



***EFFECT OF AMINE COMPOUND-POST TREATMENTS ON  
FORMALDEHYDE EMISSION AND PROPERTIES OF UREA  
FORMALDEHYDE (UF) - BONDED PARTICLEBOARD***

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**By**

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the Degree of Bachelor Wood Science Technology  
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## DEDICATION

Specially thanks to my beloved parents, family, supervisor and examiner, to my fellow friends, for their helping hands, support and guidance to me.

May Allah always bless us

Thank you everyone



## ABSTRACT

One of the drawbacks of using urea formaldehyde bonded particleboard is the formaldehyde emission. There are many attempts in reducing the FE from urea formaldehyde bonded particleboard by modifying the urea and formaldehyde formulation but this system would give a negative impact to the performance of the board. The aim of this study was to determine the effect of amine compound-post treatment on formaldehyde emission and properties of UF-bonded particleboard. UF-bonded particleboard was treated with solution of amine compounds at different rates of spread on the surfaces of the boards. The results show that spreading of at 20 g/m<sup>2</sup> propylamine can reduce FE to below 0.4 mg/L and this system surpassed the standard F\*\*\* limit which is < 0.5 mg/L. Ethylamine and methylamine with a spread rate of 20 – 60 g/m<sup>2</sup> were also found to reduce FE and the FE was lower than the untreated particleboard. It was also found that this treatment system did not significantly affect physical and mechanical properties of the particleboard.

## ABSTRAK

Salah satu kelemahan menggunakan urea formaldehid(UF) partikel terikat adalah pelepasan formaldehid (PF). Terdapat banyak percubaan dalam mengurangkan PF dari urea formaldehid (UF)partikel terikat dengan mengubah formula urea dan formaldehid dan tetapi sistem ini akan memberikan kesan negatif kepada prestasi papan. Tujuan kajian ini adalah untuk menentukan kesan sebatian amina rawatan selepas pada PF dan sifat rekatan UF papan partikal. Papan partikal ikatan UF telah dirawat dengan sebatian kompaun amina pada kadar yang berbeza pada permukaan papan. Keputusan menunjukkan bahawa penyebaran pada 20 g/m<sup>2</sup> propylamina boleh mengurangkan FE dibawah 0.4 mg/L dan system ini melebihi standard F \*\*\* had dimana < 0.5 mg/L. Etilamina dan methylamina dengan kadar penyebaran 20-60 g/m<sup>2</sup> juga didapati mengurangkan PF dan mengurangkan lebih rendah daripada partikel yang tidak dirawat. Ia juga mendapati bahawa sistem rawatan ini tidak memberi kesan sifat-sifat fizikal dan mekanikal partikel.

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## APPROVAL SHEET

I certify that this research project entitles “**Effect of Amine Compound – Post Treatments on Formaldehyde Emission (FE) and Properties of Urea Formaldehyde (UF)-Bonded Particleboard**” by **Nurul Izfahani binti Muhammad** has been examined and approval as a partial fulfillment of the requirements for the Degree of Bachelor of Wood Science Technology in the Faculty of Forestry, University Putra Malaysia.

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## LIST OF ABBREVIATION

AC	Amine Compound
ANOVA	Analysis of Variance
CPSC	Consumer Product Safety Commission
FCS	Formaldehyde calibration solution
FE	Formaldehyde Emission
FS	Formaldehyde Scavenger
IARC	International Agency for Research on Cancer
IB	Internal Bonding
JIS	Japanese International Standard
MC	Moisture Content
MDF	Medium Density Fiberboard
MOE	Modulus of Elasticity
MOR	Modulus of Rupture
PB	Particleboard
PF	Phenol Formaldehyde
SB	Static Bending
SR	Spread rate
TS	Thickness Swelling
UF	Urea Formaldehyde
VOC	Volatile Organic Compound
WA	Water absorption

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background of Study

Rubber wood (*Hevea brasiliensis*) particleboard is a popular wood based panel in Malaysia because of its availability and in abundant supply of raw materials. Rubber wood has good overall woodworking and machining qualities (Roslinda, 2013). The strength and mechanical properties makes it suitable for making furniture (Hong, 1995).

However, it is prone to attacks by fungi and wood borers in green and dry condition (Ho, 1999). The furniture industry has been expanding of late due to demand from European and Japanese markets (Freitag, 2007). Rubber wood has new widely utilized in the manufacturing of furniture and conventional composite products such as particleboard, medium density fiber board (MDF) and cement bonded particles (Zaidon, et al., 2007).

