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Banana fibre extraction machine

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ABSTRACT

The aim of this project is to design and develop a process to extract high quality natural fibers from the banana pseudo stems. Manual extraction of banana fiber produces good quality of fiber but it much time consuming. Labour expense is quite high and output is quite low. Hence efficient extraction of banana fiber can only be possible through mechanization. Now a day's machines exist for extracting banana fiber but are manually operated and cannot be applied for mass production. The other main disadvantages of existing machine are impurities present in rolled fiber. The efficiency of existing machine is average. It consumes time & the process is not safe. This project is specially designed for extracting banana fibre from the banana stem.

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I. INTRODUCTION

Textile industry has various untapped resource for the production of fibres, one such resource is natural plants. Natural plant stems/stalks/leaves fibers have been in use extensively in fast decade for production of Handicraft, Ropes etc. The huge availability of a natural plant stems/stalks/leaves is very tempting to use it for garment purpose. Natural plant stems/stalks/leaves is a waste after the fruit is harvested so its availability is huge. The primitive methods for extraction of natural plant stems/stalks/leaves fibers are hand scraping, hand retting. Next machines were developed where the low quality fibres with more damages were produced. Hence fibres were not used in large quantity.

The fibres extracted showed moderate to good fibre properties such as strength, fineness, fastness. Fibres may be used for apparel production such as shirts, ladies/children dress materials etc. Fibres can also be used for composite application (natural fibre reinforced composites for automobile, building construction, furniture etc). Fibres are suitable for blending with other fibres such as cotton, polyester, viscose etc. for high quality fancy textile fabrics. The machine developed was ideal for obtaining high quality fibres. Further, it can also be used for extraction of Agave family plants fibres. The machine developed is a low cost and high output machine very much suited for small scale industries. Banana is a well-known fruit crop and grown extensively in Indian peninsula. In fact, India is the leading producer of this perennial crop. It is estimated that, after harvest of fruits, huge quantity of biomass residues (60t/ha – 80/t ha) is left over as waste that constitutes pseudo stem, leaves, sucker etc. There exists a vast potential of extracting fibres from the banana pseudo stem. It is estimated that annually 17,000 tonnes of fibres can be extracted from this waste valued roughly Rs.85 crores. These enormous quantities of natural wealth can be exploited in fibre industry for the production of technical and non-technical textiles apart from its regular use in handicrafts and utility items. It involves a series of unit operations from extraction of fibre to making of final product from this natural resource. Though the manual process of extraction yields good quality of fibre but it is quite uneconomical due to its labour extensive and low output (200gm/person/day) characteristics. Hence efficient extraction of banana fibre can only be possible through mechanization. However, formulation and implementation of energy conservation drives at different steps of banana fibre extraction and processing may be taken up either one at a time or all simultaneously as practicable depending upon the various parameters. Synthetic fibre has overwhelmed all over the world as it is cheap and easy to handle. However, indiscriminate use of synthetic fibres causes severe impact on the environment as it pollutes the environment and is non-biodegradable. Thus it becomes necessary to explore natural fibres. Quite a few numbers of alternative natural fibres are already established like ramie, mesta, sisal, roselle etc. However, the main objective of growing of these plants is production of fibre only. Banana (Musa sp.) is a well-known important fruit crops grown in all over the world and can also be used as alternative source of useful quality fibres. The fruit bunches and leaves are main source of income, besides the leaves are used as bio plates for serving food in homes and functions. Though the technologies for extraction of fibres and paper making from pseudostem are available, yet it has not been adopted by the industries mainly due to high transport cost. However, there exist a vast potential of extracting fibres from pseudostem. It is estimated that annually 17,000 tonnes of fibre can be extracted from the waste portion of the banana plant, valued at roughly Rs. 85 crore (Rs. 50,000 per tonne). The fibre extracted from banana pseudostem could not command proper market owing to its restricted use in cottage industries. There appears to be good scope of profitable use of this fibre in textile and paper industries on commercial scale. Not only this, but number of high value products like carpets, coasters bags and different types of handicrafts can also be developed from banana pseudostem. In brief, banana fibre has a bright future and arena to perform in the forthcoming years.Micro Structural Features:-

