

Study and Evaluation of the Medium Density Fiberboard Made From Old Newspaper

Mohammed Ali Jaber
Polymer Science Centre
Basrah University
Basrah- Iraq
e-mail: msc_basrah@yahoo.com

ABSTRACT

Research includes Technology for the production of medium -density fiber board made from old newspaper and finding the best conditions for the manufacture of the fiber board and the required specifications. was reached methods produced industrially.

The research aims to study was effect of newspaper fiber mixed with cement and polymer blend (poly vinyl estate with MDI) and the press time 10 min on the properties of MDF panels were determined. Physical properties (thickness swelling, water absorption) and mechanical properties (Bending modulus of rupture and compressive strength) of the panels were determined according to the procedure of ASTM standards . This study showed reduction in bending modulus and increased the compressive strength of the panels as cement was loaded from 10 to 40%. Thickness swelling and water absorption of MDF panels was decreased with addition of cement to the panels

1- INTRODUCTION

Environmental pollution resulting from industrial wastes and waste living materials such as newspaper and corrugate paper is one of the biggest problems facing the human race and much concentrated effort is being put into solving this problem on a world wide basis, in advanced and less advanced countries. If these paper wastes could be use to be develop various environmentally friendly composite, not only environmental pollution could be reduced but also a big contribution could be made from the aspect of recycling wastes.

Recycled waste paper boards have the advantages of improved mechanical properties, lighter weight. Another advantage of recycled waste paper board is that it does not require the de-inking of waste paper, and it can be easily recycled, which is a key difference between the waste paper board process and the paper industry. Gypsum boards and ceiling boards are very hard to recycle and are fundamentally weak, but recycled waste paper boards are of relatively low density and have significantly higher strengths than gypsum boards. In addition, not only would such a board be able substitute for gypsum board or ceiling board as an internal finish material, but it could also substitute for medium density fiberboard and particleboard as a raw material for furniture.

Several researchers have succeeded in the recycling and the utilization of waste paper. Deppe manufactured medium density fiberboard made of waste paper and wood fibers using a dry-process, and reported that physical and mechanical properties decreased as waste paper content increased [1]. Ellis et al produced a campsite from phone books and various wastes vinyl products and reported that although the mechanical properties were superior, the dimensional satiability was poor in the composite [2]. Lee and Son manufactured composite boards made of waste papers (coating paper and old newspaper) and various wood-based raw materials (flake, particle, fiber) using a dry-process, and used PMDI,UF- and PF-resins as composite binders. Composite boards were tested and examined for mechanical properties in the fundamental research of waste paper-wood based composite [3]. These researchers, selected waste paper and other wood-based raw materials in a 50/50 mixing ratio [4, 3], however, we selected waste paper (newspaper)only. The mechanical properties of recycled waste paper boards are expected to be inferior to hardboard or medium density fiberboard, but sufficiently superior to insulation board [5] or gypsum board [6]. Stokke and Liang tested a wood based composite produced by mixing waste paper and wood based raw material (flake ,particle ,TMP,wood fiber) at 50:50 ratio and reported that although this board showed the similar bending strength was commercial board, it showed a low internal bonding strength with more than 25% increase in thickness swelling . In order to reduce this thickness swelling, they added foamed polystyrene. Past research has established the production of composite board from waste paper

through a dry process [6, 7, 4, 9, 10], but some additional research upon issues such as improved water resistance, fire redundancy, and others are necessary.

Old newspaper was selected as a raw material in this research. Due to the fact that recycled waste paper board does not require de-inked waste paper as a raw material, and it is easily recycled, thus contributing to the enhanced recycling of waste materials. In addition, because waste papers are bio-degradable, it should reduce secondary environmental pollution and thus reduce overall costs. In the present study, physical and mechanical tests for the waste paper boards were undertaken.

Moreover, we believe that this waste paper board adequately substitutes For gypsum board, ceiling board, and insulation board as an interior finishing material for the construction industry.

2- Material

Old newspaper was used as the raw material. Commercial polyvinyl estate and MDI (were used as a polymer blend by weight ratio (3/1)) as a binder .and Portland cement

3- Raw martial preparation

Waste paper were subjected to cutting bay machine to 1cmx1cm in size , milled in order obtain short fiber

4- Sample preparation

The section describes the processing procedures that were necessary to convert the various fibrous materials into a form that could be used to fabricate MDF type panels.

