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ABRASIVE RESISTANCE OF SENTANG (*Azadirata excelsa*), RUBBERWOOD (*Hevea brasiliensis*) AND KEMPAS (*Koompassia malaccensis*)

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ABSTRACT. The abrasive resistance of Sentang (*Azadirata excelsa*), were studied using an abrasive resistance testing machine. Aluminium oxide was used as the abrasive medium. The wood specimens of 50 x 12 x 75 mm in sizes were mounted onto the test holder using epoxy adhesive. The abrasive wear on the specimen was obtained by grinding against a revolving steel disk covered with the abrasive medium. The specimen holder revolved clockwise at a constant speed of 32.5 rpm while the steel disk revolved at a speed of 23.5 rpm in the same direction. The abrasive medium were changed after 2000 revolutions. The loss in weight of the specimen were measured after every 100 revolutions of the revolving disk until a total of 1000 revolutions was achieved. The percentage loss in weight were then calculated. The data obatained from the studies were compared with Rubberwood *(Hevea brasiliensis)* and Kempas *(Koompassia malaccensis)* that are currently used for flooring materials. The three timbers tested showed different wearing resistance at both tangential and radial surface after 1000 revolutions. When measured, in terms of weight loss on radial surface, Rubberwood recorded the highest value of 0.985 gm followed by Sentang and Kempas with 0.674 gm and 0.448 gm respectively. Similarly, the weight loss on the tangential surface also found that Robberwood had the highest value of 0.749 gm as compared with Sentang and Kempas with 0.530 gm and 0.387 gm respectively. The results of the abrasive resistance tests showed that the Sentang wood is more superior that Rubberwood in terms of the wear resistance but is slightly inferior to Kempas. Sentang performs better than Rubberwood in both the radial and tangential surfaces.

KEYWORDS. **Abrasive tests, *Azadirata excelsa, Hevea brasiliensis, Koompassia malaccensis***

INTRODUCTION

Sentang (*A. excelsa*) which was promoted in the early 1990's as one of the potential tree species for forest plantation, possesses almost similar properties to Mahogany in terms of the appearances and properties. This species has been planted widely to overcome the shortage of common timber species for the wood-based industry in Malaysia. Compared with other timber trees which require more than 30 years before they could be harvested, sentang requires only between 20 to 25 years to mature and be harvested. Ng and Tang (1974) found that Sentang was one of the fastest growing timber trees with a diameter at breast height of 22.25 cm and 38.50 cm for 8-year-old and 40-year-old trees respectively. Sentang timber is reported to be suitable material for furniture, components for house building, interior finishing, paneling, veneer and plywood (Wong, 2002). However, information on their performance as a flooring material are still lacking and need further investigations.

The purpose of the study was to investigate the suitability of sentang timber as a flooring material. The abrasive resistance method was employed in this investigations. For the purpose of comparison, common flooring timbers such as kempas *(K. malaccensis)* and rubberwood *(H. brasiliensis)* were also tested.

MATERIALS AND METHODS

The timbers of Sentang , Rubberwood and Kempas were obtained from sawmills and sawn into test specimens of dimension 50 x 12 x 75 mm. Ten each of the radial and tangential specimens were used for the test (Figure 1). Prior to the test, the specimens were first conditioned at 22°C and 65 % relative humidity in a conditioning chamber to obtain the final moisture content of 12%..

