

---

\*

( / / : / / : )

Archive of SID

/ gr/cm<sup>3</sup>

(

( )

:

...

---

)

PF (

°C

( )

( )

( )

)

(

( )

Archive of SID

) ( )  
( ) ( )

---

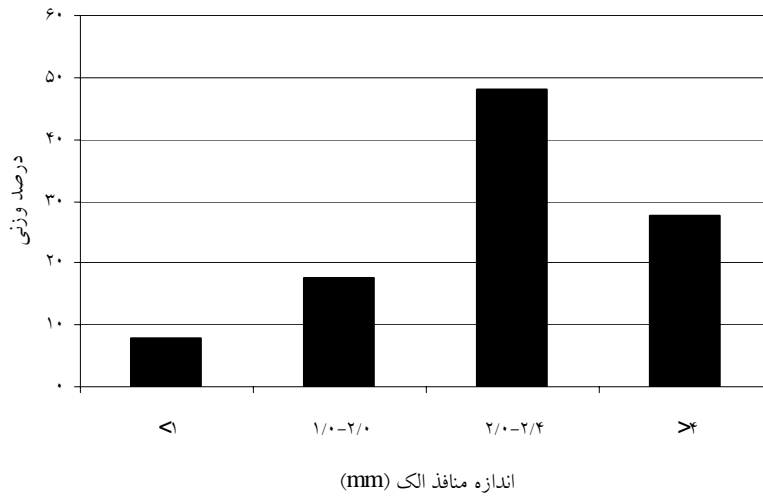
Shyong Hwang  
Le Fru  
Cleat

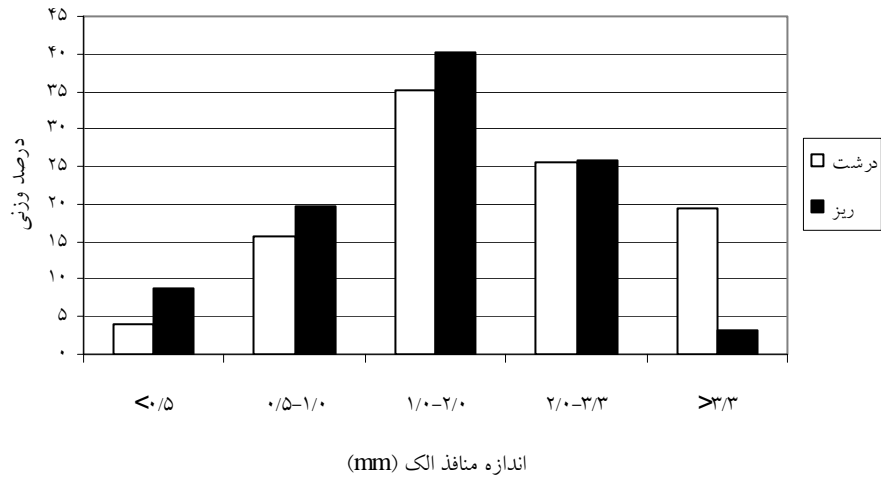
---

Grigorious  
Ellis

pH  
Bison  
pH

Quality Control 44011





pH	(s) *	(cp)	(%)	(gr/cm <sup>3</sup> )
/			/	/

=\*

Archive of SID

±  
DIN

± )  
(  
52360

kp/cm<sup>2</sup>

(CRD)

						MOE	MOR
/	/ **	/	/ **	/ **	/ **	/ **	(A)
/ *	/ **	/ **	/ *	/ **	/	/ **	(B)
/	/	/	/	/ **	/	/ **	(C)
/	/	/	/	/	/	/	A×B
/	/ *	/	/	/	/	/	A×C
/	/	/ *	/	/	/	/	B×C
/	/	/	/	/	/	/	A×B×C

