Improved Mechanical Properties of New Melamine Prepared Resins

Saja S. Jabbar Al-Taweel Haider A. Jamel Laith S. Jassim

College of Science *College of Education* *College of Education*

University of Al – Qadissia

(NJC)

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Abstract

The melamine resin has a good chemical properties against alcoholic and water solutions but it has a very long time of reaction and curing. The period of reaction by could be rapid the reaction between urea – melamine to improve the functionality and adhesion then improve the mechanical property of melamine resin only .

Five mass ratios of urea to melamine (U:M) and melamine to formaldehyde (M:F) were prepared as (2:50,4:50,6:50,8:50,10:50) (1:9,2:8,3:7,4:6,5:5) gm/gm at different operation conditions of temperature (20-110^{o}C), mass ratio (1-10) , and time of reaction (1-3 hrs). by using a design reaction system of nitrogen and reflux. The drying system was applied to the prepared adhesives and then check the optimum conditions of preparation on the testing properties .

The results indicated that optimum mass ratio which gave an optimum mechanical properties is 6:50 (U:M) , and 3:7 (M:F). The impact load is 9 J/cm for (U:M) and 12 J/cm (M:F), compression load is 0.5 kN/Cm (M:U), 0.8 kN/Cm (M:F), tensile load 42 dyne /cm (M:U) and 97 dyne /cm (M:F),and bending load of 2.3 mm and 2.2 mm for (M:U) and respectively (M:F).

الخلاصة

إن لاصق الميلامين يمتلك خواص كيمياوية جيدة ضد المحاليل الكحولية والرطوبـة لكـن يمتلك زمن إنضاج طويل فمن الممكن تحضيره وتدعيم التفاعل بين اليوريا والميلامـين مـن اجـل تحسين الربط والالتصاق وفيما بعد تحسين الخواص الميكانيكية للاصق الميلامين.

تم في هذا البحث تطبيق خمس خلطات وزنيه مـن اليوريـا إلـى الميلامـين (U:M) (2:50 ، 4:50، 6:50، 8:50، 10:50) وخمس خلطات وزنية من الميلامين الى الفورمالديهايـد (M:F)(1:9,2:8,3:7,4:6,5:5) عند ظروف تشغيلية مختلفة للتحضير مثل درجة الحرارة (110^oC) وزمن تفاعل (1hr- 3) وذلك باستخدام منظومة تفاعل مصممة لهذا الغرض. تم تطبيق نظام تجفيف خاص لهذه اللواصق المحضرة ثم يتبع ذلك التأكد من مثالية الظروف المـستخدمة علـى الخـواص المحسنة حيث أثبتت النتائج إن الخواص الميكانيكية للخلطة(6:50) (U:M) و(3:7)(M:F) تمتلك خـ ـواص متتاليـ ـة لخـ ـواص الـ ـصدمة(M:F)(12J/cm) ،خـ ـواص الانـ ـضغاط عنـ ـد(M:U)(0.5kN/cm)،(M:F)(0.8kN/cm)، خـ ـواص الـ ـشد (M:U)(42dyne/Cm) و(M:F)(97dyne/cm) ومعامل انحناء عند (2.3mm) لـ (M:U) و (2.2mm) لـ (M:F).

Introduction

Industrial adhesive containing melamine–formaldehyde (MF) and urea -formaldehyde (UF) cross linking have been used for over fifty years where this types of adhesive are provided in liquid or and are composed of monomeric and oligomeric species containing reactive functionality including amino , methylol , and alkoxy species , to form a three dimensional polymer adhesive films (1-4). Vaughn and co-workers (5) have evaluated a new commercially MF and verified its enhanced reactivity and lower temperture cure response, other workers (6) try to design a reaction mixture of melamine and additive to give rapid low temperture cross linking by the using alcoholic such as methanol , ethanol , and butanol (6). Developed producible water soluble resin of melamine–formaldehyde through four steps of hydroxymethyllation, low PH condensation and high PH rearrangement reaction (7) Mark was improved the adhesion between the fibers (whether they are wet or dry) by using the excess of formaldehyde to melamine with about 3 mole F/1 mole M where 2 mole bound into colloid and 1 mole free .On the other hand pick Study the application of both urea and formaldehyde with melamine in molded structure.