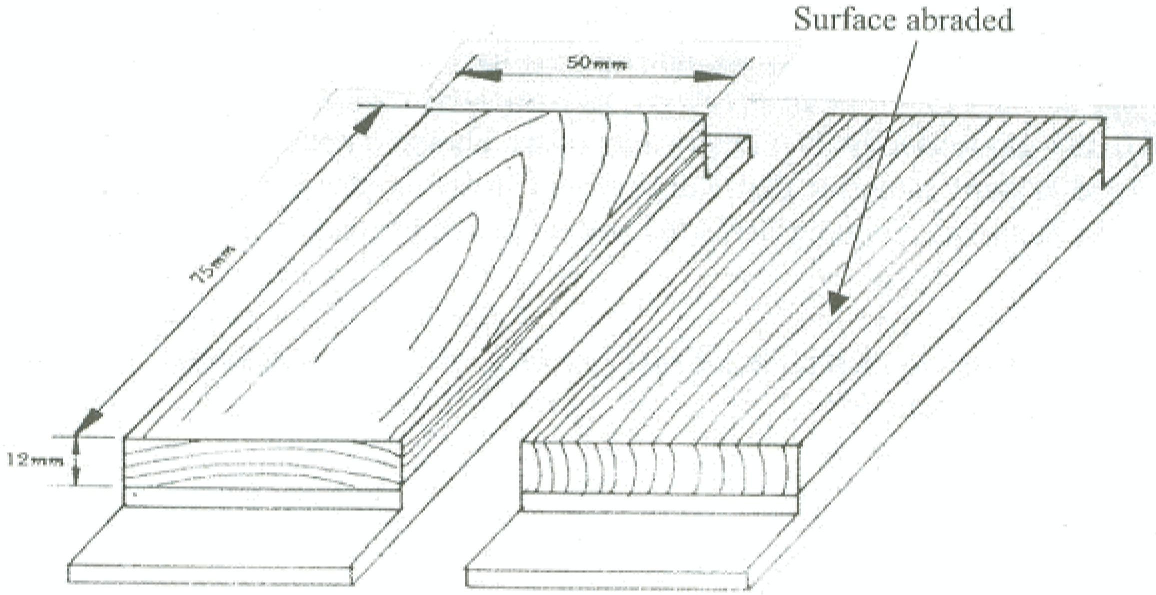

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Figure 1. Shape and size of specimen

For the density determination, samples measuring 1cm x 2cm x 2cm were obtained from all the specimens tested. The procedures for density determination is in accordance with the method used in American Standards For Testing Materials (ASTM) D 2395-83 (Anon,1985).

The abrasive resistance test procedure was adopted from the American Standards for Testing Materials, D1037-78 (Anon, 1985). The abrasive medium used was number 80 grit aluminum oxide. The test specimens were mounted onto the holder using epoxy adhesive. The holder which carries a dead weight of 4.5 kg on top was used to apply fixed pressure on the specimen during each revolution. The abrasive wear on the specimen was obtained by grinding against a revolving steel disk covered with the abrasive medium. The specimen holder revolved clockwise at a constant speed of 32.5 rpm while the steel disk revolved at a speed of 23.5 rpm in the same direction. The specimen was lifted to a distance of 1.6 mm and dropped back into contact with the revolving disk through a mechanically agitated hopper at a rate of about 46 g / min. The abrasive medium was changed after 2000 revolutions. The loss in weight of the specimen was measured after every 100 revolutions of the revolving disk until a total of 1000 revolutions was achieved. The percentage loss in weight was then calculated (Figure 2).

RESULTS AND DISCUSSION

The results obtained from this study on the three species Sentang, Rubberwood and Kempas are showed in Table 1. The average, minimum, maximum and standard deviation values for the density, loss in weight after every 100 revolutions and percentage loss in weight after 1000 revolutions of the abrasive disk are given for the two types of sample tested, *i.e* tangential and radial faces.

The three timbers tested showed different wearing resistance at both tangential and radial surfaces after 1000 revolutions. Generally, the radial surface is less resistance to wear than the tangential surface. When measured at in term of weight loss on radial surface, Rubberwood recorded the highest value of 0.985 gm followed by Sentang and Kempas with 0.674 gm and 0.448 gm respectively. Similarly, the weight loss on the tangential surface also found that Rubberwood had the highest value of 0.749 gm as compared with Sentang and Kempas with 0.530 gm and 0.387 gm respectively (Figure 3). The study also indicates that high density of wood do not necessarily show good abrasion properties. For example, Rubberwood which has a density of 635 kg/m^3 had a higher weight loss than Sentang which has a density of 555 kg/m^3. Shakri & Helmi (1995) in their study of Acacia mangium reported that high density and fine textured timber do not necessarily show good abrasion properties. Youngquist and Muthe (1948) reported that besides density, other factors related to the anatomical structures of the wood, in particular the size, arrangement and distribution of the pores and the structure of the fibres, also play an important role in influencing the resistance to wear.

Using criteria which include the resistance to abrasive action, density, strength group and texture of wood, Lim (1983) considered Kempas as suitable for heavy traffic while Shukari (1983) reported that Rubberwood should only be used under light traffic condition. Based on similar wearing resistance obtained, Sentang flooring could be rated as suitable for light traffic conditions. Normally, to enhance flooring resistance and appearance, wood must be coated with finishing materials.