A. Natural Fibres: Natural fibres are obtained from natural sources. It has many advantages over artificially manufactured synthetic fibres. These fibres have high specific properties with low density. They are eco-friendly unlike synthetic fibres because they are biodegradable and non-abrasive. The disposal of natural fibre composites is easy, they can be easily combusted or decomposed at the end of their product lifecycle. As compared to the cost benefits synthetic fibres, natural fibres comparably offer high security if used for automotive applications.

B. Characteristics of a banana fibre: The physical and chemical properties of banana fibre are considered below:

A. The chemical composition of banana fibre is cellulose (50-60%), hemicelluloses (2530%), pectin (3-5%), lignin (12-18%), water soluble materials (2-3%), fat and wax (3-5%) and ash (1-1.5%).
B. Its appearance is similar to that of bamboo and ramie fibre; however banana fibre has better fineness and spin ability.
C. It has shiny appearance depending upon the extraction and spinning process
D. It has very strong fibre with 3% elongation and light weight.
E. Its average fineness is 2386 Nm, average strength is 3.93 cN/dtex and average length is 50 ~ 60 mm (or 38mm).
F. It absorbs and releases moisture easily.
G. It can be spun by different methods like ring spinning, open-end spinning, best fibre spinning, and semi-worsted spinning.
H. It is bio-degradable and has no negative effect on environment and thus can be categorized as eco-friend fibre.

C. Mechanical Extraction of Banana Fibre:

The manual (or) semi mechanical extraction of banana fibre was tedious, time consuming and causing damage to the fibre. So after intensive study and research a simple low cost user friendly CTRI Banana Fibre Extractor machine was designed and developed for extracting Banana fibre mechanically from banana pseudostems, leaf stalks and flower stalks.

The method is simple and the machine is sufficient to extract fibre from Banana stems. It is very user friendly. Anyone can operate it with a training of just 30 minutes. This machine reduces the drudgery of manual extraction of fibre and provides a clean working environment. It will help the workers to produce more fibres and get increased income.

The usage of banana fibre for textile purposes predates written history. The evidence of this can be found in epics like Ramayana where Sita and Rama wore “Naravastra” clothes made from banana fibres Not only in India but also references of the history reveal that the banana fibre cloth was made around 13th century in japan. Japan's currency, the Yen, is made out of banana fibre. They used to produce fibres of different softness andfineness that yield yarn and textile with different qualities for specific use in olden days extracted fibre was used for making rugs, ropes and for tying flowersPhilippines and japan are the countries using banana fibre on large scale for commercial banana fibre to japan, Singapore, East Asian countries. Demand for textiles and readymade garments is increasing in India with increase in population and spending power. According to article research it indicates that a billion tonnes of banana plant stems are wasted every year. According to the Philippine Textile Research Institute, banana plantations in Philippines alone can generate more than 3,00,000 tonnes of fibre

II. LITERATURE REVIEW

[1]R. Bhoopathi, M. Ramesh, C. Deepa, this paper concluded that the present unsustainable environmental condition natural fibers are serving better material in terms of biodegradability, low cost, high strength and corrosion

resistance when compared to conventional materials. The benefits of components and products designed and produced in hybrid composite materials instead of metals recognized by many industries. The main objective of this experimental study is to fabricate the banana-hemp-glass fibers reinforced hybrid composites and to evaluate the mechanical properties such as tensile strength, flexural strength and impact strength. There are three different types hybrid laminates are fabricated by hand lay-up method by using glass, banana and hemp fibers as reinforcing material with epoxy resin. The specimen is prepared according to ASTM standards and the experiment has been carried out by using universal testing machine (UTM). From the experimental results, it has been observed that the bananahemp- glass fibers reinforced hybrid epoxy composites exhibited superior properties and used as an alternate material for synthetic fiber reinforced composite materials. Morphological examinations are carried out to analyze the interfacial characteristics, internal structures, fiber failure mode and fractured surfaces by using scanning electron microscopy (SEM) analysis.The banana-glass fiber, hemp-glass fiber and banana-hemp-glass fiber reinforced hybrid composties are fabricated and the mechanical properties such as tensile strength, flexural strength and impact strength of these composites are evaluated. The following conclusions have been derived from the experimental investigations.

