THE EFFECT OF TANNIN RATIO AND pH ON THE PHYSICAL PROPERTIES OF EUCALYPTUS TANNIN PHENOL FORMALDEHYDE (ETPF)

NOR AMANINA BINTI BAHRUM

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Especially dedicated to

My beloved parents

"Bahrum bin Salleh and Hasnah Binti Mat Jusoh"

sisters and family,

Maziyati Binti Bahrum

And

Special dedication for this four years to Nurul Syafika Hazwani binti Darsani, Nurul Najihah binti Abd Manaf, Noor Fatien Shahieda binti Md Sabri and Siti Hajar Hisamuddin and all my beloved classmates and others friends.

ABSTRACT

The current increase oil prices has intensified the efforts to seek for renewable resources to be converted into biopolymers .Tannin can alternatively replace phenol (partial or full substitution) in adhesive. Because of their polyphenolic structure tannins have a range of actual and potential uses. This study evaluates the properties of tannin from Eucalyptus tree bark for adhesive application. The results show that Eucalyptus tannin has suitable properties for adhesive: pH 13.2; gel time 23.3 min ; and viscosity 45.6 cP. The effect of the tannin content on the bonding properties of the Eucalyptus tannin phenol formaldehyde (ETPF). Subsequently for the bonding properties, phenol formaldehyde (PF) and ETPF 3-layer plywood boards were fabricated from mixed light hardwood (MLHW) veneers. The veneers were spread with the adhesive at 200 g/m^2 single glue line. Veneers with tannin phenol formaldehyde resin were assembled and hot pressed at 130 ℃ for 7 min. The controls PF resin assembled were pressed at 140˚C for 6 min. The testing procedure based on BS EN 314 in order to proof the bonding quality by means of shear strength. The results of the shear test showed that the plywood bonded with ETPF met the requirement the EN 314 standard higher than 1.0 Mpa. It was conclude that Eucalyptus tannin can be used as partial replacement for PF adhesive.

ABSTRAK

Peningkatan pada masa sekarang harga petroleum telah menyebabkan penumpuan di dalam pencarian sumber boleh diperbaharui bagi penghasilan biopolymer.Tanin alternative boleh menggantikan fenol (penggantian sebahagian atau penuh) dalam pelekat.Oleh kerana tanin struktur polifenolik mereka mempunyai pelbagai kegunaan sebenar dan berpotensi.Kajian ini menilai sifat-sifat tanin dari kulit kayu Eucalyptus untuk permohonan pelekat.Keputusan menunjukkan bahawa Eucalyptus tanin mempunyai ciri-ciri yang sesuai untuk pelekat : pH 13.2; masa mengeras 23.3 min ; dan kelikatan 45.6 cP. Selepas itu untuk sifat ikatan, veneer telah dihasilkan menjadi papan lapis 3 lapis; Contoh papan lapis adalah veneer yang tersebar dengan pelekat pada garis gam tunggal 200 g/m^2. Veneer dengan tanin phenol resin formaldehida dipasang dan panas ditekan pada 130 ℃ selama 7 minit. Kawalan resin PF yang dipasang ditekan pada 140˚C selama 6 minit. Prosedur ujian berdasarkan BS EN 314 untuk membuktikan kualiti ikatan dengan kekuatan ricih. Keputusan ujian ricih menunjukkan bahawa papan lapis yang terikat dengan ETPF memenuhi keperluan standard EN 314 yang lebih tinggi daripada 1.0 Mpa.

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APPROVAL SHEET

I certify that this research project report entitled "**The effect of tannin ratio and pH on the physical properties of Eucalyptus Tannin Phenol Formaldehyde (ETPF)"** by Nor Amanina Binti Bahrum has been examined and approved as a partial fulfilment of the requirements for the Degree of Bachelor of Wood Science Technology in the Faculty of Forestry, Universiti Putra Malaysia.