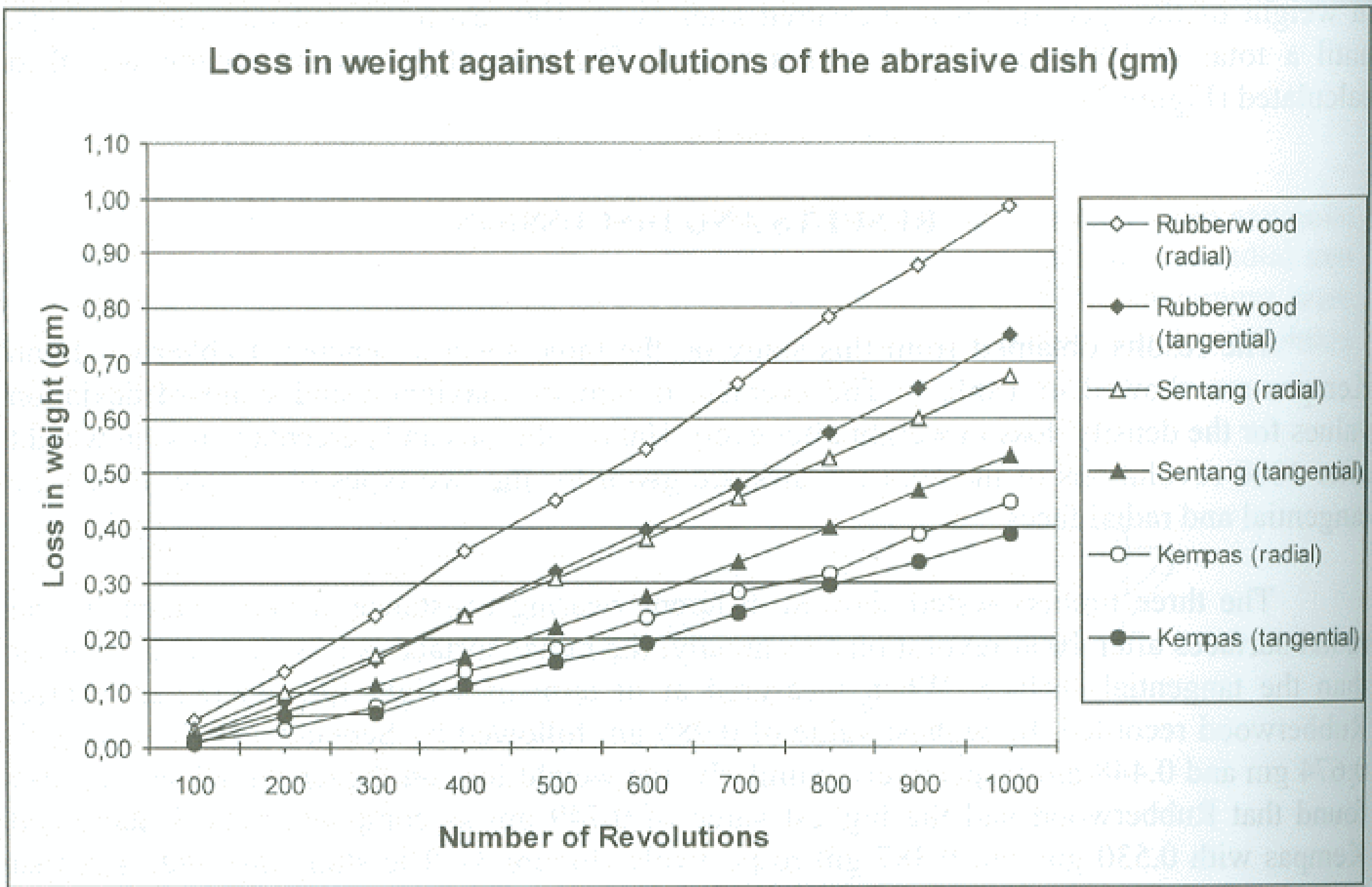

Figure 2. Amount of wear an each surfaces after each revolution of disk.

