INNOVATIVE USES OF EMPTY FRUIT BUNCHES AS A POTENTIAL WEAVING MATERIAL

(INOVASI TANDAN BUAH KOSONG SEBAGAI POTENSI BAHAN ANYAMAN)

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Abstract

The oil palm industry in Malaysia is the largest agricultural sector, exceeding rubber plantation in size by more than double the planted area. This industry generates enormous quantities of oil palm biomass in the form of empty fruit bunches (EFB). In the past, EFB waste was either burnt or left on the ground to become mulch: neither manner of disposal being environmentally or economically viable. The EFB fibres were, however, found to be strong and stable, and could be easily processed into various applications for mattress and cushion manufacturing, landscaping and horticulture, ceramic and brick manufacturing, and flat fibre board manufacturing. In Malaysia, the use of EFB fibres as a new material for weaving and crafts is still underexplored, particularly by art and design students, weaver, and artists. This research demonstrates steps involved in acquiring the natural fibre and various finishing processes – through scientific and non-scientific tests. It furthermore proposes the best methods that might become used in the future. The findings aim to show new potentials for the country's biomass and weaving industries, thus generating revenue to benefit many parties in the future, especially weavers in Malaysia.

Keywords: oil palm, empty fruit bunches (EFB), recycled waste, environmentalism, innovation, fabric weaving.

Abstrak

Industri kelapa sawit di Malaysia merupakan sektor pertanian yang terbesar sehingga melebih dua kali ganda daripada kawasan perladangan getah yang ditanam. Selain itu, industri ini juga telah mengeluarkan kuantiti biomas yang besar yang terhasil dari tandan kosong kelapa sawit (EFB). Pada masa lalu, sisa EFB kebiasaannya di bakar atau dibiarkan diatas tanah bagi menjadi bekas sungkupan di mana ia lebih menjimatkan dan mesra alam. Gentian EFB ini didapati kukuh, stabil dan boleh diproses dengan mudah ke dalam pelbagai dimensi gred yang dapat diaplikasi dalam bentuk tertentu seperti pembuatan tilam dan kusyen, penstabilan tanah / pemadatan untuk kawalan hakisan, landskap dan hortikultur, seramik dan pembuatan bata serta pembuatan papan lapis berserat. Di Malaysia, penggunaan EFB sebagai material baru dalam tenunan dan kraf tidak pernah di terokai terutamanya di kalangan pelajar seni rekaan, penenun dan pelukis. Kajian ini menunjukkan langkah-langkah proses yang terlibat dalam memperolehi serat semula jadi. Kajian ini juga menyaksikan pelbagai proses kemasan, melalui pengunaan ujian secara saintifik dan bukan saintifik dalam menghasilkan fabrik yang berkualiti tinggi dengan kaedah yang betul untuk dijadikan rujukan di masa hadapan. Penemuan ini diharap dapat mewujudkan satu dimensi baru dalam industri biomas dan tenunan negara, sekaligus dapat menjana pendapatan serta memberi manfaat kepada orang ramai terutama di kalangan penenun melayu pada masa hadapan.

Kata Kunci: *kelapa sawit, tandan kosong sawit, sisa kitar semula, mesra alam, inovasi, kain tenunan.*

Introduction

The Malaysian palm oil industry generates enormous quantities of waste from two sources: plantations and palm oil mills. The wastes generated are considered to be a useful by-product, as they contain nutrients and other valuable materials. Waste from plantations comprise palm trunks and fronds, whereas the principal wastes produced by oil palm mills are empty fruit bunches (EFB), fibres, shells, and effluents (Ahmad Fiesal Othman, 2001). According to Palm Oil Research Institute of Malaysia, the potential uses of by-products or co-products from these wastes may contribute significantly to the future income of the oil palm industry. In addition, Malaysia Palm Oil Berhad (MPOB) with Forest Research Institute Malaysia (FRIM) and several other governmental agencies have also collaborated to conduct various researches on the country's biomass. These parties are moving forward at a fast pace, conducting research to improve the productivity of the agricultural sector and the usage of waste from oil palm biomass.

The oil palm biomass waste, which includes trunks, fronds, EFB, fibres, and kernel shells, were normally burnt to ashes and used as fertilizer by planters. (Rosnah Mat Som, W. Hasamudin, Ab Gapor Md Top, Kamarudin Hasan, 2006). However, this biomass, especially EFB, has the potential to be processed commercially into industrial building materials such as boards, wall and ceiling panels, and other products (Bernama, 2001). Several studies on the usage of oil palm biomass have proven that EFB fibres are strong, flexible, stable, and may be used to produce various products such as pulp and papers, wood-board panels, tyre components, and oil-palm furniture.

Corley and Tinker explain in their book, "The Oil Palm", a mature oil palm will produce between twenty and thirty tons per hectare (t/ha) of above ground biomass or dry plant matter each year (Corley & Tinker, 2003 p.7). From that, the total dry matter production over a twenty-five-year planting cycle will be well over 400 t/ha. The idea of using some of this dry material to create new products has been considered for at least twenty years. Thus, it is clear that biomass waste from palm oil mills has the potential to be used in producing other products, and the research on producing high value craft products using oil palm fibres has yet to be explored and studied.

