Key Engineering Materials Vols. 471-472 (2011) pp 1091-1094
Online available since 2011/Feb/21 at www.scientific.net

doi:10.4028/www.scientific.net/KEM.471-472.1091

Manufacturing High Performance Wood Composite Panel from Paulownia

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Keywords : Manufacturing, wood composite panel, fast growing, paulownia.

Abstract. Regarding conservation policies of natural forests and environmental concerns forced wood composite panel manufacturers to consider using other lingo-cellulosic resources. Plantation fast growing species such as poplar, eucalyptus , paulownia and others is already started in many countries. Fast growing trees usually produce light wood with low strength so manufacturer has low certainty on using them for manufacturing wood composite panel. This study oriented toward examination of application of paulownia wood particle for manufacturing wood composite panel. In this study, specific press pressure at two levels (30 bar and 40 bar) , and press time at two levels (8 and 12 minutes) were used as independent variables. 12 experimental panels were made in laboratory. Mechanical properties such as MOR, MOE and IB were evaluated. Results showed that panels made at press pressure of 40 bar and press time of 12 minutes presented the highest MOR (41.28 MPa) and MOE (4128 MPa) but the highest IB (1.14 MPa) was observed in composite panels made at press pressure of 30 bar and press time of 8 minutes. Based on EN Standard MOR of Particleboard ranged from 12 to 15 MPa and MOE ranged from 2500 to 3000 MPa and IB ranged from 0.4 to 0.6 MPa . Comparing Above mentioned values with EN values it can be seen that Mechanical properties of wood composite panels made from paulownia are much higher than EN standard. These results are very good ground to focus on fast growing species such as paulownia to compensate wood raw material shortcoming in wood industry.

Introduction

Reduction in wood harvesting from Iran natural forest has caused serious impact on wood industry[3]. Capacity of production in most mills has reduced during last 5 years and some of them in uncertain situation and may shot down if wood supply problem is not solved. Utilization of wood from fast growing species plantation is one of the alternatives. Paulownia is a very fast growing species. Its density is ranged from 0.28 to 0.35 gr/cm ^{3}and its chemical components contains : cellulose 47.25%, hemicelluloses 29.71% , lignin 20.23% and extractives 2.71%. its PH is 5.38. This study has been oriented towards investigation on application paulownia for manufacturing particleboard in mixture with native species.

Methods and Materials

In this study, press pressure and press time were considered as variables. Other parameters were kept constant for all experimental boards. Regarding variables, four conditions for manufacturing experimental boards were provided and three replicates were made from each manufacturing conditions. Totally 12 experimental 3 layer-boards were manufactured .Physical and mechanical properties of experimental boards were determined following DIN68763. Data was analyzed using SPSS software.

Results and discussion

Effect of variables on modulus of rupture (MOR) is shown in Figure 1. Particleboard MOR is ranged from 5 to 20 MPa [6]. As seen, MOR of all manufactured experimental particleboard from mixture of paulownia and industrial wood particles is higher than control. Among manufactured experimental boards, those manufactured using press pressure of 40 bar and hot pressed for 12 minutes presented the highest MOR (41.28 MPa). It means that MOR has been improved 100 percent by utilization of paulownia.