A known weight of the polymer blend (poly vinyl estate /MDI (3/1 ratio)) was then homogeneously mix with a known weight of Portland cement (water/ cement ratio is equal 0.4) and manually mixed with polymer. The mixing lasted 10 minutes to ensure an even distribution of the polymer in the mixture. Then a known proportion of old paper (newspaper) fiber was added to mix. This mixing was manually done for about 10 minute to obtain homogeneous material. Table (1) shows the mixing of specimens. The mix was poured in a steel mold with inter dimensions of (500*400*15) mm. Each mix is compacted to a known pressure of 0.5 Mpa for 2 min before hot pressing , then the mixture then was hot pressed , to form a composite board at beak pressure of 4.3 Mpascal and temperature of 150 C . Total pressing time was 10 min at thickness of 9 mm.

Table(1) specification of the various mixtures used in the investigations

Mix designation	Polymer blend %	Newspaper fiber %	Cement %
A1	20	80	0
A2	20	70	10
A3	20	60	20
A4	20	50	30
A5	20	40	40

5-Testing

Mechanical and physical property tests were conducted on specimens cut from the experimental panels. Prior to mechanical and physical property testing at room temperature of 23°C, the specimens were conditioned at 50% relative humidity and 20°C. The specimens had minimal exposure to ambient humidity during the time required to complete the testing. Three-point static bending modulus of rupture (MOR) and modulus of elasticity (MOE) and, internal bond strength (IB) tests were performed in conformance with ASTM D1037 using a Universal testing machine (Zwick/Roll CO. Polymer research centre at Basrah university). Thickness swell and water absorption measurements were made by immersing specimens in water in a horizontal position for 24 hours at ambient temperature. This test was performed in conformance with ASTM D 1037.(14)

3-Results and discussion

3-1 Mechanical properties

3-1-1 Bending modulus of rupture and compressive strength.(11,13)

Fig.1. show the three point bending strength (MOR) of the newspaper fiberboard. The MOR showed a decreasing with increasing Portland cement ratio .Fig.2 show the compressive strength (CS) of FIB fiber board where the CS showed increasing with increasing amount of Portland cement. this result can be explained due to the addition of particle of cement are filling the vacancies in the polymer composite matrix witch cause decreases the elasticity of the polymer chains that lead to increasing rigidity of the fabricated fiberboard . A noticeable result is the increasing of the CS and decreasing the MOR

3-2 Physical properties

3-2-1 Density(12)

The results regarding actual densities of the waste paper fiberboard as a function of the cement ratio are presented in Fig.(3) this figure show the decrease the density of fiberboard with decrease the cement ratio that's result from the density of cement particle .

3-2-2 Water absorption and thickness swelling (14)

Figs.(4) and (5) showed the water absorption and thickness swelling for the manufacturing fiber board as a function of the cement ratio , these figs. Show the increasing of water absorption and thickness swelling of these particleboard when decrease the cement particle these result because the addition of cement particle are filling the vacancies in the polymer composite matrix witch cause increasing the water absorption and thickness swelling .

CONCLUSIONS

Bending strength of board, is dependent of ratio of cement added, the bending strength decreased with increased the cement ratio. The compressive strength increased with increased of cement. The physical properties are improved by additive the cement therefore can be used the cement with the (poly vinyl estate and MDI) to improved water absorption and thickness swelling . Based on the findings of this study, it

appears that newspaper can be considered as a potentially suitable raw material for manufacturing MDF products.