The properties of urea-melamine of thermoset structure give unique combination of molded properties which are un matched by any other plastic raw material in the same price range making it ideal for wide range of application practically in domestic field

(1-3) .A new development melamine resin to resistance water by the addition of urea resin (4) others are used urea to improve the flexural strength of melamine and other mechanical properties (5) .The reaction between melamine and urea is (6) :

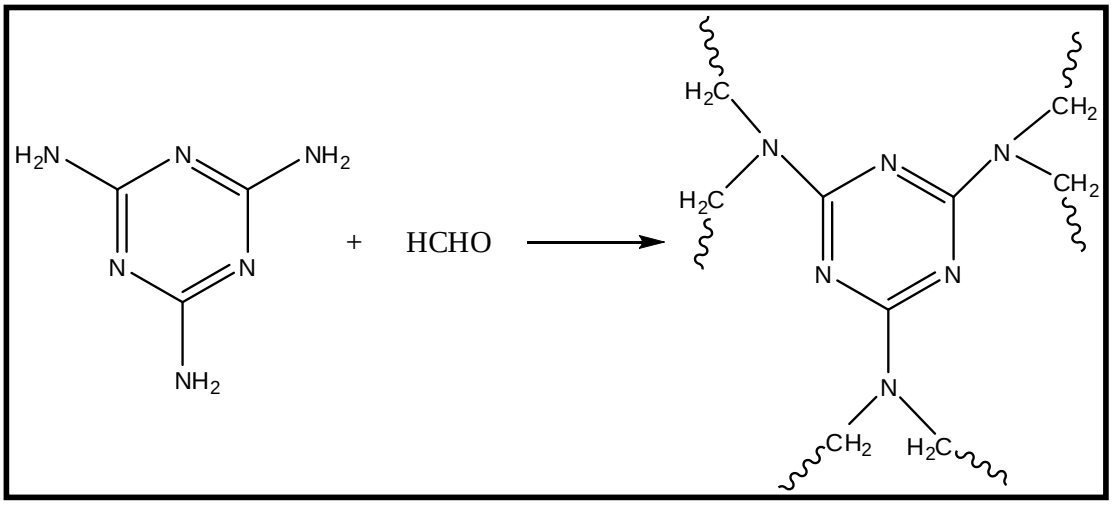


Figure: A

The Aim of Present Work:

The aim of this to improve the chemical and mechanical properties of melamine resin by the use of Urea, formaldehyde and other very cheep additive material.

Experimental Part:

Materials:

1. Melamine of white standard grade general powder supplied by BDH Company.
2. Flower (commercially).
3. Urea (Industrial).
4. Formaldehyde liquid (37%) concentration.
5. Wood available (cut pieces) at a specified dimensions.

Procedure:

The raw materials are applied to a design section system of (1L) three neck end with reflux and under inert ambient by nitrogen flow rate where the basis of adhesive such as urea and melamine was reacted as the reaction indicated in theoretical section (fig A).

Five mass ratio of mixing applied to the reaction system continuous stirred tank reactor (CSTR) until the temperature of reaction reach (110ºC) let stay for (1: 5) half hours then applied the very cheep additive hardener of flower and other material to quick solidified the

produced adhesive film between two sheets of wood , then this film joints cured at (150ºC) for (1 hr) in order to cured the crosslink adhesives by heat , where table (1) indicate the experiments mixtures applied to the plywood joints.

Table (1): Experimental mixtures used in this work

No. of Exp.	Melamine (g) 1 2	Formaldehyde(g) 2	Urea(g) 1	Ratio F/M	Ratio U/M
1	50:9	1	2	1:9	2:50
2	50:8	2	4	2:8	4:50
3	50:7	3	6	3:7	6:50
4	50:6	4	8	4:6	8:50
5	50:5	5	10	5:5	10:50

Properties:

1. Mechanical properties :

The mechanical properties of Impact, Bending, Tensile and Compression were applied to the prepared specimen according to the procedure of ASTM :

(i). Impact Test:

By charpy impact tester according to (ISo-179).

(ii). Bending Test:

By applied three points bending test, due to (ASTM-D790).

(iii). Tensile Test:

By Zweigle tester due to (D-560) ASTM.

(iv). Compression Test:

By Hydraulic piston type due to slandered (ASTM-D695).

2. Chemical Properties:

To check the chemical resistance of above adhesive, the resistance to moisture and chemical solutions were applied (8, 9).

