



***EFFECT OF NAOH CONCENTRATION IN ALKALINE SULFITE
ANTHRAQUINONE AND METHANOL PULPING ON BULUH MADU***

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BY

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For the Degree of Bachelor of Wood Science and Technology in the
Faculty of Forestry
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ABSTRACT

The objective of this study was to determine the effect of pulp and paper properties of Buluh Madu using alkaline sulfite anthraquinone and methanol (ASAM) pulping at different NaOH concentration. Bamboo chips were cooked at three different levels of sodium hydroxide, namely 14, 16 and 18% for 90 minutes. Other pulping parameters that remained constant were the use of 0.5% ethylene diamine tetraacetic acid (EDTA), with an 80/20 ratio $\text{Na}_2\text{SO}_3/\text{NaOH}$, 0.1% anthraquinone, 15% methanol and a temperature of 170°C in the cooking process. Samples prepared using 18% NaOH resulted in the highest pulp yield, 42.70%, and a Kappa number of 21.34. It seems that NaOH percentage significantly effect on the paper properties (tensile, tear and burst strength) and doesn't much effect on the pulp properties (pulp yield, Kappa number and freeness). The high quality of bamboo pulp and paper produced by the ASAM pulping process was found to be beneficial for the use in paper and paperboard manufacturing.



ABSTRAK

Kajian ini dijalankan adalah untuk menentukan kesan sifat pulpa dan kertas daripada Buluh Madu yang dihasilkan dengan menggunakan proses pemulpaan alkali sulfit anthraquinone dan methanol (ASAM) pada kepekatan NaOH yang berbeza. Gentian buluh ini dimasak dengan menggunakan tiga kepekatan NaOH yang berbeza iaitu pada tahap 14, 16 dan 18%. Proses pemulpaan ini juga menggunakan sebanyak 0.5% EDTA dengan nisbah bagi $\text{Na}_2\text{SO}_3/\text{NaOH}$ sebanyak 80/20, 0.1% anthraquinone dan 15% methanol pada suhu 170°C . Sampel yang disediakan dengan menggunakan 18% NaOH memberi hasil pulpa yang tertinggi iaitu 42.70%, dan juga memberi nombor Kappa sebanyak 21.34. Melalui kajian ini didapati bahawa perbezaan kepekatan NaOH lebih memberi kesan yang setara terhadap sifat kertas tetapi ia tidak memberi kesan yang setara terhadap sifat pulpa buluh. Kualiti sifat pulpa dan kertas yang dihasilkan menggunakan proses ASAM didapati boleh memberi manfaat kepada industri pembuatan kertas dan papan kertas.



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APPROVAL SHEET

I certify that this research project entitles “Effect of NaOH concentration in Alkaline Sulfite Anthraquinone and Methanol Pulping on Buluh Madu” by “Norsurehasuhada Bt Mohd Asri” has been examined and approved as a partial fulfillment of the requirements for the degree of Bachelor of Wood Science and Technology in the Faculty of Forestry, Universiti Putra Malaysia.

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LIST OF ABBREVIATIONS

AD	Air dry weight
ANOVA	Analysis of variance
AQ	Anthraquinone
ASAM	Alkaline Sulfite Anthraquinone and Methanol
CH ₃ OH	Methanol
DP	Degree of polymerization
EU	European Union
ISO	International Organization for Standardization
KMNO ₄	Potassium permanganate
MC	Moisture content
MT	Million tonnes
NSSC	Neutral sulphite semi chemical
NaOH	Sodium hydroxide
Na ₂ SO ₃	Sodium carbonate
OD	Oven dry weight
TRS	Total Reduced Sulfur
UNEP	United Nations Environment Programme



CHAPTER 1

INTRODUCTION

The word paper comes from the Greek term for the ancient Egyptian writing material called papyrus, which grow abundantly along the Nile River in Egypt. In ancient times, the Egyptians extracted the fibrous interior of this types of plants into fashion of kind of writing material. At 3000 BC in Egypt, papyrus was produced and was sold to ancient Greece and Rome (Needham, 1986). However, the discovery of the art of papermaking in all probability belongs to the Chinese. The invention was officially was reported to the Emperor by Ts'ai Lun. The first papers seem to have been made to some extent from the inner bark of the paper mulberry tree and to a larger extent from bamboo.

Paper is made of pulped cellulose and papyrus is made from the sliced sections of flower stem of the papyrus plant, pressed together and dried. Paper is a commodity of thin material produced by the joint off fibres, typically vegetative fibre contains of cellulose, which subsequently held together by hydrogen bond. While the fibres used are naturally in origin, a wide variety of synthetic fibre like polypropylene and polyethylene, may be incorporated onto paper as a way of imparting desirable physical properties.