=\*\*

=\*

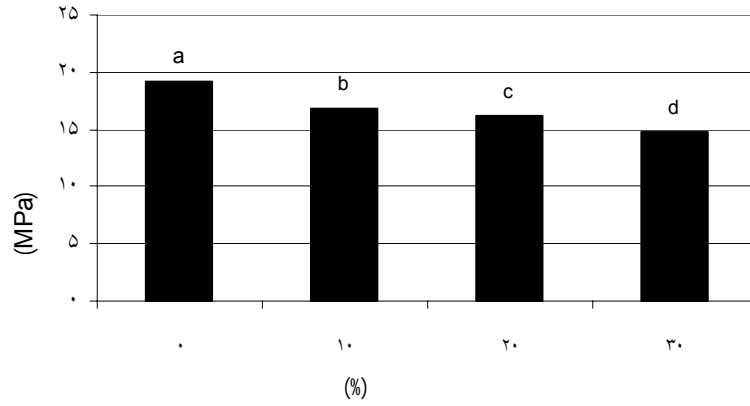
(MOR)

( )

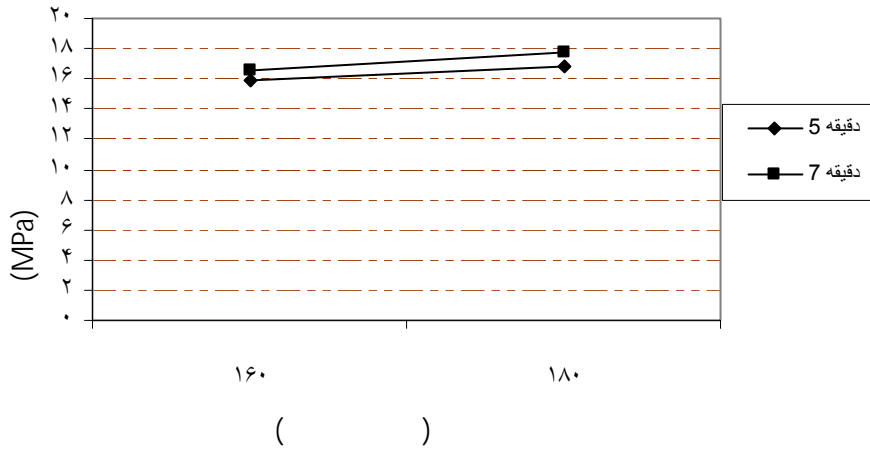
(% )

% /

( )



( )



(.)

MOE

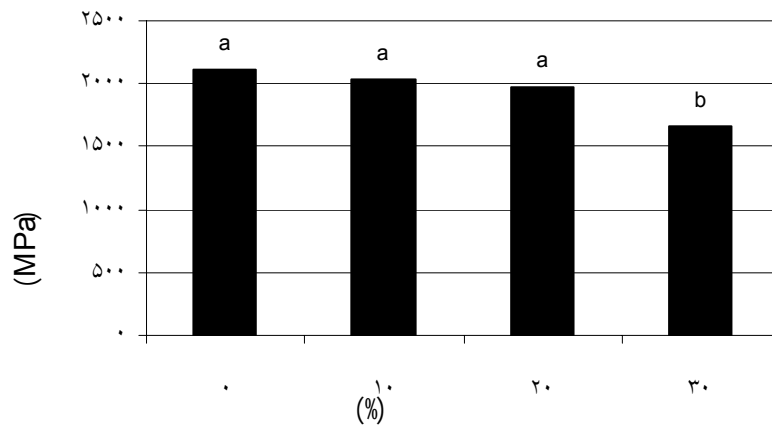
%

(MOE)

(% )

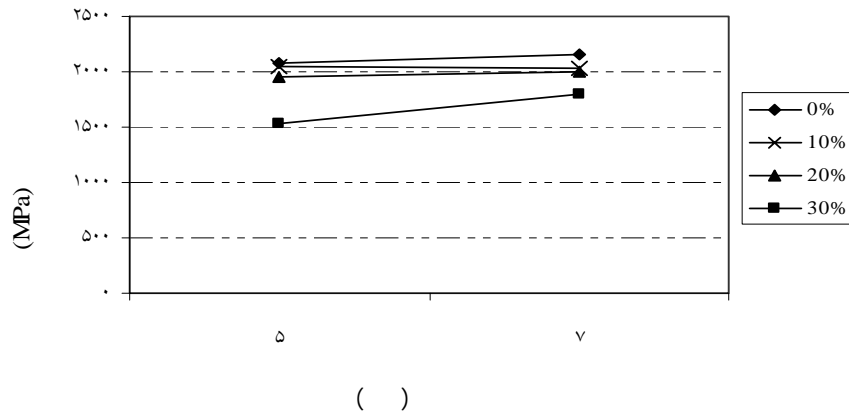
.( )

