Proceedings of the 7th International Conference on Mechanics and Materials in Design,
Albufeira/Portugal 11-15 June 2017. Editors J.F. Silva Gomes and S.A. Meguid.
Publ. INEGI/FEUP (2017)

PAPER REF: 6826

ANALYSIS AND ASSESSMENT OF FLAMMABLE SELECTED WOOD BASED PANELS RECEIVED FROM RENEWABLE RAW MATERIALS AT ACCELERATED PRODUCTION SYSTEM

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ABSTRACT

Poland, in comparison with other UE countries, in terms of wood industry production is the leader, especially when production of wood-based panels is considered. For instance, 6.8 million m^3 of wood-based panels were produced in 2010 which made 12% share in UE market, so that Poland has been second largest manufacturer in Europe after Germany. Modern and efficient lines of Polish plants and highly educated staff result in competitiveness and high quality of products as well as in high export rate. The main factor determining high position on the European market is constant stream of raw materials. Since 2006 wood-based panel industry have been facing shortage of wood reaching 5 million m^3 and that value slowly increases. The main suppliers of wood are State Forests (pl. Lasy Państwowe) (ca. 60%) as well as sawmill plants and plywood manufacturers supplying waste wood (ca. 40%). Those resources are entirely consumed and no additional amounts of raw materials are available. Taking into account the policy of State Forests, searching for other underutilized resources of wood is necessary. Moreover, having in mind that chips, particles and fibers for panels are produced from 40-year-old trees, while average wood-based panel furniture life-time is 20 years in Poland (in UE ca. 5 years), it is obvious that shortage in raw materials are very likely to occur, unless new feedstocks are revealed. Therefore, an intense research on the fast-growing species is observed and plantations are considered new sources of raw material.

Keywords: wood panels, furniture, fiber board, fire resistance.

MATERIALS AND METHODS

The research material used in this study was prepared at the Faculty of Wood Technology at Warsaw University of Life Sciences. Panels were made of larch wood harvested from selected plantations of fast-growing State Forests and wood shavings and industrial fibers (pine). Larch fibers were obtained from laboratory defibrator at Research & Development Centre for Wood-Based Panels in Czarna Woda, and industrial fibers came from one of the domestic manufacturers of MDF panels. The fibers were glued down with industrial urea-formaldehyde resin used in the production of MDF. They were added to the resin industry hardener.

For experimental testing was prepared twelve samples, of which three samples of wood-based panels of various kinds of wood shavings and wood fibers with dimensions of 100x100 mm and a standard thickness of 18 mm. The thickness of panels was not the same due to stratification of some panels during their production. This was the result of very high humidity of fibers or wood shavings. During the compression of such panels at the

temperature of 180°C to 190°C water turns to steam, which leads to occurring of huge amount of water vapour and it is not able to evaporate completely before the compression of panels. In the final stage of production, when such panel in taken out of the press, cumulative water vapour must evaporate which, in turn, leads to blow out of panel, which causes delamination of the panel. To evaluate the fire properties characteristics of the woods quantitatively, a cone calorimeter testing ISO 5660 was done. The testing involves a constant radiant heat being irradiated onto the surface of the sample, and then the sample would ignite a spark igniter. First, each specimen of dimensions 100 x 100 x 10 mm is wrapped in aluminum foil and exposed horizontally to an external heat flux of 30 kW/m^2. Several parameters are examined from a cone calorimeter test, such as average and peak heat release rate (av HRR and pk HRR, kW/m^2), total heat release (THR, MJ/m^2), effective heat of combustion (EHC, MJ/kg), total smoke production (TSP, m^2), yield CO and CO_2 (Y_{CO}, Y_{CO2}, kg/kg), specific extinction area (SEA, m^2/kg).

CONCLUSIONS

1. Ignition time when exposed to the heat flux of 30 kW/m2, for wood-based panels from raw material plantation, was longer than the panels produced from industrial raw material. Against the background of the other panels, having in mind fire safety, the worst results give the chipboard obtained from the industrial wood shavings. The average of required time from the moment of heating the surface of the panel to the start of the flame combustion of formed volatile phase was the lowest.

2. The average value of maximum heat release rate (HRRmax.) is the largest for fiberboard produced from industry raw material, where the value was 197,67 kW/m2, while fibreboard obtained from the plantation raw material HRRmax average value was 162.75 kW / m2 (it was the lowest value compared to all the tested panels). The smallest value HRRmax was recorded for fibreboard obtained from the plantation raw material and it was 123.91 kW/m2.

3. Decisively against all samples the worst result obtained fibreboard of industrial raw material. It gained the highest rate of heat release (HRR) of the total heat rate (THR), the total amount of smoke produced (TSP), the effective heat of combustion (EHC) and the intensity of the smoke release (TSR). It means that using these panels in the market of wood-based panels is generally unfavorable from the point of fire safety.

4. The study found that panels made of larch rapidly growing fared best compared to other wood-based panels, ie. industrial raw material used for mass production of wood-based panels. Panels of larch rapidly growing (tested chipboards and fibreboards) have lower value of heat release rate (HRR), total heat rate (THR), the total amount of smoke produced (TSP the effective heat of combustion (EHC) and the intensity of the smoke release (TSR) compared to the industrial panels. This is very important for the safety of users in the process of development and generation of environmental fire.

5. In analyzing the parameters characterizing the dynamics of the generation of smoke: SEA (Specific Extinction Area) and TSP (the total amount of smoke produced) can be stated that the lowest risk in fire conditions would create fiberboard of larch plantation. Moreover, during all tests it was noticed that the release of smoke through the panel in the middle stage of combustion is maintained at a uniformly low level, which can significantly impact the safer evacuation of the space covered by smoke. In this situation, every minute is precious, and therefore in the case the intensity of the smoke production is so important.