

Pineapple Leaf Fibre (PALF): From Waste to Wealth



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INTRODUCTION

In agricultural processes, a lot of residue is produced during harvesting or processing activities which is called agro-waste. Currently, the agro-waste has created environmental and technical issues at the disposal stage. Transformation of agriculture waste to wealth is a good approach in order to develop a sustainable agriculture industry in our country. Nowadays, most of the agro-waste is disposed to serve as fertilizer or burnt in an open field (Figure 1). Both methods are ineffective and contribute to environmental pollution.



Figure 1: Open field burning of pineapple leaf

Open-field burning is a process of uncontrolled combustion during which carbon dioxide (CO₂) is emitted into the atmosphere along with carbon monoxide (CO), unburnt carbon (CH₄), nitrogen oxides (NO_x) and comparatively less amount of sulphur dioxides (SO₂) (Butchaiah G. et al. 2009).

In pineapple cultivation, the pineapple leaf can be processed to produce a value-added product. In the year 2010, the total planted area of pineapple was 17,601 hectares (Perangkaan Agromakanan, 2010) and the total estimated amount of pineapple leaf produced was 28,469 MT. Extraction process of pineapple leaf fibre can be conducted mechanically by using a kenaf decorticating machine. This machine is very effective and practical in transforming the pineapple leaf to value-added material.

PROCESSING OF WASTE TO WEALTH

There are several important steps involved in processing pineapple leaf to value-added material, namely extraction, drying and grinding. The pineapple leaf is manually collected at the farm by using hand aids (Figure 2). However, at the commercialisation stage, the leaves should be collected by using machinery to increase processing efficiency.



Figure 2: Pineapple leaves from farm

The extraction process of pineapple leaves to obtain fibre is carried out using the kenaf decorticator machine (Figure 3). This machine is able to separate the fibre from the other particles. The machine is powered by a 20HP diesel engine.



Figure 3: Mechanical extraction of pineapple leaf fibre using kenaf decorticator

The extracted fibre will be dried in a solar drying house to reduce moisture content in its particle (Figure 4). Initially, the moisture content of pineapple leaf fibre after the extraction process is 65% to 70%. The fibre can be dried in a solar drying house for 3 days (depending on weather conditions) to attain 15% moisture content. The main purpose of this process is to prepare the material for the next process requirement.

The temperature and relative humidity inside the Solar Drying House (ISDH) for three days are recorded with a



Figure 4: Drying process of pineapple leaf fibre in a solar drying house

Data Logger (WatchDog). Based on the recorded data, temperature range ISDH is 58°C (maximum) and 24°C (minimum) as shown in Figure 5. The temperature would start to increase from 8.00 a.m. to 3.00 p.m. Thereafter, the temperature would begin to decrease until 10.00 p.m. and the minimum temperature would be maintained until 8.00 a.m. the next day.

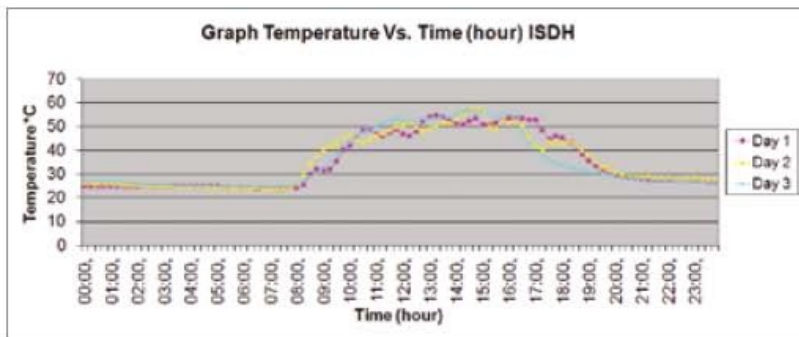


Figure 5: Graph of temperature vs. time (hour) ISDH

The range of relative humidity (RH) is 96% (maximum) and 20% (minimum) as shown in Figure 6. The relative humidity would start to drop at around 8.00 a.m. until 1.00 p.m. After that, the relative humidity exhibits a constant at minimum value prior to a gradual increase at 4.30 p.m. until it reaches the maximum value the next day. Apart from temperature and relative humidity, there are other factors which may influence the drying rate of the fibre such as layer thickness, particle size and the stirring process.

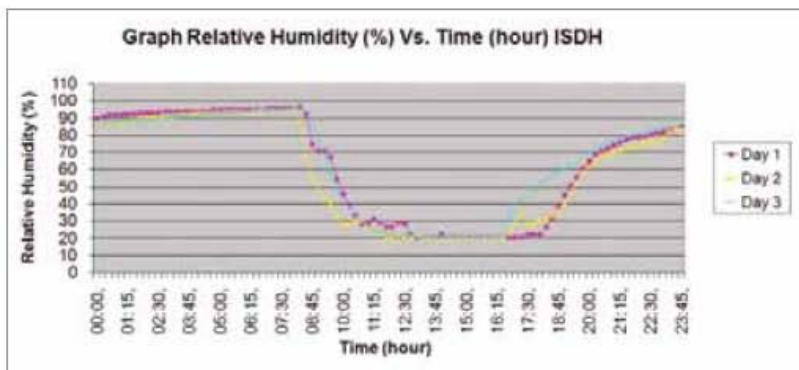


Figure 6: Graph of relative humidity vs. time (hour) ISDH

After the drying process is completed, the dried pineapple leaf fibre is ground with a cutting mill to further reduce the particle size of the fibre (Figure 7). Powered by a 1.5kW electric motor, the cutting mill is suitable for laboratory use. The ground fibre is filtered using a sieving mechanism to produce a standard size of particle (Figure 8). The pineapple leaf fibre shown in Figure 8 is filtered using a 0.5mm sieve. In this process, several sizes of the sieving mechanism are evaluated to produce fibres of different quality.

The ground fibre is very useful to produce value-added products such as bio-composite and bio-fuel.

FUTURE DEVELOPMENT

In future, improvement of the existing process, product development and economic viability assessment must be completed prior to the commercialisation stage of the technology. Improvement of the existing process includes machinery evaluation towards technology up-scaling. Product development should be conducted to complete the technology development cycle. For example, the ground fibre can be processed to produce engineered wood products. Nowadays, a lot of research pertaining to product development from waste has been conducted by research institutions and local universities. In order to determine technology viability, economic analysis must be performed to obtain better revenue indication in the future.



Figure 7: Cutting mill to grind PALF



Figure 8: PALF in powder form

CONCLUSION

Processing of pineapple leaf to provide value-added products is a better approach to reduce the waste for a sustainable agriculture industry. The fibre can be used to produce a wide range of products for diverse applications.

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