.( )



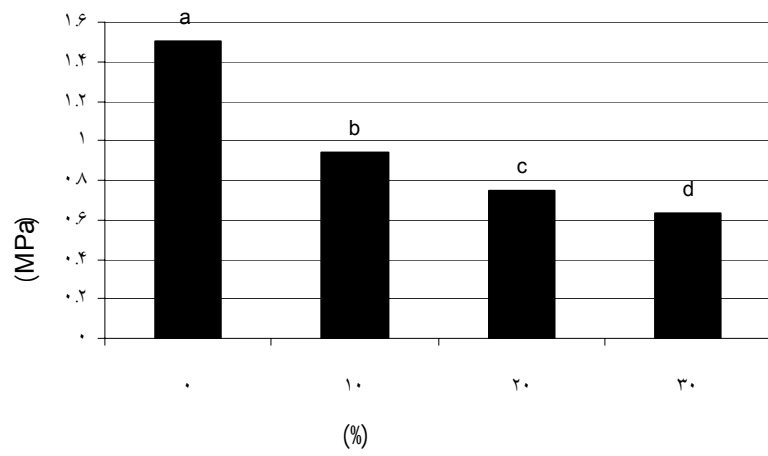
AN

.( )

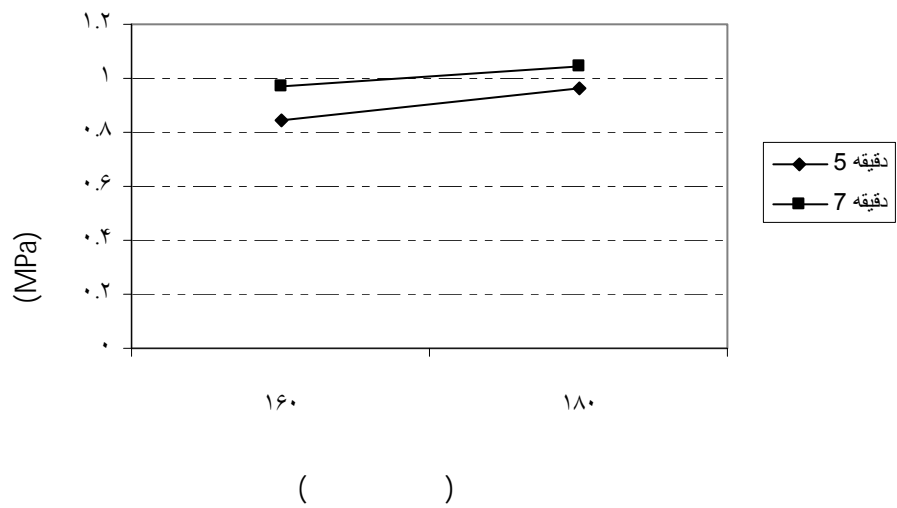


IB

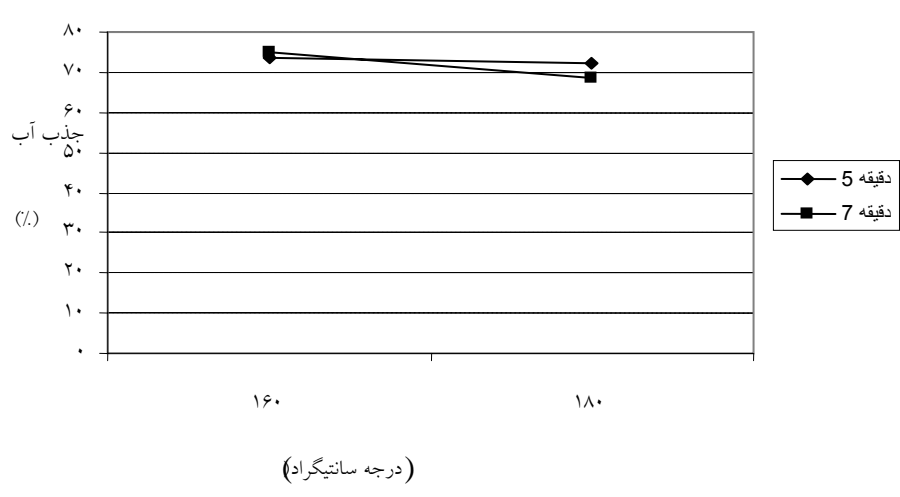