In contrast, Malaysia's ASEAN neighbours, including Indonesia, Thailand and Myanmar, are ahead in producing craft products from natural fibres and biomass wastes. In Indonesia, various yarns and ropes are produced from natural fibres of coconut husk, banana trunk and pineapple leaves. Thailand, Myanmar and Vietnam produce high quality fabrics from these natural fibres, whereas Malaysia is still left far behind in terms of research on the application of natural fibres, especially the oil palm fibres, in the production of textile and craft products. This has spurred researchers to carry out research on oil palm fibres, and take the initiative to produce high quality by-products, especially for craft textile products. In line with the national government's campaign on the recycling of waste material (*Kitar Semula),* this research demonstrates the specific potential of EFB as an alternative material for weaving.

What Are Empty Fruit Bunches (EFB)?

After separating the fruitlets from the fruit bunch, what remains is called the empty fruit bunches (EFB). EFB is a fibrous mass that has conventionally been considered as mill waste. Although EFB fibers are residual, the fibers were also considered as one of the 'good' natural fibres whose fibres have strong characteristics, being coarse, thick, clean, biodegradable and more compatible than many other fibres. Therefore, this research sees EFB fiber as suitable for use in producing woven products.

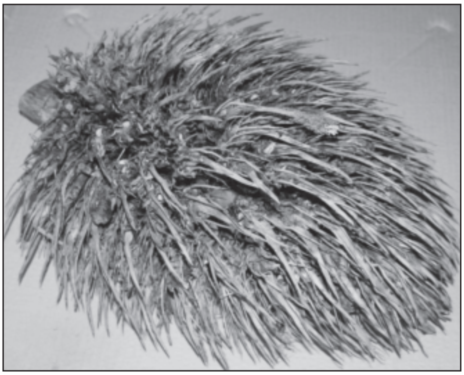

Figure 1: Empty Fruit Bunches.

The Processing Method of EFB Yarn and Woven Fabrics

The processing of EFB into yarn and woven fabric involves a number of steps, several involving laboratory work and the application of chemical agents. This experimental research attempts to determine an appropriate methodology for production, and includes the particular chemical agents and formulations that might produce the most useful results. All scientific tests carried out involve the use of standard tools, equipment, advanced machinery, and chemicals, which have the validation and recognition of the International Organization for Standardization (ISO). The tests were conducted in the Textile Laboratory of the Faculty of Applied Sciences, University of Technology Mara (UiTM) Shah Alam, Malaysia.

Fibre Extraction Process

i. Cleaning Process

Fresh EFB fibres are first cleaned in the fibre extraction process by boiling, beating, and steaming the fibres. The purpose of the fibre extraction process is to remove impurities such as dirt and grime from the EFB. However, for this study, this process was only conducted on fresh EFB, which is believed to have the ideal characteristics for the production of the aforementioned material.

ii. Scouring Process

Three types of EFB are used for the scouring process: loose fibre, EFB yarn, and EFB woven fabric. The EFB woven samples are scoured in a caustic soda solution to remove impurities from the sample surface. After scouring, the samples appear clean and clear, but become smaller, with slight shrinkage of the woven structure. This could be due to the loss of impurities, oil, and moisture during processing.

iii. Bleaching Process

The bleaching process aims to whiten the loose fibre, yarn and fabrics, and prepare them for subsequent colour application. In this stage, hydrogen peroxide is used as a bleaching agent, and results show it to perform very well on the EFB materials by eliminating unwanted colours and making them whiter.

Spinning Process

In the spinning process, fibres are twisted and spun into yarn. The rough, thick texture and the inconsistent length of the test materials result in breakage of the fibres, thus incurring many delays in the spinning process. To resolve this problem, oil is sprayed onto the fibres to moisten and soften them. The results obtained from this step show that EFB fibres can be spun into rough yarn; however, the roughness and thickness of the yarn might be improved in several ways. First, by reducing the number of fibres spun in order to produce a finer yarn. Second, by applying certain twisting and spinning techniques to produce strong and compact yarn. And third, by combining EFB fibres with synthetic fibres during the spinning process in order to produce a yarn with a unique appearance.

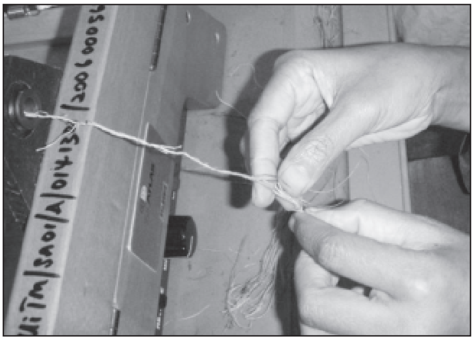

Figure 2: Fibre inserting and twisting process.