Table 1: Loss in weight of Sentang, Rubberwood and Kempas

Species	Average Density (kgm^{-3})	Surface Abraded		Loss in weight againt revolutions of the abrasive disk (gm)										Percentage loss in weight after 1000 revolutions (%)
				100	200	300	400	500	600	700	800	900	1000	
Rubberwood	635	Radial	**Average**	**0.049**	**0.140**	**0.241**	**0.356**	**0.453**	**0.546**	**0.661**	**0.785**	**0.876**	**0.985**	**2.486**
			Maximum	0.053	0.145	0.257	0.393	0.482	0.567	0.693	0.793	0.892	1.004	2.670
			Minimum	0.045	0.135	0.224	0.331	0.421	0.521	0.624	0.777	0.861	0.972	2.320
			Std. Dev	0.003	0.004	0.012	0.023	0.023	0.017	0.030	0.007	0.014	0.014	0.152
		Tangential	**Average**	**0.022**	**0.084**	**0.158**	**0.241**	**0.318**	**0.395**	**0.477**	**0.574**	**0.651**	**0.749**	**1.830**
			Maximum	0.027	0.101	0.172	0.257	0.339	0.412	0.499	.0667	0.679	0.811	1.930
			Minimum	0.018	0.068	0.148	0.229	0.299	0.374	0.459	0.532	0.631	0.702	1.740
			Std. Dev	0.004	0.014	0.011	0.012	0.015	0.015	0.018	0.054	0.021	0.050	0.073
Sentang	555	Radial	**Average**	**0.035**	**0.101**	**0.170**	**0.240**	**0.306**	**0.378**	**0.454**	**0.527**	**0.598**	**0.674**	**2.146**
			Maximum	0.049	0.121	0.193	0.269	0.339	0.407	0.485	0.558	0.635	0.721	2.300
			Minimum	0.026	0.089	0.157	0.218	0.283	0.348	0.417	0.484	0.551	0.621	1.980
			Std. Dev	0.009	0.012	0.015	0.021	0.024	0.027	0.029	0.032	0.035	0.040	0.124
		Tangential	**Average**	**0.020**	**0.066**	**0.115**	**0.165**	**0.219**	**0.274**	**0.336**	**0.402**	**0.467**	**0.530**	**1.918**
			Maximum	0.026	0.079	0.129	0.181	0.243	0.302	0.376	0.452	0.527	0.601	2.260
			Minimum	0.015	0.048	0.096	0.150	0.199	0.245	0.295	0.341	0.392	0.449	1.400
			Std. Dev	0.005	0.011	0.014	0.014	0.020	0.027	0.037	0.049	0.059	0.068	0.352
Kempas	878	Radial	**Average**	**0.013**	**0.034**	**0.076**	**0.138**	**0.182**	**0.236**	**0.281**	**0.316**	**0.389**	**0.448**	**1.096**
			Maximum	0.016	0.042	0.088	0.152	0.194	0.247	0.299	0.352	0.403	0.463	1.270
			Minimum	0.009	0.029	0.055	0.128	0.163	0.223	0.261	0.227	0.366	0.432	0.970
			Std. Dev	0.003	0.005	0.014	0.009	0.013	0.009	0.014	0.051	0.014	0.011	0.117
		Tangential	**Average**	**0.008**	**0.061**	**0.062**	**0.113**	**0.155**	**0.191**	**0.246**	**0.295**	**0.338**	**0.387**	**0.864**
			Maximum	0.011	0.190	0.067	0.122	0.167	0.211	0.257	0.311	0.352	0.399	0.930
			Minimum	0.005	0.022	0.055	0.103	0.142	0.171	0.233	0.271	0.321	0.373	0.750
			Std. Dev	0.002	0.072	0.005	0.009	0.010	0.016	0.010	0.016	0.013	0.010	0.071