The most common source of these kinds of fibres is wood pulp from pulpwood tree, largely softwood and hardwood. The demand of paper in the world need and alternative raw materials to replace the insufficient of wood resources. About 1 million tons of paper are used every day. Non wood

lignocellulosic fibres resources have the potential to complement the conventional wood supplies because it has short cycles and rapid regeneration (Cherubini, 2010). Since, 1970 the use of non-wood materials in the production of pulp and paper has attracted interest worldwide. Recently, non-wood fibres was mainly produced in the developing world, and it showed that non wood pulping capacity has been growing at a faster rate compared to wood pulping capacity. Non-wood plant fibres like kenaf, bamboo, straw and bagasse had been suggested to replace wood supplies wood as alternative materials for pulp and paper industries.

Bamboo is one of the source that appears as an alternative resources for pulp and paper industry, particularly in the tropical areas of the world (Susi, Teddy and Henggar, 2014). Bamboo is the fast growing plants that comes from *Gramineae* botanical family. Each species of bamboo is suitable to grow at well drained and open environment and also in several different climates. The growing rate for bamboo is about 3 – 5 years to reach maturity. Because of that, it is known as eco-friendly materials that has been widely used as an alternative source for papermaking production in the world (Anon, 2011). In Malaysia, about 329 000 ha plantation of bamboo and it is commercially used as scaffolding, food and also for pulp and paper industry (Mohamed et al, 2009).

Buluh Madu is one type of bamboo species that are suitable used for handicraft products, furniture, chop-sticks, toothpicks or skewers of food and can also be used as an attractive ornamental plant (Walter and Michael,

2015). But the most important uses of Buluh Madu is in the shoots production. In Malaysia, the demand for this kind of bamboo is increasing for the production of shoots. Buluh Madu was planted in area about 17 ha which can produced 12 tons per month production.

Alkaline sulfite anthraquinone and methanol (ASAM) pulping process, is an alkaline sulphite reinforced by the addition of anthraquinone and methanol. This type of pulping is approach as a pollution free pulp production because one of the major areas of activity is “organosolv” pulping, that is, the process of using organic solvents to aid in the removal of lignin from the wood. ASAM process can result in excellent strength properties of pulp. Unbleached ASAM pulp are characterized by low kappa number with high yield and viscosity giving a better freeness CSF before refining (Moradbak et al, 2016). ASAM process are the most effective pulping method and this has been confirmed by Brogdon and Dimmel (1994), who compared the delignification efficiency of different pulping systems and they are concluded that the alkaline sulfite-anthraquinone-methanol liquor is the most selective one, causing a minimum of recondensation.

1.1 Justification

In Malaysia, pulp and paper industries have established and growing to supplying the citizen consumption for paper and paper product uses. Unfortunately, the production and supply are growing at slow rate compared to other Asian countries. The paper is made up from both hardwood and softwood. The price in the market is increased rapidly due to the lack of hardwood and softwood. Because of this reason, the discovery of an alternative resources could be using interminable in future. By the way, research and development could be developed and brought to technological advancement. In the production of pulp and paper, the use of non-wood materials has attracted interest worldwide (Moradbak et al, 2016).

Buluh Madu is one of the non-wood plant that has great potential for paper production and offer consistency of raw material for papermaking industries. This bamboo is chosen because of its sustainability, fast growing characteristic and suitability in papermaking (Emma, 2010). Other than that, bamboo doesn't require debarking before chipping and it can reduce a huge operational cost and maximize the production. Besides, bamboo fibres is an anti-bacterial characteristic, which can prevent the formation and spreading of fungi or bacteria in the papers when it is produced from the bamboo pulps (Nordin, 2010).

ASAM pulping was chosen among other types of pulping to compare the pulp and paper properties of bamboo. ASAM pulping can be applied to all pulping raw materials. This pulping process can produces pulps with a high yield and

high viscosity (Moradbak et al. 2016). Without degrading the pulps, the delignification process can be extended to low kappa numbers. Research states that the strength of ASAM pulps is 10 – 20% higher as compared with kraft pulps (Patt, Kordsachia & Schubert, 1998).

1.2 Objectives of study

The main objective of this study is to determine the effect of sodium hydroxide (NaOH) concentration in alkaline sulfite and methanol bamboo pulping (ASAM) using Buluh Madu.

The specific objectives of this study:

1. to determine the effect of pulp properties of Buluh Madu using ASAM pulping at different NaOH concentration
2. to analyze the effect of paper properties of Buluh Madu using ASAM pulping at different NaOH concentration

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