Soda Anthraquinone (Soda AQ) and Bio-Chemical Pulping Process On Napier Grass for Papermaking Industry

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A thesis submitted in
fulfilment of the requirement for the award of the
Doctor of Philosophy

Faculty of Civil and Environmental Engineering
Universiti Tun Hussein Onn Malaysia

SEPTEMBER 2018

Special dedication to my beloved parents (Mohd Hatta bin Suliman and Hapsah Binti Satibi), sister (Mimi Haziqah Binti Mohd Hatta) for their love and encouragement

and

Special thanks to my friends, my fellow housemate and faculty members for all your care, support and best wishes.

ACKNOWLEDGEMENT

In the name of Allah S.W.T, The Most Gracious and Merciful.

Alhamdullilah, praise to Allah S.W.T. for giving me the strength to complete my project successfully. First and foremost, I would like to give my deepest thanks to both my parents (Mohd Hatta Bin Suliman and Hapsah Binti Satibi) and other family members (Mimi Haziqah Binti Mohd Hatta) for their continuing support and encouragement in completing this project.

I would like to express my deepest gratitude to my supervisor, Assoc. Prof. Ts. Dr. Zawawi Bin Daud for constantly guiding and encouraging me throughout this study and research. I would like to convey my greatest appreciation with Prof. for giving me the professional training, advice, motivation and suggestions to carry this project to its final form.

In preparing this project, I was in contact with many people, researchers, academicians and practitioners who have contributed towards my understanding and thoughts. My heart felt thanks to each and every one of them.

In particular, my sincere thanks are also extended to all my friends and others who have provided assistance at various occasions. Regrettably, it is not possible to list all of them in this limited space.

Thank you. May Allah S.W.T. bless upon all of you.

ABSTRACT

Nowadays, our nature sources become decrease where effect to paper industry. Thus, use of non wood (Napier grass) as a base material by an additive should became an alternative fibre for papermaking industry. The aim of this study to analyse the chemical composition of Napier grass; to determine the effects of different optimization pulping process on the pulpability and mechanical properties; to determine the surface characterization of paper by different pulping process. Napier grass sample would be undergoing of different pulping process (Soda-AQ pulping, Bio-chemical and combination pulping). The chemical properties involved in this study were determined according to relevant TAPPI test, Kurscher–Hoffner and Chlorination methods. Meanwhile, fibre dimension and pulp properties were measured after the pulping process. The mechanical strength of handsheet produced (tensile, burst, tear and fold) was investigated according to the TAPPI test method. Scanning Electron Microscope (SEM) was used to determine the morphological characteristic of the Napier grass paper. Results show high cellulose (60.2%); 1% NaOH solubility (52.0%) and lower of lignin (10.7%); ash (14.1%) and hemicellulose (23.8%) contents of Napier grass. The best optimum condition from pulpability and mechanical analysis were 16% concentration of alkali charge, 160 ^{0}C of temperature. Optimization pulping combination both dosage made a remarkable of high pulp yield produce (38.88%), low rejected pulp (5.2%), by a lower kappa index number (13.42%) and short fibre length (8.2%) from pulpability and mechanical properties for tearing strength, 5.58 Nm^2/g; high folding endurances, 987 Nm; high burst strength, 358.2 kPa*m^2/g; and higher of tensile strength, 5.11 Nm/g compared to single additives. Fibre structure image from combination dosage by SEM had completely different with a treatment by anthraquinone and *xylanase* enzyme act as a factor which lead a highly strong fibre to produce a good paper from non-wood materials to be compete with a wood-base paper for industry. Napier grass by the additional of additives from anthraquinone and xylanase enzyme could makes a confirmation for this agriculture plant to be an alternative fibre for pulp and papermaking industry for future.

ABSTRAK

Pada masa kini, sumber alam semakin berkurangan, dimana ini memberi kesan terhadap industri kertas. Maka, penggunaan tumbuhan (rumput Napier) sebagai bahan asas dengan kehadiran aditif akan dijadikan sebagai serat alternatif bagi industri pembuatan kertas. Matlamat kajian ini adalah untuk menganalisis komposisi kimia rumput Napier; mengenalpasti kesan proses pemulpaan pengoptimaan yang berbeza (Soda anthraquinone, Bio-kimia dan kombinasi pemulpaan) terhadap ciri-ciri keupayaan pulpa dan mekanikal; menentukan pencirian permukaan kertas pada proses pemulpaan yang berlainan. Ciri-ciri kimia yang terlibat dalam kajian ini (selulosa, hemiselulosa, kandungan abu, kandungan lignin dan solubiliti oleh 1% NaOH) telah ditentukan berdasarkan ujian TAPPI, kaedah Kurscher-Hoffner dan pengklorinan. Kekuatan mekanikal yang dihasilkan (tegangan, pecah, koyakan dan lipatan) dikaji mengikut kaedah ujian TAPPI. Pengimbasan Mikroskop Elektron (SEM) digunakan untuk menentukan ciri-ciri morfologi permukaan kertas. Keputusan kajian menunjukkan selulosa komponen adalah tinggi (60.2%); solubiliti 1% NaOH (52.0%) dan lignin yang lebih rendah (10.7%); bersama kandungan abu (14.1%) dan hemiselulosa (23.8%) kandungan rumput Napier. Ciri – ciri optimum yang terbaik bagi analisis keupayaan pulpa dan mekanikal adalah pada konsentrasi alkali 16% dan suhu 160°C. Pengoptimaan bagi proses pemulpaan gabungan dos (kimia dan biologi) menghasilkan hasil pulpa yang tinggi (38.88%), bagi hasil pulpa tidak diperlukan rendah (5.2%), dengan bilangan indeks kappa yang rendah (13.42%) dan panjang serat yang pendek (8.2%) daripada ciri-ciri keupayaan pulpa dan sifat mekanikal bagi kekuatan sifat koyakan, 5.58 Nm2 / g; sifat lipatan yang kuat, 987 Nm; kekuatan pecah yang tinggi, 358.2 kPa * m2 / g dan kekuatan tegangan yang lebih tinggi, 5.11 Nm/g berbanding dengan penggunaan satu proses aditif pemulpaan. Imej struktur serat dari dos gabungan oleh SEM memberi kekuatan yang kuat kepada serat menghasilkan kertas yang baik dari bahan bukan kayu bersaing dengan kertas asas kayu untuk industri. Rumput Napier dengan gabungan anthraquinone dan enzim *xylanase* menjadi tanda aras untuk tanaman pertanian

dijadikan sebagai serat alternatif untuk industri pulpa dan pembuatan kertas untuk masa depan.

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