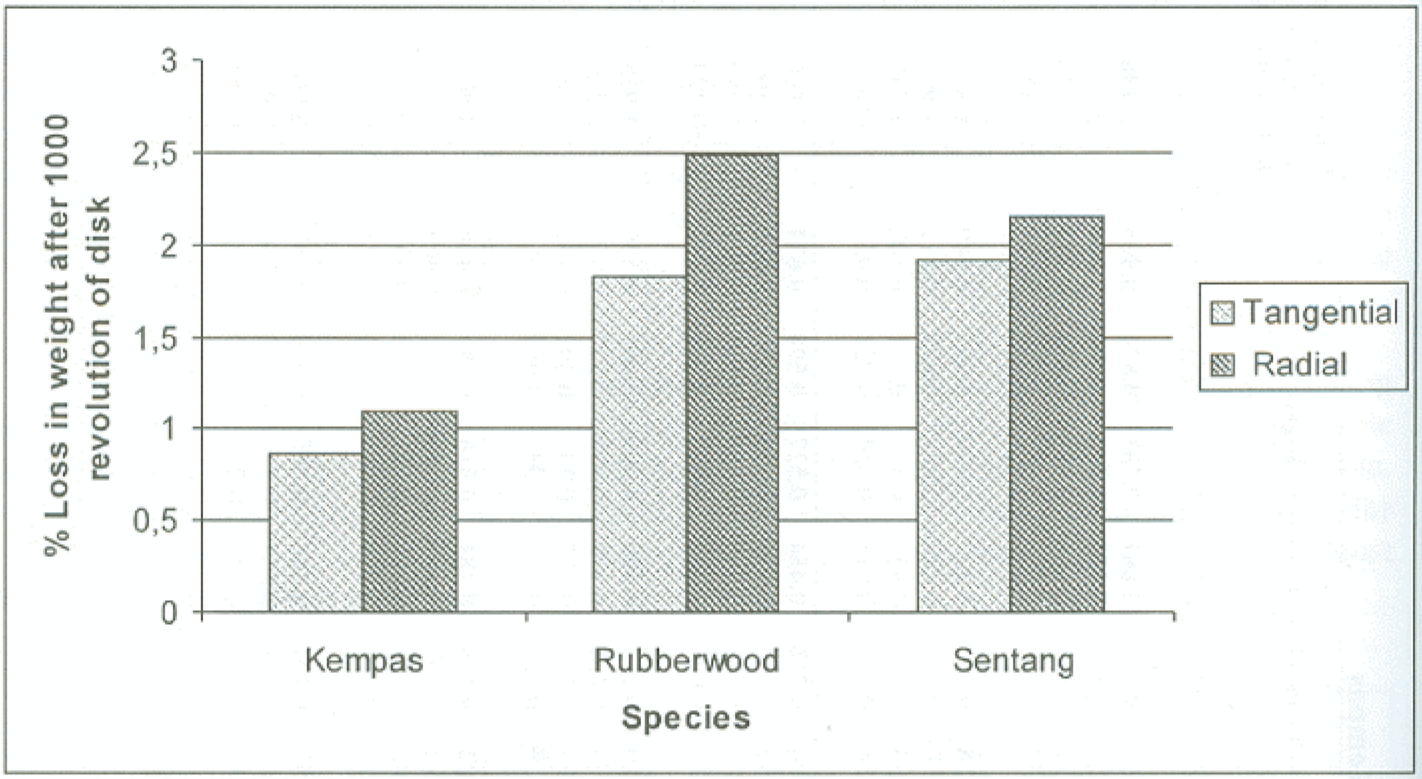

Figure 3. Percentage loss of weight after 1000 revolutions of abrasive disk on different species and face.

CONCLUSION

The results abtained from this study show that in term of wear resistance, Sentang performs better than rubberwood in both the radial and targential surfaces. Kempas is more superior than both the rubberwood and sentang as flooring material. Sentang flooring would be more suitable for residential and offices usage as they are more appealing in appearances compared to the rubberwood.

REFERENCES

Anonymous. 1985. American Standard for Testing Materials (ASTM) D 1037- 78. Standard test methods for evaluating the properties of wood-based-fibre and particle panel materials. Annual book of ASTM Standard Vol. 04-09 (Wood). : 239.

Anonymous. 1985. American Standard for Testing Materials (ASTM) D 2395-83, Standard test methods for specific gravity of wood and wood-based materials. Annual book of ASTM Standard Vol. 04-09 (Wood). : 495

Shukari, M. 1983. The abrasive resistance of Rubberwood. *The Malaysian Forester 46*, **4**: 455-462.

Shakri, M.S. and Hilmi, M.T. 1995. Abrasion properties of Malaysian Timbers. *Journal of Tropical Forest Products*, **1(2)** : 132-144

Lim, S.C. 1983. End-uses of Malaysian Timber IV – Flooring. *Malaysian Forester 46*, **2**: 278-285.

Ng, F.S.P and Tang, H.T. 1974. Comparative growth rates of Malaysia trees. *The Malaysia Forester*, **37(1)**: 2-23.

Wong, T.M. 2002. A Dictionary of Malaysian Timbers. Revised by Lim S.C and Chung. R.C.K, *Malayan Forest Records No.* 30, Forest Research Institute Malaysia (FRIM), Kepong.

Youngquist, W.G. and Muthe, B.P. 1948. The abrasive resistance of wood as determined with the U.S. Navy Wear-Test Machine. F.P.L., Forest Service, U.S. Department of Agriculture No. 1732.