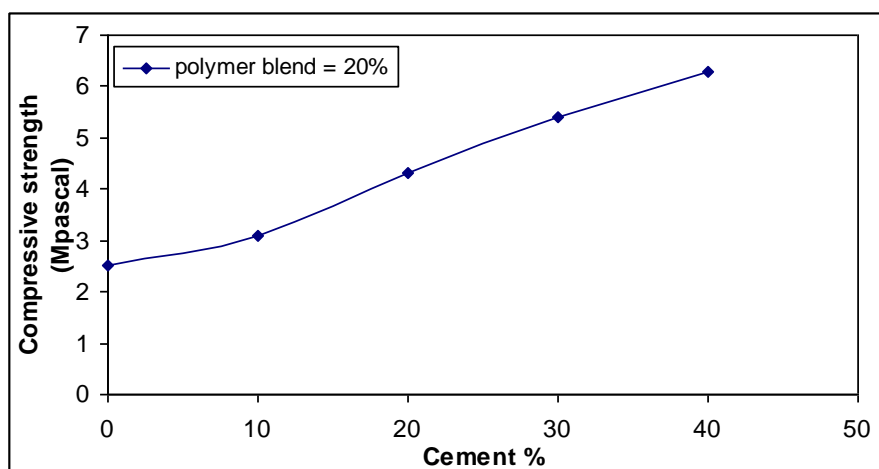


Fig.(1) the effect of cement on the compressive strength

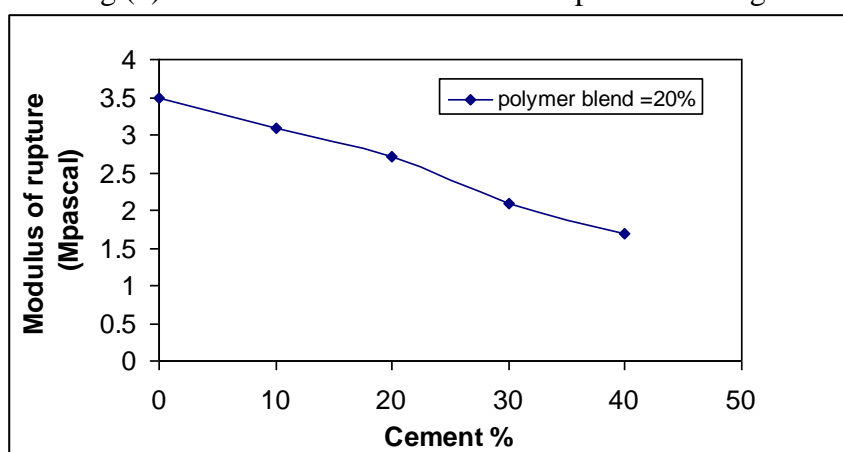


Fig.(2) the effect of cement on the modulus of rupture

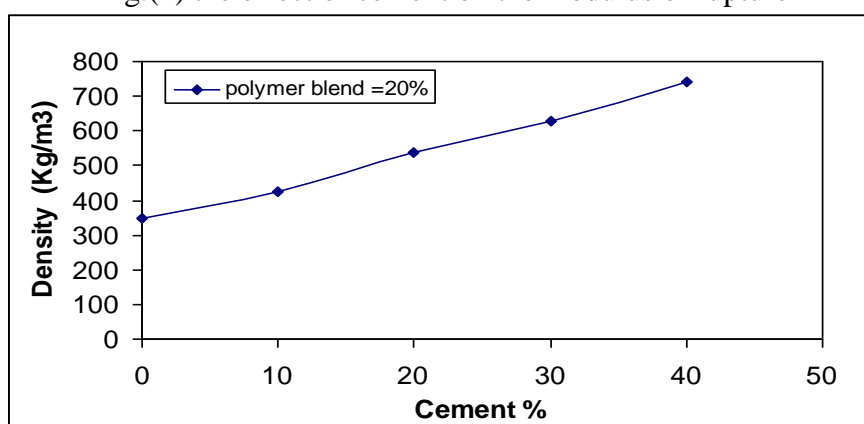


Fig.(3) the effect of cement on the density

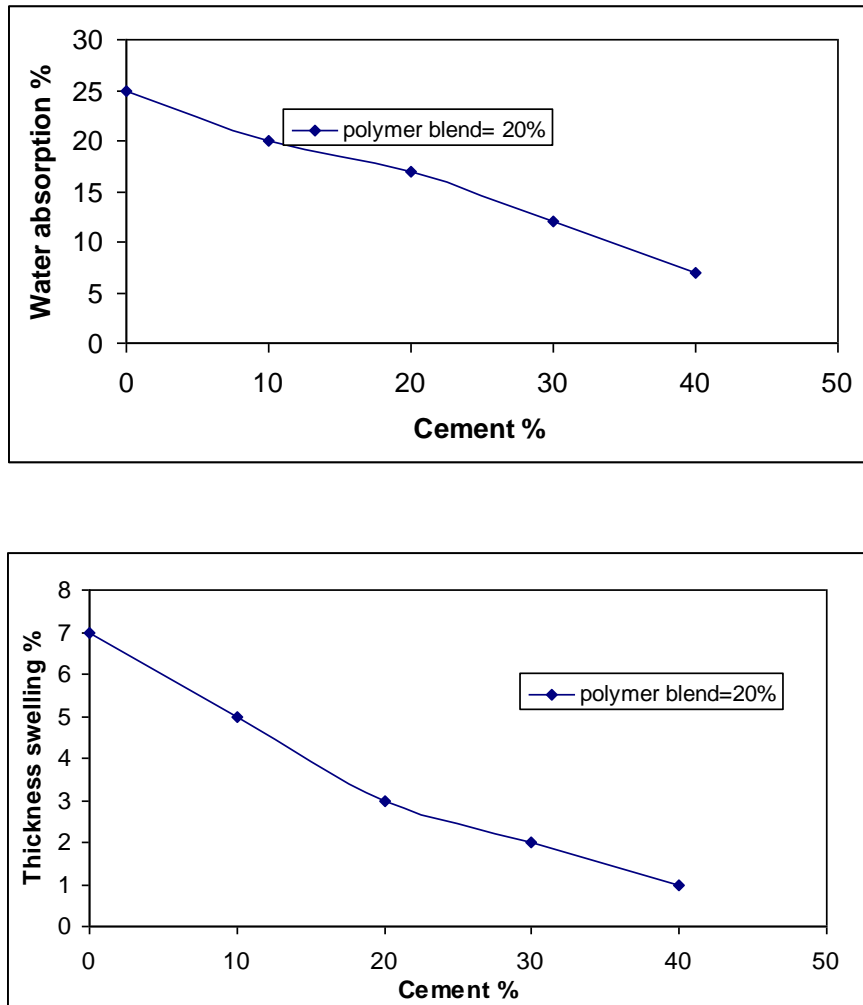


Fig.(5) the effect of cement on the thickness swelling

REFRANCESE

- 1- Deppe, H.J. (1985). The Utilization of Wastepaper and Refuse Fiber Material for Particleboard and MDF. In: Proceedings of 19th International Particleboard Symposium, Maloney, T.M. (ed.), pp. 127–143, Washington State University, Pullman, WA.
- 2- Ellis, s. c., Ruddick, J, N, R.,and Steiner, P.R. 1993. A feasibility study of composite produced from telephone directory paper, plastics, and other adhesives. Forest prod.J.43.
- 3- Lee, P.W. and Son, J.I. (1993). Oxygen Indices of Paper Sludge and Wood Particle Mixed Boards, Seoul Nat'l Univ. J. Agric. Sci., 18(1): 7–12.
- 4 -Lee, P.W. and Son, J.I. (1995). Studies on Manufacturing of Wood Composites from Coating Paper and Old Newspaper – Mechanical Properties of Wood Composites from Coating Paper and Old Newspaper –The Korean Society of Furniture Technology., 6(1/2): 11–19.
- 5- International Organization For Standardization. (1972). Fibre Building Boards – Determination of Bending Strength, ISO 768-1972 (E).
- 6- International Organization For Standardization. (1980). Gypsum Plasterboard – Specification, ISO 6308-1980 (E).
- 7- Krzysik, A.M., Youngquist, J.A., Rowell, R.M., Muehl, J.H., Chow, P. and Shook, S.R. (1993). Feasibility of Using Recycled Newspapers as a Fiber Source for Dry-process Hardboards, Forest Prod. J, 43(7/8): 53–58.
- 8- Laundrie, J.F. and McNatt, J.D. (1975). Dry-formed, Medium Density

Hardboards from Urban Forest Materials, USDA Forest Service Research Paper, FPL 254.

