Innovating New Materials from Natural Fibers in Product Design

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Introduction

The development of technology plays a crucial role in modern economic growth and is a key factor in the environmental crisis. Currently, many green design methods have been developed to support the designer in reducing the environmental impact of the product throughout its lifecycle. Design has a principal role to play in developing these 'new solutions'. It is estimated that eighty to ninety percent of a product's environmental and economic costs are committed by the final design stage, before production begins. Therefore, by integrating environmental considerations into the earliest stage of product conceptualization and design development, there is potential to bring far-reaching environmental benefits (Graedel et al., 1994).

At present, environmental considerations fall outside of the area of expertise of most designers. Indeed, in the industrial sector, designers have traditionally been seen to be concerned primarily with product styling and are inexperienced about technical elements of production and associated environmental impacts. Since the world is struggling with the issues of reducing the abandoned natural wastes, it is necessary to innovate these wastes to new value added products. Every year, millions of tones of wood, paper, and other cellulose-based materials are recycled - and millions more burned, placed in landfills, or otherwise disposed of. This research explores on how the effective use of natural fibers from agro waste can contribute to the development of more environmentally responsible practices in the industrial design sector. It introduces key elements of the ecological approach to design and investigates the role that design can play in bringing more resource-efficient products, looking specifically at potential materials with a longer life span. There is a broad consensus that environmental issues can no longer be excluded from the design process, however, in the material sector, design led solutions to environmental problems have been slow to develop. This study will discus on the raw materials innovation, engaging in innovation, and offers solutions to represent the new look of product design. Hence, there is a need a green innovation, design method for this situation. The ability of design to influence the environmental profile of goods and services was acknowledged by Our Common Future, often referred to as 'The Brundtland Report' (WCED, 1987). Best known for its popularization of the term "sustainable development", the report also made recommendations for a new approach to design and production, setting out terms for 'a production system that respects the ecological base' and, 'a technological system that searches continuously for new solutions'. In realizing the needs of sustainable materials, recycle materials represent high value in the market need nowadays.

Agro Wastes Scenario

Malaysia has an abundance of agro waste material that has not been fully utilized to a maximum extent. Thus, the finding of a new alternative fiber in non wood material will be favorable in product design. Depleting

forest tree to get the wood material had made an impact in the environment and especially humans. As this issue becomes more crucial, alternative fiber from non wood material are seen to give a good solution to saving our environment from being destroyed for the purpose of human development. Besides Malaysia, other Asian countries like China accelerated dynamically in their economic growth, which result in the increasing production of paper and paperboard products. However, the uses of wood in paper production have an effect on our environment system. Thus, many countries have decided to utilize the non wood fiber in paper making industry (Mohanty, Misra, & Drzal, 2005). The use of natural fibers as reinforcements in polymer composites to replace synthetic fibers like glass has received an exclusive attention because of the advantages, including cost effectiveness, low density, high specific strength, as well as their availability as renewable resources.

In this study the types of natural fibers from Kenaf and Corn skin were used to develop the new materials for tangible products. However, this paper will discuss on the Kenaf fibers that were tested in creating new materials for daily products (Figure 1). Kenaf (Hibiscus cannabinus L.) Is a traditional, third world crop after wood and bamboo that is poised to be introduced as a new annually renewable source for industrial purpose in the so-called developed economies, especially for daily needs (Chin & Yousif, 2009). The kenaf bast fibers were found to have great potential as new materials in product design. They have flexural strength combined with its excellent tensile strength which makes it the material of choice for a wide range of non-woven products.

Figure 1: Kenaf fibers (Hibiscus cannabinus L.)

Methods And Analysis

In order for design to bring environmental benefits, it appears vital that designers should engage with the challenges and opportunities that environmental impact reduction demands. Minimizing pollution 'end of pipe' and recycling wastes will bring environmental benefits. In this study, various methods of testing were applied during the process of sorting and carding the natural fibers. The main consideration in minimizing the usage of chemicals in the process of extracting the fibers using natural pH6 to pH7 of water during the whole process. The characteristics of the natural fibers were studied in order to identify their potentials in creating new materials. Further development of drying methods was also counted in the process

to identify the tensile strength of the fibers. These procedures were applied to kenaf fibers. Various experimental combinations of fiber and starch properties were developed during this process (Figure 2). The content of kenaf fibers was varied from 5% to 20% by weight. The matte and translucent effect are the characterization based on the formulariztion parameters in the whole process.