3. Procedure:

It could notice the below term:

A. use clean wood sheet in order to adjust the functionality occurred.

B. Good stirring for reaction mixture in order to homogenate the reaction.

C. enough time for reaction and crosslinking of structure.

Results and Discussion:

Mechanical - adhesion properties:

A. Impact Test (J/cm):

Figure (1) show the effect of urea resin on the impact load of new melamine prepared film, the impact load resistance increased with increasing the amount of urea used and the melamine bonding reason (M:U). This may be attributed to the reason indicated by the reason indicated by Skeist (10).

Figure (2) indicates that the resistance to impact load is increased with increasing the additive of melamine bonding resin until reach optimum mixing value at 3:7 (M:F) (12 J/cm) the continuous addition of melamine bound into collide adhesive film, increase the functionality between adhesive and wood sheets (8).

B. Bending Test (mm):

Figure (3) shows the relation between resistance to distortion load and amount of melamine bonding resin and this relation stated that the distortion is increased with increasing amount of the melamine bonding resin until reach 6:50 (2.3mm) (M:U) then it failur due to reason stated by Skeist (10).

Figure (4) indicated that the resistance to distortion is increased with increasing additive of melamine bonding resin until reach optimum value at 3:7 (M:F) (2.2mm) and this agreement with the result obtained (8).

C. Tensile Test dyne/cm:

Figure (5) stated the effect of melamine bonding resin on the distortion load of tensile , the resistance is decreased with increasing melamine bonding resin until reach the value of 42 dyne/cm then it increased this may be sharply due to reason indicated by Skiest (10).

Figure (6) shows the relation between weight ratio of melamine bonding resin and resistance to distortion load , where the resistance to distortion is increased with increasing of melamine bonding resin until reach the optimum value (97 dyne/cm) at 3:7 (M:F) this may be attributed to the reasons indicated (8).

D. Compression Test KN/cm:

Figure (7) shows the effect of melamine bonding resin on the compressed load applied, the resistance is increased with increasing the melamine bonding resin until reach optimum value at 0.5 KN/cm. This relation is increased due to the reason above (10).

Figure (8) stated the relation between melamine bonding resin and the compressed load, the resistance is increased with increasing melamine bonding resin until reach the optimum value (0.8kN/cm) at 3:7 (M:F) then continuous to increase with increasing additive ratio, this may be due to reason indicated (8).

Conclusion:

1. The adhesive film 6:50 (M:U) have optimum mechanical properties.
2. The Newer adhesives are cheep and have a good mechanical properties.

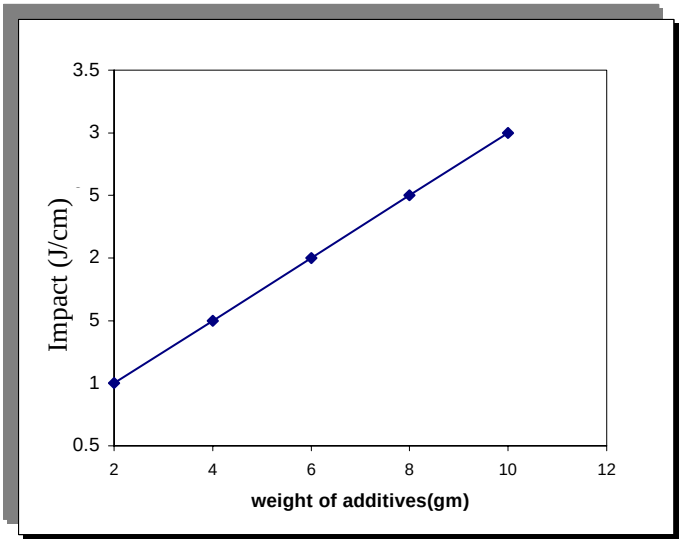


Figure (1): Additive of (M:U)