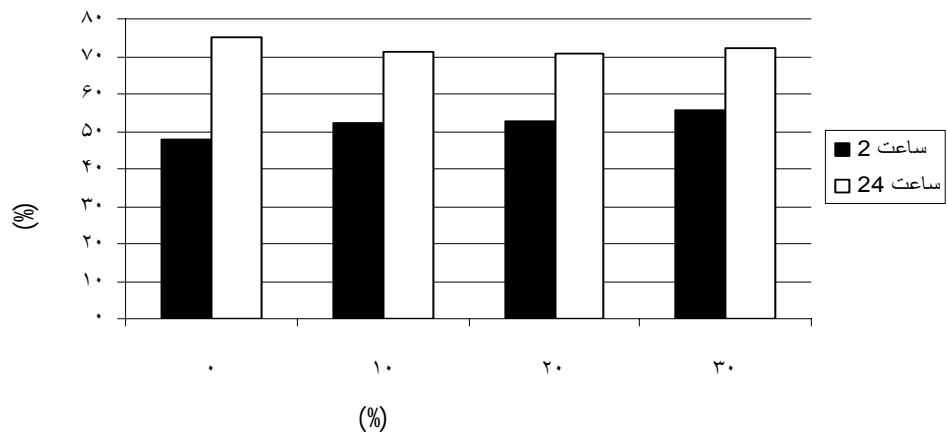
(IB)







Archive of



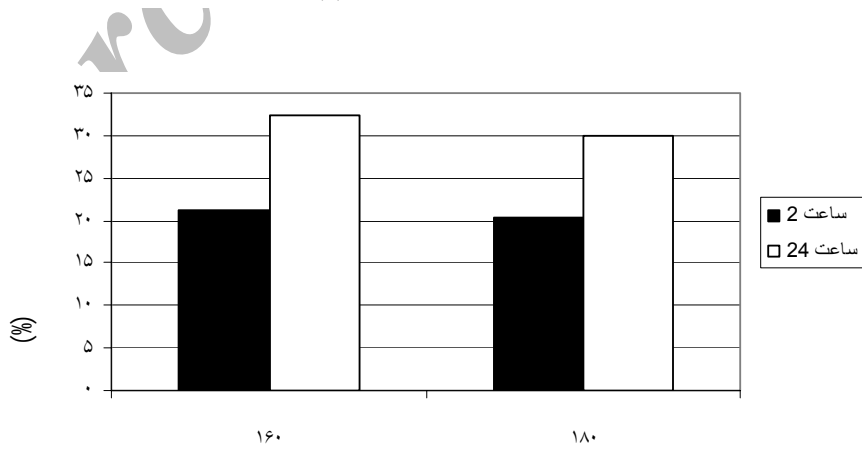
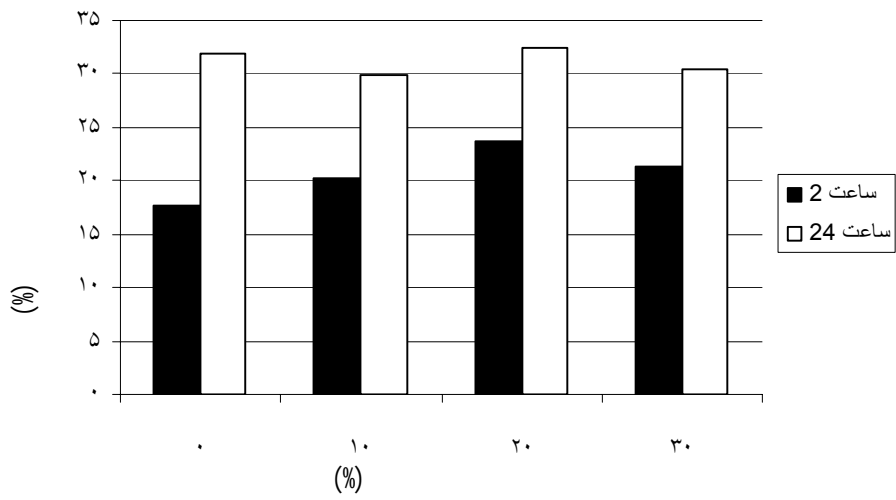
( )

