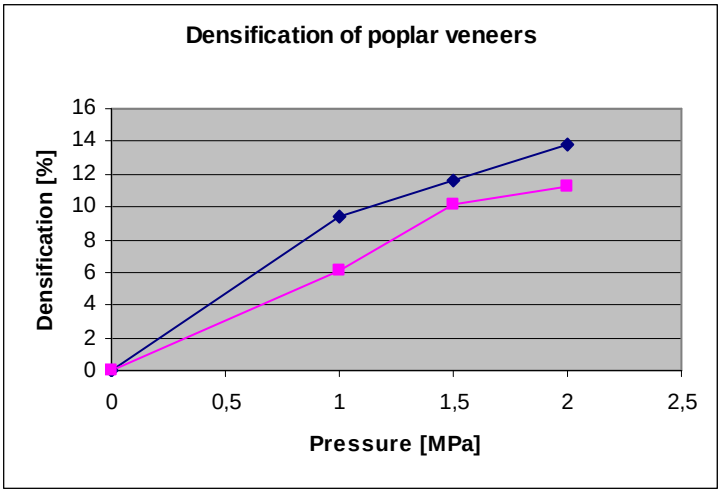
I was first to prepare LVL products from poplar wood material and to investigate the mechanical properties of LVL specimens.

I was first to have done semi-industrial experiments to demonstrate the manufacturability of LVL products under Hungarian industrial circumstances.

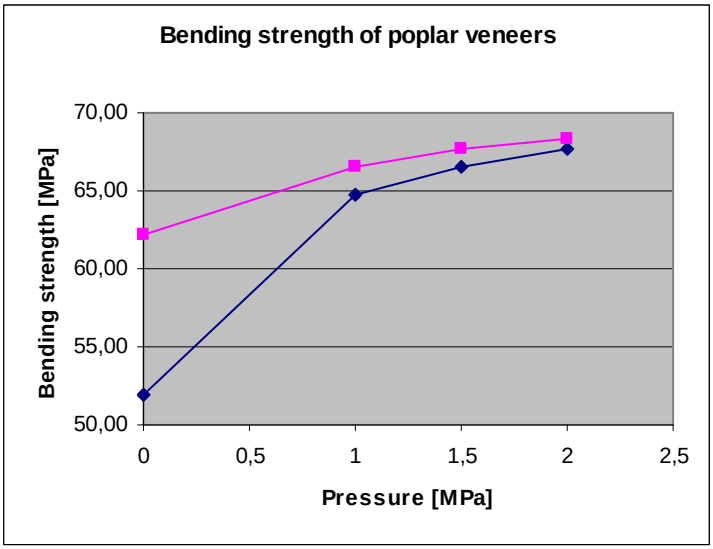
I was first to prepare poplar-beech and poplar-oak LVL, and these products may make Hungarian LVL production more successful and more economical.

Thesis Statements

1. I stated after the results of densification experiments of highest and lowest density Hungarian poplar wood kind that, veneer, rotary peeled from low density poplar log, has significantly higher densification by applying the same press values. In case of I214 clone, value of densification was measured to be 12-14%, in case of Marylandica it was 6-10%.



2. After the bending test of I214 and Marylandica veneers, I stated that the bending strength of poplar veneer increases significantly with densificaion, relatively to the non-pressed veneers. Increment of I214 poplar venees' bending strength was 24-30%, and increment of marylandica veneers' bending strength was 7-10%



Notation: **Marylandica Poplar Veneer**

I214 Poplar Veneer

3. I found that it is possible to produce "high" strength LVL products from any Hungarian poplar species. Bending strength of I214 poplar LVL product was measured to be 67.72 MPa and in case of Marylandica LVL product it was 72.53 MPa.
4. I stated that poplar-beech and poplar-oak LVL products showed significantly higher bending strength relatively to poplar LVL products. Entry of this sort of LVL product to the Hungarian forest products market is highly recommended.
5. My semi-industrial experiments showed that LVL products can be produced in Hungarian industrial facilities. Based on this experiments, I prepared a complete technology for a typical Hungarian plywood factory to start manufacturing LVL products.

Publication list

Sanadi, Anand R.; Hunt, J.F.; Caulfield, D.F.; Kovacsvolgyi, G.; Destree, B. 2002. *High fiber-low matrix composites: kenaf fiber/polypropylene*. In: sixth international conference on woodfiber-plastic composites; 2001 May 15-16; Madison, WI. Forest Products Society, Madison WI: p. 121-124. (http://www.fpl.fs.fed.us/pdcomp/publist.htm)

Bohnhoff, D.R., P.A. Boor, F.A. Charvat, M. Gadani, and G. Kovacsvolgyi. 2002. *UW & LBS full-scale metal-clad wood-frame diaphragm study. Report 2: Frame loading and data acquisition systems.* ASAE Paper No. 024008. ASAE, St Joseph, MI.

Anand Sanadi, John Hunt , Kovácsvölgyi Gábor, Sanjot Kurhana, Brian Destree, David Caufield, 2003. *Újrahasznosított polipropilén alkalmazásával készült lignocellulóz alapú kompozitok mechanikai tulajdonságainak javítása*, Magyar Tudomány Napja 2002 A Kémiai Intézet Tudományos Ülése 2002. november 7.
(konferencia kiadvány) 107-110 o.

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Bohnhoff, D.R., P.A. Boor, F.A. Charvat, M. Gadani, and G. Kovacsvolgyi. 2002. *UW & LBS full-scale metal-clad wood-frame diaphragm study. Report 2: Frame loading and data acquisition systems.* Presented at the 2002 ASAE Annual International Meeting, Chicago, IL.

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Anand Sanadi, John Hunt , Kovácsvölgyi Gábor, Sanjot Kurhana, Brian Destree, David Caulfield, 2002. *Újrahasznosított polipropilén alkalmazásával készült lignocellulóz alapú kompozitok mechanikai tulajdonságainak javítása*, Magyar Tudomány Napja 2002 A Kémiai Intézet Tudományos Ülése

Research Reports:

NKFP Erdő - Fa Kutatási program 6.3. Az értékes minőségi hengeresfa feldolgozásának korszerűsítése 6.3. Új furnér és furnéralapú termékek hazai gyárthatóságának vizsgálata alprogram kutatási jelentései 2001-2004, University of West-Hungary

Fa Kutatási program 6.3 „Az értékes minőségi hengeresfa feldolgozásának korszerűsítése 6.6. A minőségi hengeresfa fahasznosítási lánca számítógépes nyomon követési módszerének kialakítása, figyelemmel a gazdaságosság, a minőségtanúsítás és az eredettanúsítás követelményeire" alprogram, University of West-Hungary