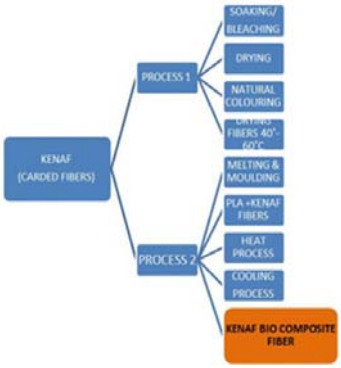

Figure 2: Process of Kenaf bio-composite

Kenaf Biocomposite Material In Product

Kenaf (Hibiscus cannabinus L.) is a fiber plant native to east-central Africa, where it has been grown for several thousand years for food and fiber. It is a common wild plant of tropical and subtropical Africa and Asia. It has been a source of textile fiber for such products as rope, twine, bagging and rugs. It is easy to grow, has high photosynthesis rate and is used as industrial building material for board production. In Malaysia, kenaf production is one of the industries promoted under the East Coast Economic Region. Kenaf was an eco-friendly product and treated as a new commodity that could be transformed as a new source of growth in Malaysia to diversify the country's commodities sector (Ashori, etl.,2006). Kenaf has a unique combination of long bast and short core fibers which makes it suitable for a range of paper and cardboard products as well as bio-composite materials in product design.

In this research, kenaf fibers were developed as alternative materials for furniture and lamp shades. Froggy lamp shades (Figure 3), was developed by Nazlina and Nur Farah, are the formalization of poly lactic acids (PLA) with a combination of biodegradable kenaf fibers they managed to extend the output of kenaf into new materials in product design. The usage of kenaf mesh and long fibers creates an interesting texture to the products. With the considerations of various testing on bonding and melting processes, various extensions of aesthetic surfaces were created in these experiments. As for the reinforced PLA-kenaf bio composite, physically the fiber can be seen and exposed on the surface of composite. Higher kenaf fiber, more fiber is clearly seen and creates an interesting surface texture of bio composite. The invention of these children's lamp products is inspired by the shapes of a frog. The lamp shade design is user natural bio composite materials developed from the kenaf and coloured with natural dyes from plant pigment, as well as PLA. This Froggy lamp is a representation of fun and an environmentally friendly product for modern living. These ecofriendly bio-composites from plant fibers are novel materials and have great potentials in the material world (Figure 4).

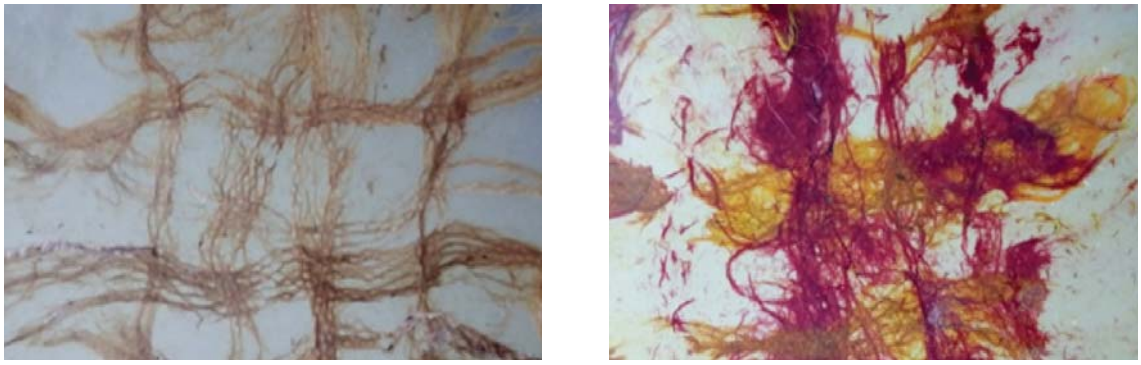

Figure 3: Biocomposite materials developed from kenaf fibers

Figure 4 : Value added product from kenaf biocomposite for the Salone Satellite 2014, Milan (ID: MY 14-00507-0101)

Conclusions

The future of natural fiber composite appears to be exciting because they are environmentally friendly, cheaper and create an aesthetic value to the products. The combinations of kenaf and PLA resulted in its strength. The effective use of natural fibers from agro can contribute to the development of more environmentally responsible practice in the industrial design sector. It introduces key elements of the ecological approach to design and innovate new materials that can extend their potential through a longer life. It can be concluded that the use of bio composites will reduce the environmental problems as well as create a new impact to the product design. The future of natural fiber composites appears to have a great potential as it is cheaper, lighter and environmental friendly.

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