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Review on PALF Extraction Machines for Natural Fibers

Yusri Yusof[1, a], Anbia Adam[1, b]

[1]Universiti Tun Hussein Onn Malaysia (UTHM), Johor, Malaysia

[a]yusri@uthm.edu.my, [b]anbiaadam@gmail.com

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Abstract PALF (pineapple leaf fiber) is one of the abundant sources that have been used for ages to be processed as different end product. The methods to extract the fiber are abounding. However comparisons between the machines are needed to ascertain the better function of machines and whether all natural fibers can be extracted using the same exact machine. Data shown indicates that different types of methods used to extract the fibers and sometimes theoretically worked for certain types of fibers.

Introduction

Natural fibers have begun to pace towards becoming the main alternative source in the modern world industry. It can be applied in various ways from composite reinforcement, textile and even medical use. Currently, in this 'environmental-friendly-era' that we are living in, natural fibers hasdefinitely gain its place in the heart of most industries as it is biodegradable and most crucially, renewable.

There are plenty of sources which can be extracted into natural fibers, like kenaf, jute, sisal, pineapple leaf, banana and others. However, one of the most sought after yet, undervalued source for natural fiber here in Malaysia, to be specific- state of Johor, is from none other than pineapple leaf. Pineapple leaf fiber (PALF) is abundantly available and can be obtained at lower cost since its full potential is being overlooked by the community while treated as waste to which usually end up in the dumpster or worse, disposal by incineration; defying the whole purpose of being environmental friendly.

Certain methods and machines have been recognised to extract the PALF or any other natural fibers whether by decorticating, crushing or retting.In hoping to attain the answer to the question, this review will contemplate on the on extraction machineson natural fibers .

Extraction Machines

As early as 1900's, or even long before that, people have invented different types of fibre extraction machines that goes by different kind of names; decortication, abstraction, defibration and others. However, they all serve the sole purpose to extract fiber from the plants. In United States of America and Canada, fibers from plants such as flax and kenaf were highly regarded to be used as sources for textile commercialization [5].

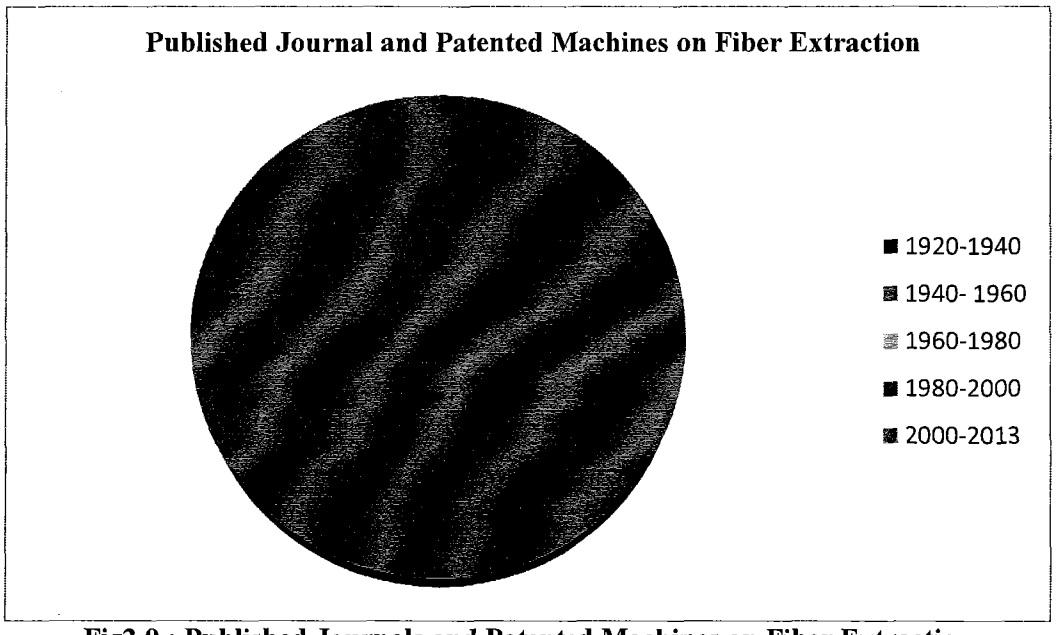

Fig2.0 : Published Journals and Patented Machines on Fiber Extraction

2.1 Machines' Innovations and Responses

Fig 2.0 shows the published journals and patented machines on fiber extraction which was attained by segregating the mentioned elements according to its published and patented year. Having said that, during the era of 1900's, the invention and patent for fiber extraction machine were blooming to meet the vast demand from the textile industries [23]. Ergo, explaining the reason behind dominant patents on between years of 1920-1940 as shown in Fig2.0.Nevertheless, the natural fibers demand met its downfall later after synthetic fiber founds its way towards society following the World War II [23]. Not until recently, natural fibers have managed to attract and gain more attention for environmental reason and its economical price [24].