Approved by:

_____

Prof Dr.Paridah Md Tahir
Faculty of Forestry
Universiti Putra Malysia
(Supervisor)

_____

Prof Dr. Mohamed Zakaria Hussin
Dean
Faculty of Forestry
Universiti Putra Malaysia

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TABLE OF CONTENT

LIST OF TABLES

PAGES

LIST OF FIGURES

LIST OF ABREREVIATION

%	percent
ANOVA	Analysis of Variance
g	gram
INTROP	Institute of Tropical Forestry and Forest Products
LSD	Least Significant Difference
Na_2CO_3	Sodium carbonate
Na_2SO_3	Sodium sulphite
PF	phenol-formaldehyde
SAS	Statistical Analysis System
w/w	weight/weight

INTRODUCTION

1.1 Background

Eucalyptus is a diverse genus of flowering trees and shrubs from family of Myrtaceae. It is a members of the genus dominate the tree flora of Australia, and include the tallest known flowering plant on Earth (Onifade, 2010). It has about 600 species based largely on their bark characteristics. According to (Hussein, 2010), there is a large plantation in Africa, Kaduna State. Nigeria has also recorded the best yield of eucalyptus trees in Africa.

Eucalyptus trees are essentially utilized as fuels, as timber in construction and poles for electricity and telecommunication transmission line .These primary uses have made them important component of third world economies. Eucalyptus tree are essentially used as essential oil for making ornamentals (Onifade, 2010). It is also the main wood species for pulp and paper industry. Most of these industry generates bark as residues. If these tannin rich barks can be processed to recover the tannin, the pulp and paper mills would be more efficient and eco-environmental friendly.

Tannin (or tannoid) is an astringent, polyphenolic biomolecule that binds to and precipitates proteins and various other organic compounds including amino acids and alkaloids. Tannin can be obtained in the bark, wood, leaf or fruits of plant. Tannins are usually subdivided into two groups which is hydrolysable tannin and condensed tannin. Hydrolyzable tannin-derived from simple phenolic acid like gallic acid or ellagic acid and when heated they give away pyrogallol. When out in the open air hydrolysable tannin changes to brownish colour.

Hydrolysed by mild acids/mid bases to yield carbohydrates and phenolic acids. Under the same condition condensed tannin do not hydrolysed. It also hydrolysed by hot water or enzymes. Condensed tannins are soluble in water and alcohol, they do not dissolve in organic solutions-when reacted with nitrogenous bases, polysaccharide, some alkaloids, few glycosides and protein all tannins form precipitate (Barbosa *et al*.,2009).

Extraction of Eucalyptus tannin to obtain a phenolic-rich extract for application in the leather industry, application in the leather tanning industry. The final extracts showed leather retanning aptitude equivalent to a commercial extract of chestnut and revealed good performance in the production of leather articles like box-calf and nubuck (Paula, 2013).

Due to the phenolic structure, tannin can be used as are placement of phenol for adhesive formulation. The substitutes of phenol with tannins in wood adhesive formulations has been done worldwide. Countries that have carried out research on adhesive formulations are Australia, South Africa, Korea, Europe and North America. These natural based polyphenolic resources have huge potential market for wood based industries worldwide (Hoong *et al*., 2010).

1.2 STATEMENT OF PROBLEMS AND JUSTIFICATION

In most of wood processing mills, Eucalyptus bark is categorised as a waste material. As reported by (Hassan *et al*. 2009), Eucalyptus bark can be processed into tannin powder for

adhesive application. However, substitution of tannin into phenol formaldehyde resin is relatively difficult particularly in controlling its viscosity. Hassan *et al*. (2009) associated this behaviour to the pH of the tannin. They found that viscosity is affected by the pH found that at alkali pH the viscosity became very high that cause difficulty in application. Tannin has pH ranging from 5 to 7, whereas phenol formaldehyde has pH between 11-12.As reported by earlier studies, at an alkaline pH the viscosity of the tannin became very high, thus causing the problem during adhesive formulating **(**Fontain et al., 2008).

In this study, Eucalyptus tannin was extracted and formulated in phenol formaldehyde at different pH value. Phenol formaldehyde have gained a wide acceptance because of their strength properties and weather resistance properties. Nevertheless, due to the high price of the petroleum based phenol, other alternatives should be sought for. One of alternative, is by using tannin to produce tannin phenol formaldehyde.

1.3 OBJECTIVE

1. To determine the effect of pH and tannin content on the physical properties of the Eucalyptus tannin phenol formaldehyde (ETPF).
2. To determine the effect of pH and the tannin content on the bonding properties of the Eucalyptus tannin phenol formaldehyde (ETPF).

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