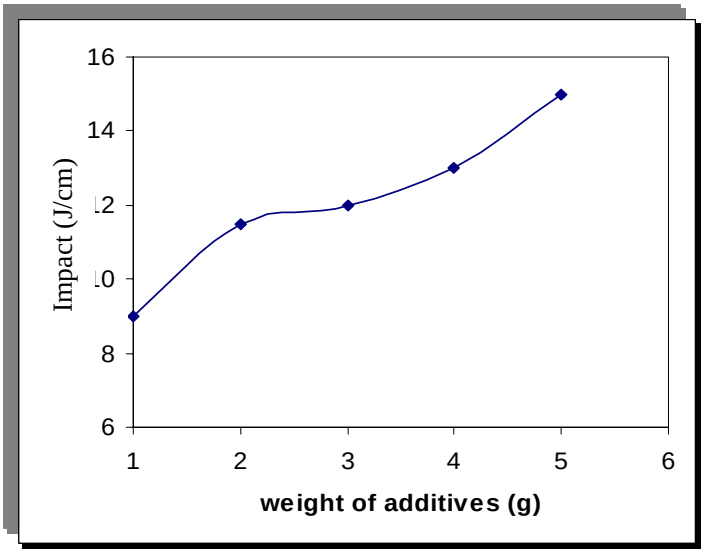


Figure (2): Additive of (M:F)

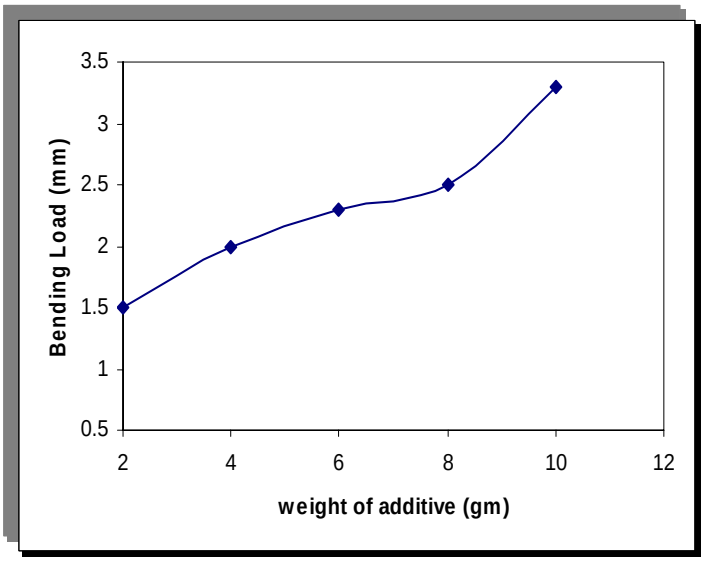


Figure (3): Additive of (M:U)

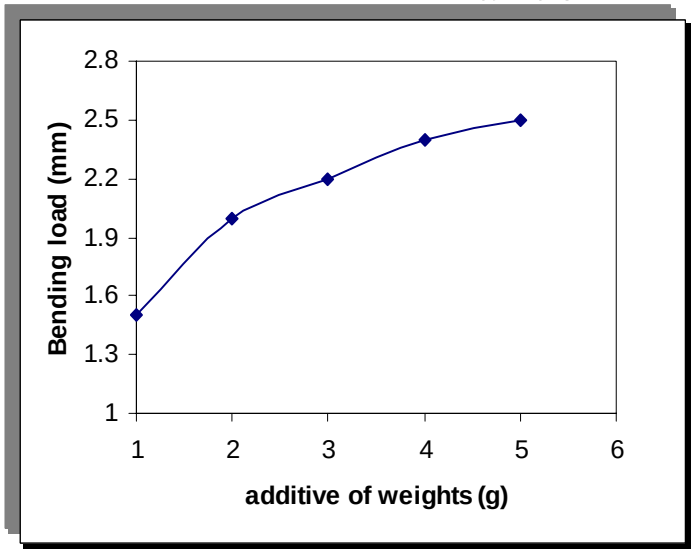


Figure (4): Additive of (M:F)