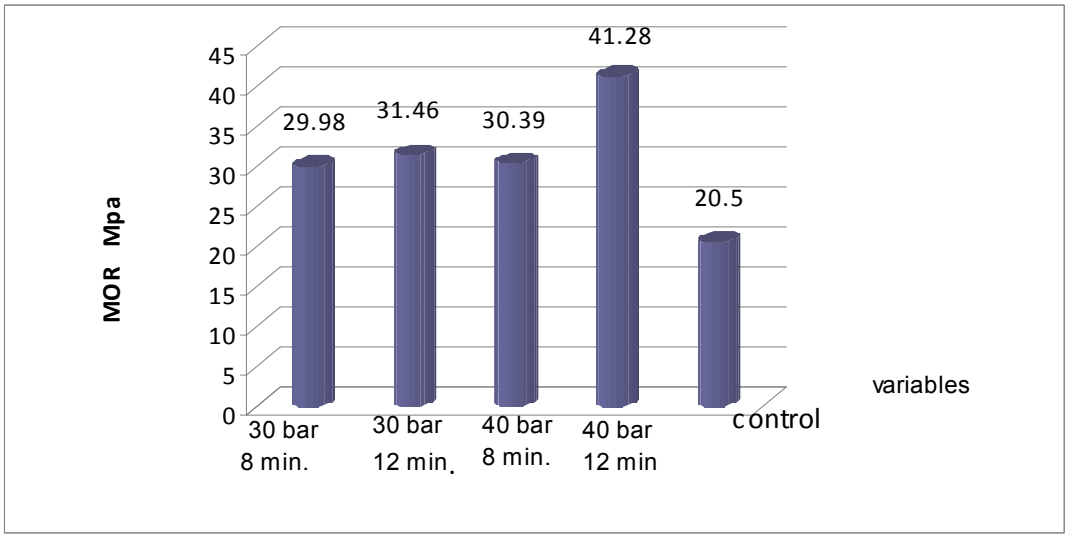

Fig. 1 Effect of variables on MOR

Effect of variables on MOE is presented in Figure 2. As it is seen, MOE of all experimental panels is higher than MOE of control panel. The highest MOE (4128 MPa) is presented by expermimental boards manufactured at press pressure of 40 bar and hot pressed for 12 minutes.

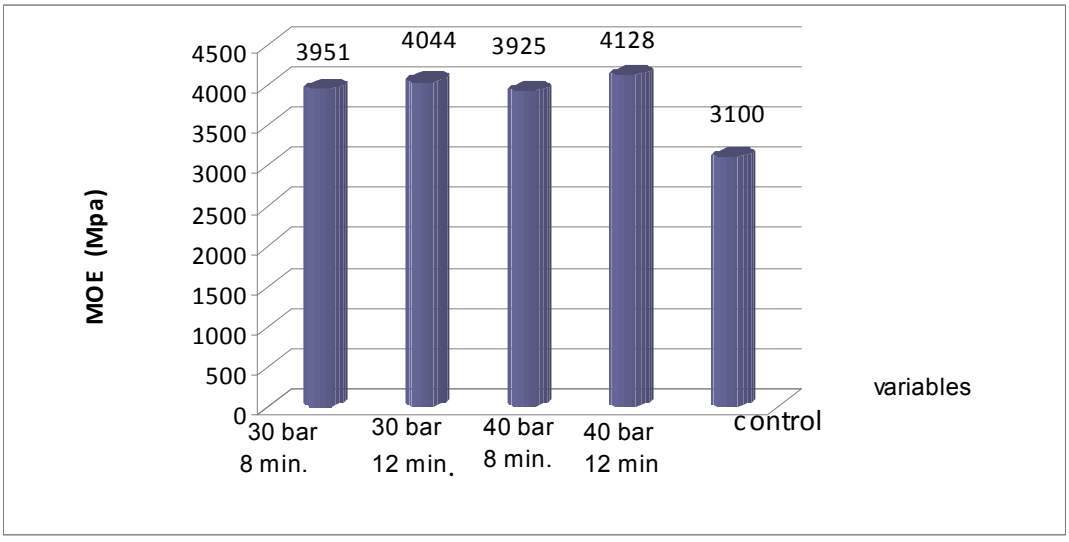

Fig. 2 Effect of variables on MOE

Effect of variables on IB of experimental boards is shown in Figure 3. As seen, the highest IB is presented by boards manufactured at press pressure of 30 bar and hot pressed for 8 minutes. IB of other experimental boards is equal with control.

