THE EFFECT OF DRYING TEMPERATURE OF WOOD CHIPS ON THE INTERNAL BOND STRENGTH OF PARTICLEBOARD

Ioannis A. Kakaras and Antonios N. Papadopoulos

Technological Educational Institute of Karditsa, Department of Wood and Furniture Technology-Design, 43100, Greece

SUMMARY

The purpose of this communication is to report results obtained in a study whose scope was to examine the effect of drying temperature of wood chips on the internal bond strength of particleboard. It was found that the internal bond strength was significantly increased by increasing the drying temperature. This was attributed to the breakdown of the particles dried at high temperatures.

INTRODUCTION

Many treatments have been applied over the past 50 years to improve the dimensional stability of particleboards including heat treatment, heat post treatment (heat treatment of boards after manufacture), steam treatment and steam pre-treatment. When wood is dried at temperatures of 100 to 180\(^\circ\)C, the equilibrium moisture content of wood can be improved (Suematsy et al. 1980) by as much as 3% compared with air-dried wood (Schneider 1973). Also the accessibility of hydroxyl groups in hemicellulose to water may decrease and in turn, swelling is reduced when wood with moisture contents below 15% is heated at temperatures of about 100\(^\circ\)C (Hillis 1984). The purpose of this communication is to examine the effect of drying temperature of wood chips on the internal bond strength of particleboard.

EXPERIMENTAL

Industrially produced wood chip furnish, comprising mixed softwoods (60%) and hardwoods (40%) was the raw material used in this study. Each furnish was screened first through a mesh with 5 mm apertures to remove oversize particles and then through a mesh with 1 mm apertures to remove undersize (dust) particles. After screening, the chips were dried to 3% moisture content (MC). Two drying temperatures were selected, namely 85\(^\circ\)C for 24hr in a common laboratory kiln and 650\(^\circ\)C for 1 minute in a Bison-Combi 80 flash high temperature dryer. A commercial urea formaldehyde (UF) particleboard resin was used for the manufacture of boards. 8% resin (solids on oven dry mass of particles) was added in all cases. Where necessary, additional water was added to bring the furnish to the target moisture content level (12%); this was done after resin application. The total blending and mixing time was 7 minutes. Mats were randomly hand-formed on a circular aluminum caul. Mats were pressed in an electrically heated hot press, for 16 minutes at 160\(^\circ\)C. Target board density was 650 Kg/m\(^3\) and target board thickness 15 mm for all boards. Five replications of each board were made, giving a total of 10 boards. Boards were conditioned at 20\(^\circ\)C and 65% relative humidity prior to testing of internal bond strength (IB) (EN 319).

RESULTS AND DISCUSSION
The effect of drying temperature of wood chips on the internal bond strength of particleboard is illustrated in Figure 1. From this, it can be seen that drying wood chips at 650°C resulted in 12.7% improvement in internal bond strength of particleboard compared with chips dried at 850°C.

In order to explain the above result, particle size distribution of the two furnishes used in this study, i.e. furnishes dried at 850°C and 650°C, was carried out. According to Talbott and Maloney (1957), an increase of 36% of the internal bond strength of particleboard was observed when the particle size was decreased from that not passing through a 4 mm mesh screen to that passing through a 4 mm mesh screen but not passing through a 16 mm mesh screen. The results of this analysis are presented in Figure 2. From this, it can be seen that there is a 14.1% increase in the weight of small particles (those passing through a 2 mm mesh screen) in the furnish dried at 650°C. This breakdown of the wood particles probably happens as the particles move in three passes in the high velocity, high temperature air stream through the drums of the dryer. The 12.7% increase in internal bond strength is likely to be the result of an interaction of the mechanical breakdown and the thermal degradation of the wood particles which happens during the high temperature drying procedure.

**CONCLUSIONS**

The internal bond strength of particleboard was significantly increased by increasing the drying temperature. This was attributed to the breakdown of the particles dried at high temperatures.
Figure 2: Particle size distribution of the two furnishes used in this study (black: dried at 85°C; grey dried at 650°C).

REFERENCES