( )

( )

( )

( )



( )

...

:

/ % ,WA24= / %)

(TS24=

( % )

( TS24= / % ,WA24= / %)

MOE)

( % MOR %

)

,MOR= / MPa)

MOE MOR

(

(MOE= MPa

MPa ,MOR= / MPa) DIN EN312-4

(MOE=

%

( ° C )

( ° C )

Archive of SID

(IB= / MPa)

(IB= / MPa)

(% )

(IB= / MPa) DIN EN312-4

( )

- 3- Ellis, S.C., J.N.R. Ruddick & P.R. Steiner, 1993. A feasibility study of composites produced from telephone directory paper, plastics, and other adhesives. *Forest Products Journal*, 43(7/8): 23-26.
- 4- Grigorious, A.H., 2003. Waste paper-wood composites bonded with isocyanate. *Wood Science and Technology*, 37: 79-89.
- 5- Le Fru, X., M. Galhac, M. Zanetti, A. Pizzi, 2004. Recycling melamine-impregnated paper waste as board adhesives. *Holz als Roh-und Werkstoff*, 62(6): 419-423.
- 6- Maloney, T.M. 1993. *Modern particleboard and dry-process fiberboard manufacturing*. Miller Freeman Inc.
- 7- Shyong Hwang, G., E. Chen Wang, Y. Chang Su, 2006. Preparation of composite board using foil-laminated and plastic-laminated liquid packaging paperboard as raw materials. *Wood Science*, 52(3):230-235.
- 8- Clead, W., 1970. Uber die Mitverwendung von alt papier fur die Herstellung von Spanplatten. *Holz als Roh-und Werkstoff*, 26(3): 8-105.

Archive SID

## Utilization of Recycled Banknote in Manufacturing Particle Board

A. A. Enayati<sup>1</sup> and O. Hosseinaei<sup>2</sup>

<sup>1</sup> Associate Prof, Faculty of Natural Resources, University of Tehran, I. R. Iran

<sup>2</sup> Ph. D. Student, Faculty of Natural Resources, University of Tehran, I. R. Iran

(Received 2006 Feb 28, Accepted 2007 March 17)

### Abstract

Utilizing of recycled banknote particles in combination with industrial wood particles in core layer of particleboard was studied. Recycled banknotes were mixed with core wood particles. The amount of added recycled banknote was 10, 20 and 30 percent by dry weight of wood particles. The ratio of core layer to face layer was 70: 30. Urea-formaldehyde was used as binder in manufacturing of boards. The amount of resin was 12 percent in face layer and 10 percent in core layer. Process conditions were as follows: press time, 5 and 7 min; press temperature in both sides, 160 and 180 °C. Physical and mechanical properties of the boards, including modulus of elasticity, modulus of rupture, internal bond, water absorption and thickness swelling were measured. Results indicated that increasing the amount of recycled banknote had a negative effect on the mechanical properties, especially internal bond, of treated boards in comparison to control samples. However, all mechanical properties of the samples were higher than the values recommended by standards. Concerning physical properties (water absorption and thickness swelling), increasing the ration of recycled banknotes reduced water absorption and thickness swelling after 24 hour of soaking. Increasing press time and press temperature improved all the properties studied. Generally, it can be said that recycled banknotes up to 30 be percent may be used in producing particleboard that are suitable for indoor applications.

**Key words:** Old waste banknote, wood particle, Urea-formaldehyde resin, physical properties, mechanical properties