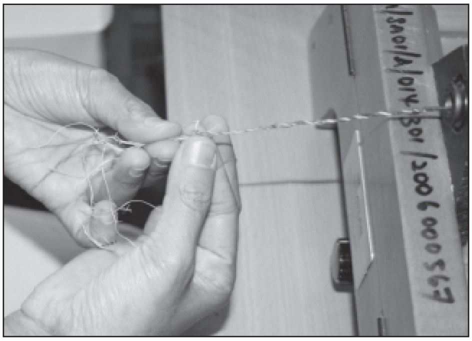

Figure 3: Fibre spinning process.

Yarn Testing

The properties of EFB yarn are examined in three tests: (1) yarn size analysis; (2) a yarn twisting test; and (3) the single yarn strength and elongation test. The objectives of the tests are to measure the thickness and fineness of the EFB fibres, to count the number of twists, and to test the yarn strength.

The first test is the yarn size analysis test. Thickness and fineness are examined according to two measurements: cotton count analysis, and linen count analysis. The result of the cotton count analysis shows that the average weight of a twisted EFB fibre is 0.3617 grams with a 0.994 cotton count. The linen count analysis records an average of 0.348 grams with a 2.861 linen counts. Based on this test, the size of EFB yarn size is considered thick and rough.

The second test is the yarn twisting test. This test is intended to determine the number of twists per centimetre of yarn. The optimum number of twists in a strand of yarn is important as it governs its strength and grade. A ten centimetre length of EFB yarn from our sample is examined under the twist counter to determine the number of twists it contains. The results of this test shows that the average number of twists per centimetre of EFB yarn is 1.58.

Final test is the single yarn strength and elongation test. In this test the strength of EFB yarn is measured. The results record that EFB yarn can be elongated up to 65.7 mm, and that the force required to break the yarn is 19.07 newtons. This shows that a single strand of EFB yarn can withstand a high degree of force, and is suitable for weaving process.

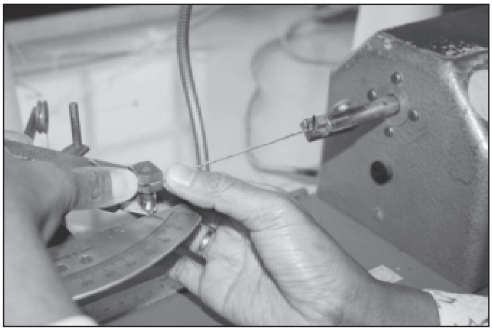

Figure 4: Yarn twisting test.

Weaving of EFB Yarn

After completing the yarn tests, the EFB yarn are employed in weaving trials in order to determine the potential of EFB yarn in woven fabrics. In this step, EFB yarn is woven using the basic plain-weave technique. A total of six samples are produced using this method. These samples are woven using EFB yarn for the warp and weft. Analysis of the woven samples shows that EFB yarn can be used as a raw material in weaving. However, EFB yarn is not suitable as warp yarn, as the single yarn strands are easily broken during the weaving process due to its weak structural integrity and hard texture. In addition, the length of EFB yarn for the warp needs to be shorter to reduce the potential of yarn breakage. The ideal size of EFB yarn as a warp is between 15 cm and 20 cm. The EFB yarn will break if the yarn used in the warp exceeds that size.

Dyeing Process

The final step is the dyeing process, which aims to infuse colour into the EFB fabrics. For this step, three Procion Reactive Dyes are used: Red MX–8B, Yellow HE-4R, and Blue MX-TR7. All three colours penetrate the surfaces and are absorbed into the EFB fabrics. This show that Procion dyes are suitable for such purposes. The colours obtained on the samples' surfaces are bright and clear, with the colour reaching all surfaces and gaps of the EFB fabric.

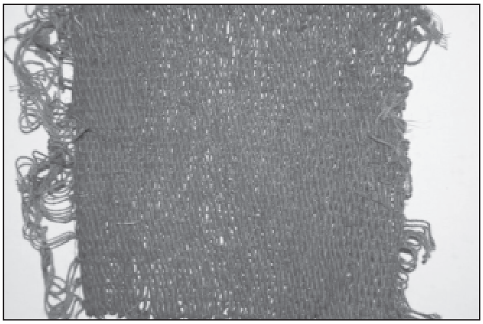

Figure 5: Fabric sample using Red MX-8B.

Conclusions

As the results above demonstrate – based in a methodology that incorporates scientific tests as well as traditional fibre production and weaving techniques – EFB fibres were proven to have potential as processed yarn and woven fabrics. The various processes employed – including scouring, bleaching and dyeing – had positive results upon the surface, texture and structure of the fibres, yarn and fabrics. The yarn and fabrics became cleaner, whiter and softer after treatment. The fabrics appeared more attractive after dyeing, which also gave a unique look to the woven products.

The most significant finding of this research is that waste from oil palm plantations and mills can be recycled as a new material for producing useful and attractive woven fabrics. We hope that it can become a guide for future research in this area, particularly for art and design students, in furthering study regarding reprocessing oil palm waste. It may also help generate additional income for oil palm farmers, biomass oil palm industries, as well as handicraft organizations.

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