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Design and Development of Kenaf Hemp Fiber Extractor

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ABSTRACT: Natural products are environmentally safe from the process of extraction of raw materials to production, consumption and disposal .Generally wood material is used for paper production which costs billions and consumes more time. An alternate and eco friendly product is kenaf, the so called 'pulichakeerai' is used for paper production. A machine is designed to separate the bast and the core fibres of the kenaf stem. The bast fibres are used for paper extraction. Before the extraction of the fibres, accurate dimensions of the stem should be identified. For this 'Image processing technology' is incorporated for detecting the core- fibre edge dimensions. A simple design 'Solidworks' simulation tool is used for the decorticator. A sketch of decorticator is designed and a real shape is obtained. The solid work sketch designed can be used for extracting the paper in a eco-friendly, trouble-free and economical manner.

KEYWORDS: Eco-friendly, Kenaf fibre, Kenaf paper, Image processing, Edge dimensions, Solid works

I. INTRODUCTION

The kenaf plant is considered one of the most promising alternatives to virgin soft and hard woods for paper production. An herbaceous annual related to cotton and okra, kenaf is a member of the mallow family indigenous to West Africa. In 1960, the USDA chose kenaf from among five hundred candidates as the most promising non-wood fiber for pulp and paper production. After much research and numerous trials runs, kenaf paper is now available from several commercial retailers and is being used by major corporations, printing and graphics firms and publishers. Companies like Apple, Sony, Warner Bros., REI, J.C. Penny, The Nature Co., The Gap, Esprit International and Birkenstock have begun to use kenaf paper for catalogues and other purposes. Major Printing and Graphics firms such as Kinkos, Anderson Lithographics, George Rice and Sons, Ventura Printing and Lithographix now provide printing services on kenaf paper.

The main uses of kenaf fibre have been rope, twine, coarse cloth (similar to that made from jute),and paper. Uses of kenaf fibre include engineered wood, insulation, clothing-grade cloth, soil-less potting mixes, animal bedding, packing material, and material that absorbs oil and liquids. It is also useful as cut bast fibre for blending with resins for plastic composites, as a drilling fluid loss preventative for oil drilling muds, for a seeded hydro mulch for erosion control. Kenaf can be made into various types of environmental mats, such as seeded grass mats for instant lawns and mouldable mats for manufactured parts and containers.

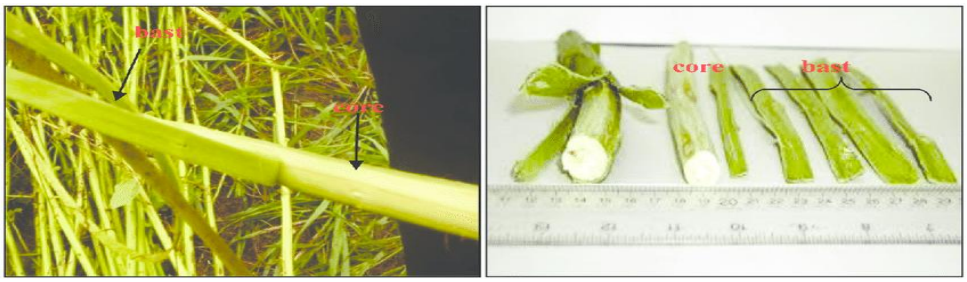

Fig.1 Kenaf stem

Additionally our college NATURE CLUB did a successful project using kenaf's incredible absorbing capacity. They made sanitary napkins using the core particles of the kenaf fibres and were applauded for their wonderful idea. This idea motivated all to know more about the fibre. After many references, literature reviews and discussions it is known that even papers can be extracted from the kenaf leaves. This paper is more of devising a machine to extract paper from the bast fibres of kenaf stem. This Project will be a unique initiative in 'Green world'.

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Fig.2 Kenaf plant

II. TREE-FREE KENAF PAPER

Earth Island Institute's Earth Island Journal was the first magazine to be printed entirely on 100% 'tree-free' kenaf paper.. Several other books have been published on kenaf, including Proceedings from the First Biomass Conference of the America's: Energy, Environment, Agriculture and Industry, and Peter Kreitler's The Earth's Killer C's. The USDA identified kenaf as the best non-wood paper alternative for several reasons:

1. Rapid growth
2. High yield
3. Exceptional papermaking characteristics

Fig.3 Bamboo fibre(brown colour) and kenaf fibre(white colour)

III. FIRST KENAF PAPER INDUSTRY

Despite its commercial and environmental advantages, the kenaf paper industry is as yet undeveloped. As of August 1995, New Mexico's Vision Paper was the only company commercially producing kenaf paper in the US. Due to significant industry start up costs, smaller economies of scale and government subsidies to the pulp, paper and timber industries, kenaf paper is more expensive than virgin wood-based papers. If the enormous costs of restoration are taken into account, development of the kenaf paper industry, which would leave forests intact while simultaneously reducing industrial pollution and energy consumption, begins to make both economic and ecological "cents/sense."However, depending on how the kenaf industry develops several environmental problems could arise.