- The banana-glass fiber hybrid composites have more tensile strength than other composites can withstand the tensile strength of 39.5MPa followed by the hemp-glass fiber reinforced composites which holds the value of 37.5MPa.
- The maximum flexural strength of 0.51kN hold by the banana-hemp-glass fiber reinforced composites followed by banana-glass fiber reinforced composites which is having the value of 0.50kN.
- The impact strength of the hybrid composites varies from the 5.33Joules to 8.66Joules.
- From the morphological observations the interfacial characteristics, internal structures of the fractured surfaces, fiber failure mode, fiber pull out and fiber dislocation are clearly observed.
- It is suggested that these banana-hemp-glass fibers reinforced hybrid epoxy composites can be used as an alternate material for synthetic fiber reinforced composite materials.

[2]K. L. Pickering, M.G.Aruan Efendy and T. M. Le, this paper concluded that Much research and progress has occurred in recent decades in the mechanical performance of NFCs. Improvement has occurred due to improved fibre selection, extraction, treatment and interfacial engineering as well as composite processing. This paper has reviewed the research that has focussed on improving strength, stiffness and impact strength including the effect of moisture and weathering on these properties; long and short term performance was addressed. NFCs now compare favourably with GFRPs in terms of stiffness and cost; values of tensile and impact strength are approaching those for GFRFs. The lower densities for NFCs lead to better comparison for specific properties. Applications of NFCs have extended dramatically including load bearing and outdoor applications such as automotive exterior underfloor panelling, sports equipment and marine structures. Further research is still required to extend their application range including improvement of moisture resistance and fire retardance. Overall, growth of NFC uptake continues at a rapid rate and there would appear to be a very positive future ahead for their application

[3] William Jordan, Patrick Chester, this paper concluded that the interfacial bonding between banana fibers and an LDPE matrix: peroxide treatment and permanganate treatment. The effects of the treatments on the tensile properties of individual banana pseudo-stem fibers were explored, with peroxide treatment enhancing the tensile properties and permanganate treatment having an inconclusive effect. Some interesting results from composite processing are briefly explored, leading to peroxide treated fibers being excluded from composite testing. The flexural and tensile properties of untreated and permanganate treated injection molded composite parts were then explored. Untreated banana pseudo-stem fibers provided a measurable increase in composite properties, especially in tensile stiffness. Banana pseudo-stem fibers provide a unique opportunity for reinforcement of thermoplastics such as LDPE. Peroxide and permanganate treatment serve to enhance the interfacial bonding of banana pseudo-stem fibers to their LDPE matrix. Peroxide treatment has the additional effect of enhancing the tensile properties of individual fibers, whereas permanganate treatment has an inconclusive effect on the tensile properties of individual fibers. In terms of composite flexural properties, untreated banana pseudo-stem fibers enhanced the strength and stiffness considerably, with an increasing effect with increasing fiber volume fraction. The permanganate treated composite behaved similarly to the untreated composite, with a slight enhancement in properties compared to the untreated composite at 10% fiber volume fraction and a slight reduction in properties compared to the untreated composite at 20% fiber volume fraction. This may be due to permanganate treated fibers breaking apart as they rub past each other during processing due to their roughened surface. In terms of composite tensile properties, untreated banana pseudo-stem fibers slightly enhanced composite strength and greatly enhanced composite stiffness with an increasing effect with increasing fiber volume fraction. The permanganate treated composite behaved similarly to their

untreated composite counterparts at equivalent fiber volume fractions, either matching or slightly underperforming the untreated properties. These trends for the permanganate treated composite do not match the trends shown in other literature, and it may be that in other literature the fibers were alkali pre-treated before the permanganate treatment. In conclusion, banana pseudo-stem fibers provide some measurable enhancement to LDPE properties, especially in terms of tensile stiffness. Permanganate treatment appeared to enhance the interfacial bonding but otherwise appeared to provide little to no advantage over the untreated composite in terms of tensile and flexural properties. This may be due to the permanganate treated fibers not being alkali pre-treated prior to permanganate treatment.