Particleboard is made of wood particles with 100 percent from waste or recycled materials that came from tiny wood chunks and sawdust that usually residues from sawmill and lumber yards. Among the end products of particleboard are for furniture, cabinetry and wall paneling. However, particleboard is not a green product because it utilizes resin to bind the wood fibers to form board. Composite wood based panel is still subject of controversy that cause hazard to

human health and environment. Adhesive that commonly used for fabricating particleboard is urea formaldehyde (UF). UF is not a moisture resistance and is meant only for indoor applications. In addition, UF is a resin which was prepared with formaldehyde.

However, the drawback of using this resin is its FE due to the hydrolysis of weak chemical bonds during board production and lifetime use (Costa, 2012).

The utilization of UF resin has been overwhelmed by some undesirable particleboard properties. Significant amount of formaldehyde will also be emitted from particleboard bonded with UF resin. As a consequence, high level of formaldehyde exposure (above 0.1 parts per million of air) can cause watery eyes, burning sensations in the eyes, nose and throat, nausea, coughing, chest tightness, wheezing, skin rashes and allergic reactions. In response to that, formaldehyde has been classified as a known carcinogen by the state of California (prop 65) and the International Agency for Research on Cancer (IARC).

It is necessity that for future research which, a modification of the existing UF resin or a new binder system which has low FE need to be explored. Scavenger or called formaldehyde catcher is one of the potential methods to reduce formaldehyde emission. The use of scavengers, such as natural or bio-based scavengers (Eom et al., 2006 ;Kim, 2009 ;Kim et al., 2006) or other compounds with good

affinity to capture formaldehyde (Boran et al., 2011; Costa et al., 2012b; Park et al., 2008), to reduce formaldehyde emission from wood-based panels is commonly adopted.

Many researches have been carried out to formulate new UF resin system by manipulating urea to formaldehyde ratio or incorporation formaldehyde scavenger in the resin system to lower down the formaldehyde emission from particleboard. These treatment systems have successfully reduce FE of particleboard, however at the same time adversely affect some of the properties. In this study, attempt was made to carry out post-treatment with amine compounds by applying on the surface of the fabricated boards in order to reduce FE.

Thus, these treatment system are expected can reduce FE of the particleboard and at the same time will not affect the performance of the particleboard.

## **1.2 Problem statement**

Last few decades, formaldehyde emission became issues in wood based panel. Formaldehyde became a concern because high levels which is 0.1 parts per million (ppm) of air transmitted into the air space that lead to the danger impacts towards human and environment too. In Malaysia, most of them aware about these problems that cause people started to worry.

This situation leads to the formaldehyde awareness by the public and the producer also. Formaldehyde emission released in air will cause a pollution and health infection to the environment and human as well. Their exposure may potentially cause a variety of symptoms and adverse health effects, such as eye, nose, throat, and skin irritation, coughing, wheezing, and allergic reactions. In long term exposure until high levels of formaldehyde can contribute with cancer in humans.

It can affect people differently which some people very sensitive to formaldehyde at a certain level while others may not have any noticeable reaction to the same level Consumer Product Safety Commission (CPSC). Formaldehyde is said to be one of several gases present indoors that cause to health effects and illnesses. Other gases such as respiratory illnesses (e.g. Colds and flu) can cause similar symptoms to those caused by formaldehyde emission. The emission of formaldehyde is comes from the base of resin formulation which contain formaldehyde base. For the wood composite, especially particleboard which gives high formaldehyde emission. Emissions from particleboard made with it are so low that some green rating systems give points to home builders who use it. (Katherine, 2008). While resin is used as binder agent between the particles to give structural strength of the board. So, formaldehyde emitted in substantial amounts when particleboard manufactured with aminoplast resin. The industry has resisted this for cost reasons. It continues to use urea formaldehyde resins, even though these



account for all the formaldehyde emissions problems associated with particleboard. These cost half as much as phenol resins (Katherine, 2008).

Some persons have developed allergic reactions, asthmatic reactions and skin rashes from skin contact with solutions of formaldehyde or durable-press clothing containing formaldehyde. Formaldehyde is normally present at low levels, usually less than 0.03 parts per million (ppm), in both outdoor and indoor air. The outdoor air in rural areas has lower concentrations while urban areas have higher concentrations (due to sources such as automobile exhaust).

Residences or offices that contain products that release formaldehyde into the air can have levels greater than 0.03 ppm. Presently, way to justification the problems occur by the formaldehyde emission being observe and researching. Among the method helps in making the recovery toward the problems through post treatment method to help in reducing FE by scavenging formaldehyde before it released to the surrounding.

### 1.3 Objective

The objectives of this study were:

1. To evaluate the effectiveness of amine compound post-treatments in reducing the formaldehyde emission (FE) from UF-bonded particleboard.
2. To assess any significant change in the properties of the post-treated particleboard.



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