2.2 Machines' Novelties

Different types of fiber extraction machines have emerged for the last century, assisting humans throughout the ages with variety of approach to offer. Table 2.0 was contrived to render a better look on the diversity of the tools in parts of machines used to extract fiber. The data was collected starting from early 1920's up to 2012.From that, as shown from Table 2.0, most extraction machine prefers to include crushing or bending as part of the extraction process. It's really troubling since according to F.P Gardner, by doing crushing or crumping, it doesn't help much in extracting the fiber, instead the fiber will become clogged as the process proceed [7,8,9], explaining the reason why he doesn't add the crushing process in his patented machines.

Table 2.0 : Tools in part of machines used to extract fibers

Patent / Journal	Blade/ Edged Blade/ Knives/ Shredder	Crusher/ Bender
Fiber Removing Machine for Flaz, Hemp, Ramie and other Textile Plants (1925)	√	√
Fiber-Decorticating Machine (1926)	√	√
Decorticating Apparatus for Treatment of Sisal and other Fibrous Leaves and Stalks (1927)	√	√
Decorticating and Defiberating Machine (1934)	√	√
Fiber Separating Machine (1937)	√	√
Method of and Machine for Abstracting and Preparing Fibers (1939)	√	-
Method and Machine for the Abstraction and Preparation of Fibers (1939)	√	-

Decorticating Machine (1940)	√	√
Apparatus for Abstracting and Preparing Fibers from Fiber-Bearing Plants (1942)	√	-
Machine for Cleaning and Separating Flax or other Fibrous Plants (1948)	√	√
Apparatus for Obtaining Fibers from Plant Leaves (1955)	√	√
Self-Propelled Fibre Harvesting and Decorticating Machine (1960)	√	√
Method for Decorticating Plant Material (1998)	-	√
Plant Material Processing System (2000)	√	√
Plant Material Processing System (2002)	√	√
Utilization of Pineapple Leaf Agro Waste for Extraction of Fibre and the Residual Biomass for Vermicomposting (2011)	√	√
Extraction Device for Fiber in Plant Stems and Leaves (2012)	√	√

Even so, for the many others who did add the crusher or bender as part of their extraction tools, have their own opinion concerning the matter. James McCrae for instance, has adapted pre-crushing action towards the plant leaves by series of smooth rolls and washing because he has reasons to believe that by doing so, it will avoid stressing the fibers, which will eventually damaging the fibers. [14] Indirectly agreeing to the subject, believes that bending and pulling the fibers over and over again thru different region at progressively increasing speeds will help preserving the extracted fibers even more. Having full believe of this statement, [11] becoming the only patented fiber extraction machine that doesn't install any type of blades or knives as part of extracting tool.

It is known that, time is the essence in extracting the fiber as the chemical in the plant leaves, change continuously progressing after the stalk has been removed, making it harder to fully extract the fibers [12]. The reason behind this is because; [12] gummy resin or sap substances which cause adhesion between the pulp and the fibres tend to harden following the tick of the clock. Therefore, extracting the fiber from the plant is better to be done as soon as workable.

Few patents like , J. Cook's and H.J Edwards's have come up with brilliant idea that uses fluid power to rotate the crushing and grinding wheels while in the meantime, also doing the part to wash the fibres and the tools itself [13,17]. Water was also used to assist the removal of the impurities from below apparatus while guiding the partially cleaned fibres thru machines in proper sequences [17]. These re no doubt are excellent ways to fully utilized natural resources whilst being environmental friendly. Some also did outstanding job in being aware of the environment like having drums to collect residues placed beneath the machines [10] or even using the unwanted pulp as biomass for vermicomposting [20].

Other than that, the huge difference between most of the machines is the structure of the fiber that produced, depending on what industries or end product the fibres will be turned into. If according to Laxmikant Chari [21], the end product of the extracted fibers are invested into paper company, thus explicating the end form of short fibers produced from his machine. Whereas, the rest of the design usually will have their way, going for long fibers to be turned to textile industry [6]. Prior to this, James McCrae [14] has patented his machine in a way that the fibre produced from leaves will be in the form of tow directly without necessity of any converting or additional steps like kneading to ease the next party, turning the tow into yarn [7].

Conclusion

As for the conclusion, different types of natural fibers have its own strength and weaknesses, which too goes the same for the different types of patented fiber machines. Nonetheless, PALF definitely needs more attention in terms of both, chemical properties research and its extraction machine since

it is still lacking in a few aspects such as the time constraints for the hardening resin, the establishment of whether to include crushing methods and others. Hopefully,this review benefits the rising PALF industry in years to come.

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