COCONUT COIR FOR PULP AND PAPER

Mohamad Jani Saad*

Introduction

Coconut is grown in more than 90 countries around the world. In Malaysia, coconut occupied about 115,000 hectares of land which is most planted in Johor, Perak and Selangor (Table 1). Coconut was ranked 4th place after palm oil, rubber and rice in term of land acreage. Coconuts are typically grown in tropical countries. The coconut husk is abundantly available as cheap residue from coconut production. The husk comprises 30 wt.% coir fibres and 70 wt.% pith, which can be separated for traditional coir fibre applications in woven carpets, ropes, brushes and matting. This can be achieved by retting procedures or mechanical decortication (Van Dam *et al*. 2004).

Coir is a natural fibre extracted from the husk of coconut and used in products such as floor mats, doormats, brushes, mattresses, etc. Technically, coir is the fibrous material found between the hard, internal shell and the outer coat of a coconut (Wikipedia 2012). The brown

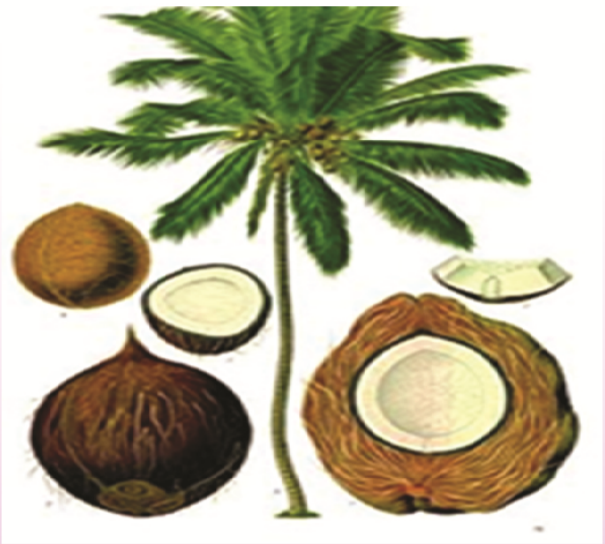
Product Evaluation Discussion

Pulp and paper products were some product that can be produced using coir fibres. Even though coir has high lignin at 30% (Table 2), it still can be turned into paper. The coir fibre pulp was chemically analysed; pulped by chemical-mechanical pulping (CMP) process and bleached by elementary chlorine free (ECF) process with four stages of chlorine dioxide (D) and alkali extraction (E). Sheets or paper were made from the unbleached and bleached coir fibre pulp. The results in Table 3 showed that in the papermaking process, the coconut coir has chemical properties that can be successfully pulped by the CMP and bleached by the ECF processes. The DEDED sequences can be used in bleaching the coir pulps. The bleached pulp produced paper with better tensile index, burst index, tear index, folding endurance as well as brightness properties but has lower opacity compared to the unbleached pulp. The bleaching process also improved the bonding strength of the coir fibre in the paper due to removal of lignin. fibre is obtained by harvesting fully mature coconuts when the nutritious layer surrounding the seed is ready to be processed into copra and desiccated coconut (Wikipedia 2012). The fibrous layer of the fruit is then separated from the hard shell manually or using dehusking machine.

To date, relatively little attention has been given to the use of coconut husk which can create environmental problem if no right disposal is practised. Practically, the utilization of coir can create economic and environmental advantages (Abdul Khalil *et al*. 2006). The fibres are renewable, nonabrasive, cheaper, available in abundance and show less health and safety concern during handling and processing (Zulkifli *et al*. 2008). These advantages can be of great potential in converting the coir fibres into various products especially pulp and paper manufacturers.

Conclusion

Coir fibre has chemical properties that can be exploited for successful pulp and paper production. The DEDED sequences can be used in the bleaching process of coir pulps. The results showed that bleaching of coir fibre pulp produced paper with better tensile index, burst index, tear index, folding endurance as well as brightness properties with lower opacity than the unbleached pulp. This is mainly due to the removal of the lignin in the coir fibre during the bleaching process which increased the bonding strength of the coir fibre paper.



Coconut tree and coir

	2011		2012		2013	
	Planted (ha)	Production (mt)	Planted (ha)	Production (mt)	Planted (ha)	Production (mt)
Johor	21124	81597	22384	88146	23055	92553
Perak	15064	123537	15958	137368	16437	144237
Selangor	10521	154591	11271	166721	11609	175057
Kedah	1650	8445	1856	7754	1912	8141
Kelantan	5587	26207	6077	29593	6259	31072
Melaka	2990	26658	3155	26233	3250	27544
N.Sembilan	1273	4262	1449	5384	1493	5653
Pahang	1772	8016	1827	6590	1882	6920
Perlis	560	1903	579	883	597	927
P.Pinang	1942	16697	2113	18059	2176	18962
Terengganu	4335	8952	2428	7117	2501	7473
Peninsular Malaysia	66819	460865	69098	493849	71171	518541
East Malaysia	39493	101690	42995	112681	44285	118315
Malaysia	106312	562555	112093	606530	115456	636856

Table 1: Coconut production and plantation in Malaysia 2011-2013 (Unit Perangkaan, Jabatan Pertanian Semenanjung Malaysia 2013)

	Ash	Extractive	Holocellulose	α-cellulose	Alkali	Hot water	Lignin	Pentosan	Silica
Coir	2.14	2.66	70.5	37.4	17.3	2.55	32.1	22.0	0.5

Table 2. Chemical components of coir (Rushdan 2002)

	Apparent density (g/cm^3)	Tensile index (Nm/g)	Burst index ($kPa.m^2$)	Tear index (mNm^2/g)	Folding (no)	Opacity (%)	Brightness (%)
Unbleached paper	0.37a	18.33a	1.85a	7.05a	8.57a	99.60a	16.28a
Bleached paper	0.44b	30.56b	3.35b	11.78b	67.43b	85.46b	82.87b

Table 3. Strength and optical properties of coir paper (Mohamad Jani S. 2014
Means with the same letter within the same column are not significantly different at 5%

Coconut coir

Paper from coconut coir

Some product from coir paper

Particleboard of coconut coir

References

1. Abdul Khalil, H.P.S., Alwani, S.M. and Mohd Omar, A.K. (2006). Chemical composition, anatomy, lignin distribution, and cell wall structure of Malaysian plant waste fibers. BioResources 1(2): 220 – 232
2. Mohamad Jani S. 2014. Effect of bleaching on coir fiber pulp and paper properties. Journal Tropical Agriculture and Food Science. 42 (1), 51-61.
3. Rushdan, I. (2002). Chemical composition of alkaline pulps from oil palm empty fruit bunches. Oil Palm Bull. 44: 19-24
4. Unit Perangkaan Jabatan Pertanian Semenanjung Malaysia 2013. Statistik Tanaman (Sub Sektor Tanaman Makanan) 2013.
5. Van Dam, J. E.G., Van den Oever, M.J.A., Keijsers, E.R.P. (2004). Production process for high density high performance binderless boards from whole coconut husk. Industrial Crops and Products, 20: 97-101.
6. Wikipedia (2012). Coir. Retrieved in 9 May 2013 from http://en.wikipedia.org/wiki/Coir
7. Zulkifli, R., Mohd Nor, M.J., Mat Tahir, M.F., Ismail, A.R. J. and Nuawi, M.Z. (2008). Acoustic properties of multi-layer coir fibres sound absorption panel. Appl Sc. 8(20): 3709-3714

Agrobiodiversity and Environment Research Centre,
MARDI Headquarters,
Serdang, P.O. Box 12301, 50774 Kuala Lumpur
*Corresponding author: jani@mardi.gov.my.