IV. KENAF PREPROCESSING

Large scale monoculture farming is often chemically intensive. Currently only one pesticide and two herbicides are registered for use on kenaf. FFPC is currently investigating other non-polluting solutions to kenaf pest and disease problems. Kenaf pulping requires less chemical inputs and consumes less energy than most virgin wood pulping processes and is thus less polluting. Chlorine, which is commonly used to clean and brighten wood pulp of kenaf, is substantially less expensive than hydrogen peroxide. Despite many concerns, kenaf paper production saves critical forest habitat and is considerably less polluting and environmentally destructive than virgin wood-based paper production.

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Fig.4 Kenaf fibre extracting machine

V. KENAF PAPER

The use of kenaf in paper production offers various environmental advantages over producing paper from trees. Generally, the raw material used for paper production is wood which is in slight brown color to which a chemical should be added to make it white. In the case of Kenaf, the fiber itself will be white in color so no need for the additional whitening process which is the major advantage. There is no availability of appropriate machinery to efficiently extract both the fibre and the core. Kenaf newsprint made for stronger, brighter and cleaner pages than standard pine paper with less detriment to the environment. Hydrogen peroxide, an environmentally-safe bleaching agent that does not create dioxin, has been used with much success in the bleaching of kenaf.

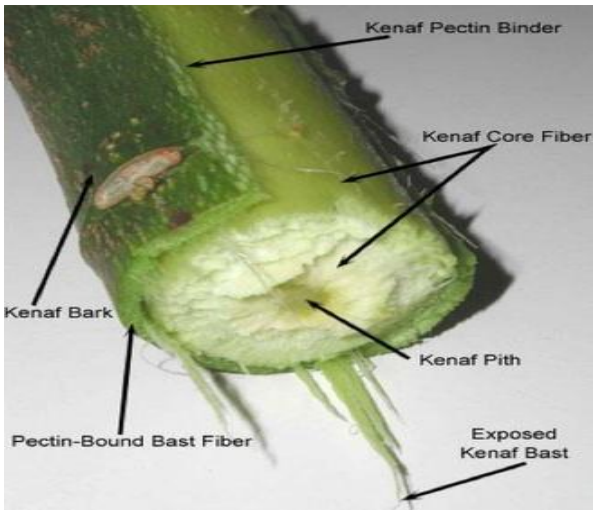

Fig.5 Cross Sectional View Of Kenaf Stem

Various reports suggest that the energy requirements for producing pulp from kenaf are about 20 percent less than those for wood pulp, mostly due to the lower lignin content of kenaf. It is estimated that growing kenaf on 5,000 acres (20 km²) can produce enough pulp to supply a paper plant having a capacity of 200 tons per day.

VI. ANALYSIS

The composites reinforced with kenaf bast fibres are found to have higher tensile, flexural and impact properties than kenaf core fibre composites.. It is observed that the elongation at break for both composites decreased as the fibre content increased. It can be concluded, that the higher cellulose content, the smaller fibre diameter and the longer fibre significantly increase the mechanical properties of the composite. It is found that the bast fibres are pure white in colour with extraordinary absorbing skills. In short, they are very much suitable for paper extraction. To find out the exact dimensions, we have used image processing technology. After knowing the exact dimensions, our device with arduino makes the blades to rotate. Thereby, separating the bast fibre from the stem for paper extraction.

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Fig.6 Analysed kenaf stem

A large and firm kenaf stem is obtained as shown below. The exact dimensions of the stem were obtained using the matlab code. Also a machine layout was developed using solidworks.

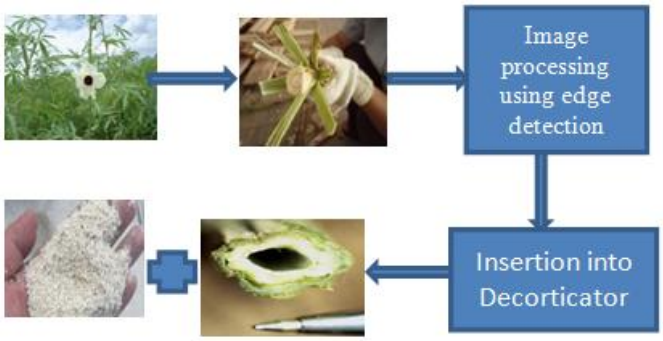

Fig.7 Blue Print of Bast Extraction

The machine will have a sharp and a light weight screw which adjusts its diameter according to the stem's dimensions. As the screw rotates we get the bast as well as the core fibres without any damage. With the obtained products, the bast is used for paper extraction which is going to be eco-friendly as well as cost effective.