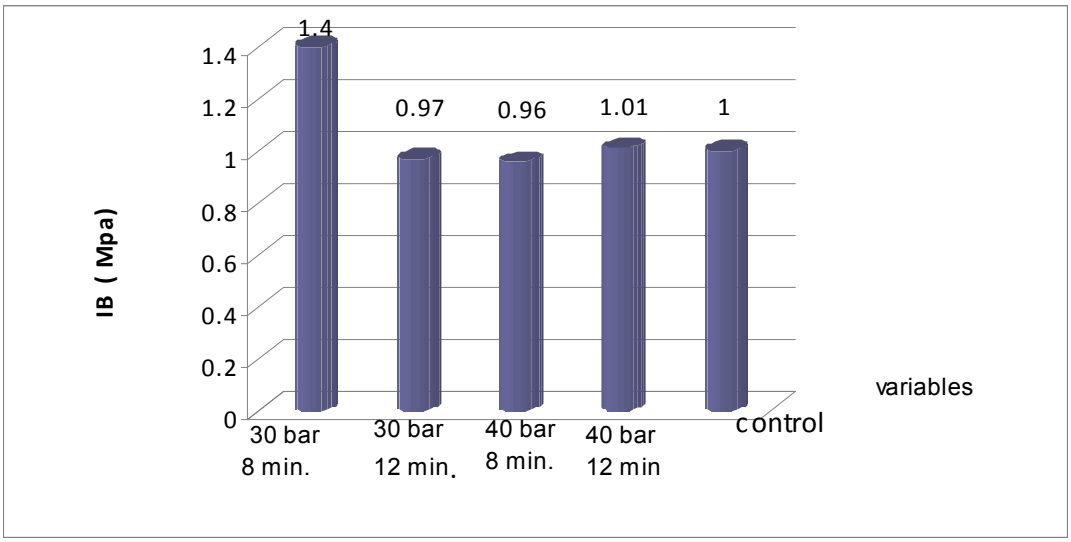

Fig. 3 Effect of variables on IB

Effect of variables on water absorption (WA) is illustrated in figure 4. As seen, WA after two hours water soaking is very low compared with absorption after 24 hours water soaking. On the other hand when press pressure and press time increased water absorption decreased. Generally water absorption of all boards is in the standard range of particle board.

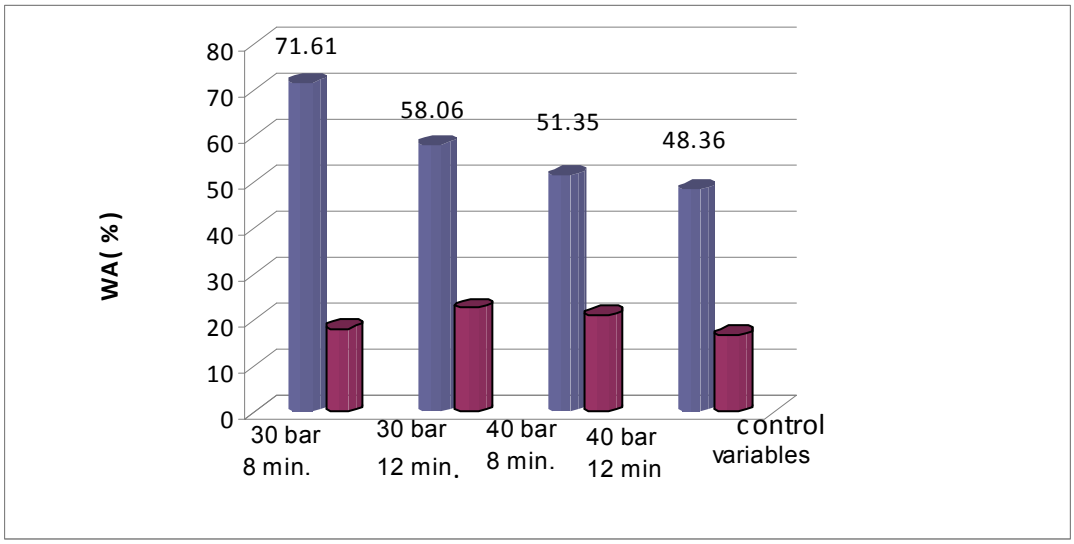

Fig. 4 Effect of variables on WA

The most important properties of paulownia is related to its low density. Low dense material allow high compression ratio [2 , 4 and 5] which improves MOR and MOE. Press pressure help mat to be compressed for this reson higher compression resulted to higher compression ratio and so higher MOR and MOE. Press time allows completion of resin curing [1]for this resean in most cases board properties improved by increasing press time.

Results of this study revealed that paulownia is a promising species in manufacturing particleboard. From practical and economical view it is suggested to utilize paulownia in mixture with other species specially heavy species because it is a very light species.

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Composite Science and Technology
doi:10.4028/www.scientific.net/KEM.471-472

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