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Review of the PhD thesis of eng. Petr Klimek

„Bio-based composites from agricultural residues and other waste materials“

OBJECTIVES

The PhD student and his supervisor selected for his thesis a topic of current interest regarding bio-based composites, especially made from agro-residues. The particleboard is the most produced panel type in Europe, which is in a difficult situation due to the shortage and price increase of traditional wooden raw materials. The main goals of this thesis were a detailed study about the state of the art from scientific journals and books, the design of wood replacement in particleboard using different easily available waste from agriculture and lab trials including the testing of the main properties of these panels. All these objectives are easy to identify and rigorously analyzed within the thesis and in the papers connected to this one.

RESULTS

The main goal of the thesis was to identify, produce and test lab scale particleboards based on many types of agricultural residues and recovered painted wood, and also to study the influence of chosen parameters on the main properties of the panels (especially the MoR, MoE, IB and TS). Complex relations between the raw materials (residues, resins and additives) on the one hand but also lab production parameters (press temperature and time) on the other hand influence the quality of the panel in unexpected ways. These aspects are well written and interpreted in the first four papers published in well-known and highly recognized international scientific journals. An important aspect resulting indirectly from the thesis is to encourage the use of such products not only for furniture but also for constructions if the surface appearance and moisture resistance are not too highly ranked.

IMPORTANCE FOR PRACTICE

The development of particleboards made from residues from agriculture and recycled wood has been partially accepted by producers for many decades. Particleboard producers tried to mix such local resources with the available wood qualities. Industrial users are still concerned due to the color versatility, complex processability in terms of tool wearing and resin formulation, low storage time and non-permanent availability during the year. Because of the increased harsh competition for wood in Europe due to the emergence of biomass plants and new pellets production, such alternative raw materials generated as waste in agriculture or from the “urban wood” are to be considered as a real option for future particleboard types.

OVERALL APPRAISAL

The work contains 148 pages counting the abstracts, list of tables, figures, content, the eight selected papers and the literature. Many charts and diagrams contain an impressive amount of data from the sources which are mentioned in the references, in order to support the explanation of the design of experiments and selected properties for testing of the new particleboard types.

Chapter 2 contains the literature study, sometimes using not updated sources for the four selected types of raw material. This part does not include complete information about the industrial manufacturing of particleboard. A very interesting subchapter (2.3) gives an original and compact presentation of the results from previously published works on this field for the main properties vs. EN standard for particleboards.

Chapter 3 presents the lab manufacturing process and testing for the particleboard in a general and shorter manner without precise data about the lab, particle size, species mixture, glue amount and board sizes or any other hints connected to the eight papers. The figures are not described in detail concerning the selected pictures. The preparation of samples for the testing of the main panels properties according to the EN standards is mentioned but some details are missing.

In Chapters 4 to 11 are the selected eight papers describing the resulted particleboards from the chosen raw materials including the laboratory trials, preparation of sample, testing and results. Some of the papers (Chapters 8, 9 and 11) present some interesting treatments of the particle and new measurement techniques at lab scale which are not directly connected to the main goals of the work. The eight chapters could easily be integrated to form a larger one or could be included in an appendix!

Chapter 11 contains, within three pages, specific limited aspects focusing on each of the eight papers and not a general independent conclusion of the whole study.

Literature research is well done with minor errors. An annex is not provided.

The general layout in terms of titles, citations, figures and tables is adequate for a doctoral thesis. The English used by a non-native speaker is satisfactory, using the special terms of the research field and is easy to understand and read. Some formulations with “we have” should be avoided in scientific works.

PRESUMPTIONS AND RECOMMENDATIONS

I agree that this version of the PhD thesis made by eng. Petr Klimek reached the level to be presented in front of the commission in a public defense meeting and wish the candidate good luck for this important event. The results of his research contain important steps for the increased use of non-wood raw materials for the particleboard industry. Using this new opportunity the most produced and widely used wood based panels in Europe could continue their successful run. The scientific experience gained during his internship stages at WKI in Braunschweig (DE) and OSU in Corvallis (USA) are reflected in the huge number and high quality of scientific papers written during the PhD study at Mendel University in Brno.

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