- 9- Okino, E.Y.A., Santana, M.A.E. and de Souza, M.R. (2000). Utilization of Wastepaper to Manufacture Low Density Boards, Bioresource Technology, 73: 77-79. 17.
- 10- Raghupathy, R., Viswanathan, R. and Devadas, C.T. (2002). Quality of Paper. Boards from Arecanut Leaf Sheath, Bioresource Technology, 82: 99-100.

11- ASTM.2000, (Stander test method for compressive strength of lightweight insulating concrete) ASTM C 495-99a, America society for testing and materials.

12 - ASTM.2000 (Stander test method for Determining Density of structural lightweight concrete) ASTM C 567, Society for testing and material.

13- Hakeem. K. Husain M.SC. Thesis(college of Engineering university of basrah (1999

14- American society for Testing and Materials.1999.standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Material . ASTM D 1037-99.

تقييم الخواص الفيزيائية والميكانيكية لالواح الفايرر متوسطة الكثافة مصنعة من ورق الصحف

د.محمد علي جابر

جامعة البصرة

مركز أبحاث البوليمر

Msc_basrah@yahoo.com

الملخص

كان الهدف من هذه الدراسة معرفة إمكانية استخدام ألياف ورق الصحف كمادة خام في صناعة ألواح ليفية متوسطة الكثافة (MDF) حيث يمكن الاستفادة منها في صناعة الاثاث . حيث تم تحديد تأثير ورق الصحف مع خليط الاسمنت والبوليمر (بولي فينيل أستيت و مثلين داي ايزوسيانيات MDI) . وتم تحديد الخواص الفيزيائية (النسبة المئوية لانتفاخ السمك ، والنسبة المئوية لامتناس الماء) والخواص الميكانيكية (مقاومة الانحناء ومقاومة الانضغاط) وفقا للمواصفات الامريكية ASTM . وأظهرت هذه الدراسة انخفاض معامل الانحناء وزيادة مقاومة الانضغاط بزيادة نسبة الاسمنت 10-40 % . ولوحظ انخفاض في النسبة المئوية لانتفاخ السمك والنسبة المئوية لامتناس الماء لالواح MDF المصنعة مع اضافة الاسمنت . استنادا إلى نتائج هذه الدراسة ، فإنه يمكن اعتبار تلك الصحف القديمة كمادة خام وتكون مناسبة لمنتجات الصناعات التحويلية لصناعة الواح الاثاث متوسطة الكثافة .