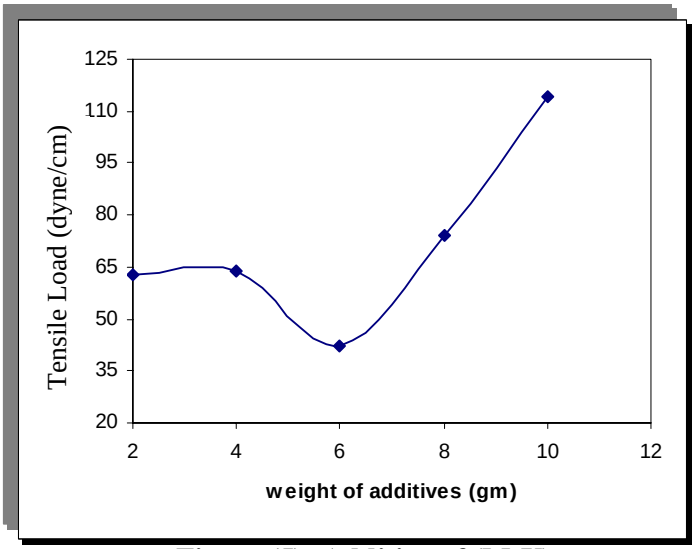
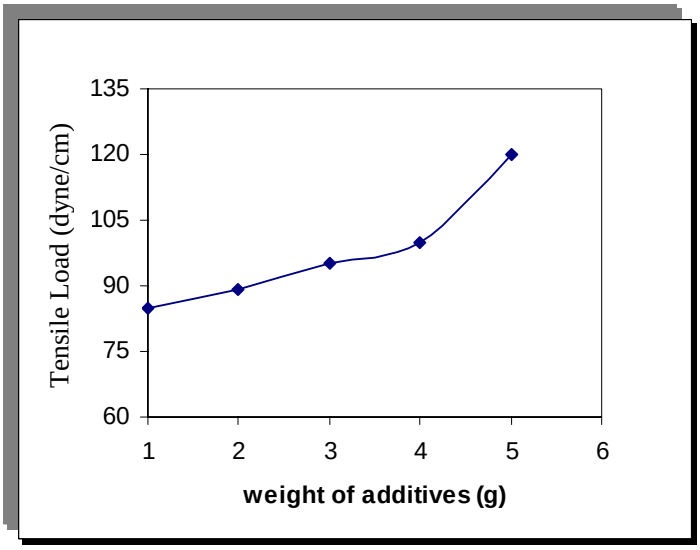


Figure (5): Additive of (M:U)



gure (6): Additive of (M:F)

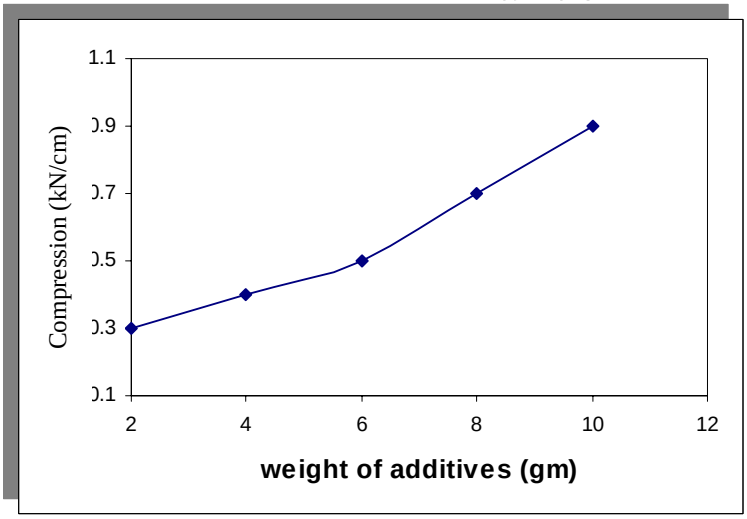


Figure (7): Additive of (M:U)

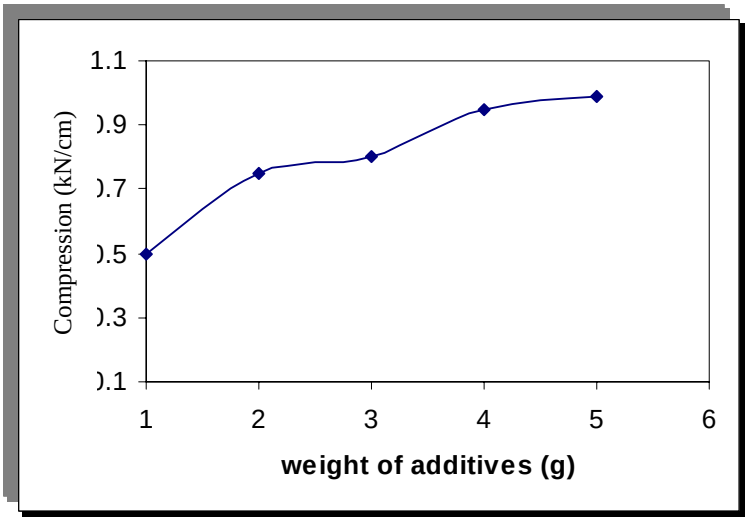


Figure (8): Additive of (M:F)

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