VI. IMPLEMENTATION AND SIMULATION RESULTS

SolidWorks is a solid modeler, and utilizes a parametric feature-based approach which was initially developed by PTC (Creo/Pro-Engineer) to create models and assemblies. The software is written on Parasolid-kernel. *Parameters* refer to constraints whose values determine the shape or geometry of the model or assembly. *Design intent* is how the creator of the part wants it to respond to changes and updates. *Features* refer to the building blocks of the part. They are the shapes and operations that construct the part. The simulation results for identifying the edges and solid works are shown below.

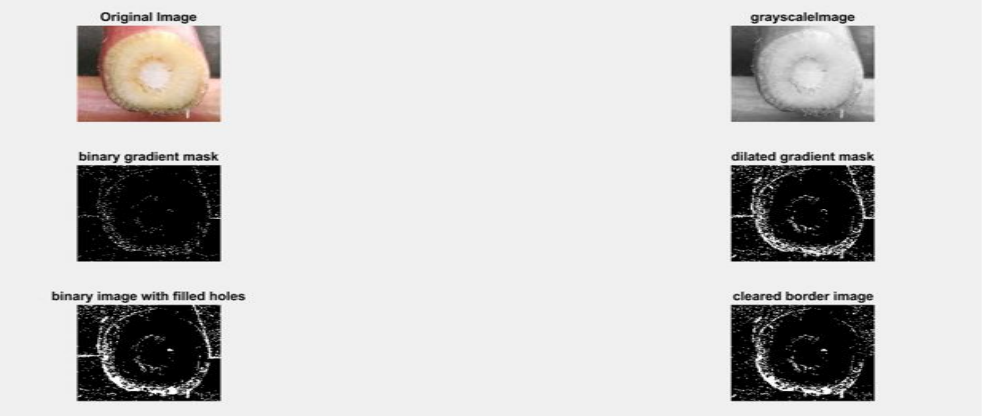

Fig.8 Simulation results-image processing

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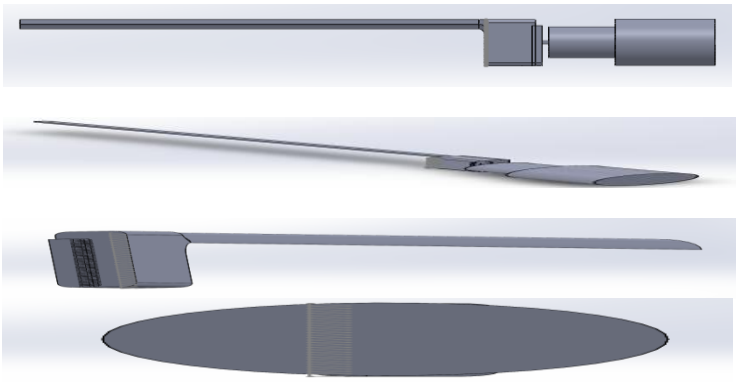

Fig. 10 Simulation results for solidworks

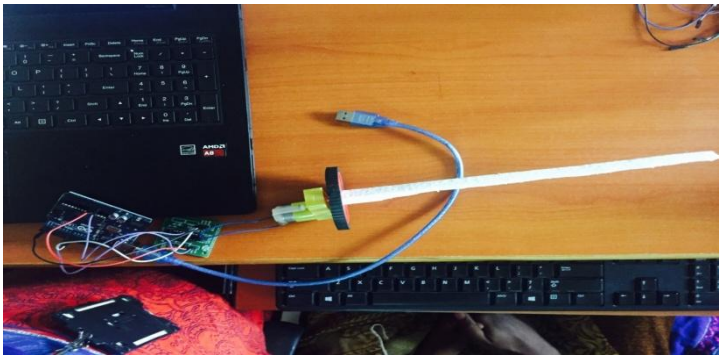

Fig. 9 Working model

VII.CONCLUSION

The kenaf plant is considered one of the most promising alternatives to virgin soft and hard woods for paper production. The core and the pulp of the kenaf stem is identified using edge detection method. After identifying, the core and bast fibre is separated with the help of the designed tool.The working model can be furthur enhanced for real time applications which will be cost effective. This work will be a unique initiative in bringing up the innovative eco friendly ideas and will go a long way in creating greener corridors with the less usage of chemical and non bio-degradable products.

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