[4]Zaida Ortega, Moisés Morón , Mario D. Monzón , Pere Badalló and Rubén Paz, this paper concluded that Fibers have been extracted by mechanical means from banana tree pseudostems, as a strategy to valorize banana crops residues. To increase the mechanical properties of the composite, technical textiles can be used as reinforcement, instead of short fibers. To do so, fibers must be spun and woven. The aim of this paper is to show the viability of using banana fibers to obtain a yarn suitable to be woven, after an enzymatic treatment, which is more environmentally friendly. Extracted long fibers are cut to 50 mm length and then immersed into an enzymatic bath for their refining. Conditions of enzymatic treatment have been optimized to produce a textile grade of banana fibers, which have then been characterized. The optimum treating conditions were found with the use of Biopectinase K (100% related to fiber weight) at 45 C, pH 4.5 for 6 h, with bath renewal after three hours. The first spinning trials show that these fibers are suitable to be used for the production of yarns. The next step is the weaving process to obtain a technical fabric for composites production.

[5]Preethi P and Balakrishna Murthy G, this paper concluded that the world. Banana farming generates huge quantity of biomass all of which goes as waste and the above ground parts like pseudostem and peduncle are the major source of fibre. Banana fibre can be used as raw material for industry for production of range of products like paper, cardboards, tea bags, currency notes and reinforced as polymer composite in high quality dress materials. Fibre from pseudostem and peduncle of four commercial cultivars of Tamil Nadu viz., Grand Naine, Poovan, Monthan and Nendran were extracted using banana fibre extraction machine. The highest pseudostem and peduncle fibre recovery were obtained from Poovan (2.71% and 1.09%, respectively) and the lowest from Grand Naine (1.07% and 0.63%, respectively). Cellulose is the major component of the fibre. The highest cellulose content was recorded in Nendran peduncle fibre (60.27%) followed by Nendran pseudostem fibre (59.23%). The other non- cellulosic substances like hemicellulose, lignin and pectin were high in Monthan pseudostem fibre (15.75, 21.56 and 4.08%, respectively). Mechanical properties like tex and fibre diameter decides the fineness. Fine fibres were obtained from pseudostem of Nendran (24.23 tex and 0.119 mm, respectively). The breaking load, breaking extension and tenacity were found to be good in peduncle fibres of Nendran cultivar (332.33 g, 2.01% and 39.56 g/tex).

[6] K. Harini1, K. Ramya2, M. Sukumar1, this paper concluded thatThe principal aim of the present study is to develop a method for the production of cellulose nanofibers, from the banana peel (BP) and bract (BB). It is also the aim of this study to produce cellulose-based biopolymers through acetyl and lauroyl modifications. The microwave digestion method and ball milling assisted ultra-sonication method was optimized for sustainable extraction of micro and nano cellulose fibers, respectively. The microwave digestion method was found to be effective in the removal of hemicellulose and lignin. Micro and nano cellulose fibers of BP and BB were found to contain type I cellulose structure. Thermal stability and crystallinity index of cellulose nanofibers were examined to be higher than it's native micro cellulose. Nano cellulose fibers were examined to be a potential source for production of acetyl and lauroyl cellulose, with a high degree of substitution and thermal stability. Hence, microwave digestion and ball milling assisted ultra-sonication method was proven to be effective in the extraction of nano cellulose fiber for development of cellulose-based polymers.

III. METHODOLOGY

A. Research Paper

For This Project We were focusing on finding research papers for prediction of research gap and the idea to find new concept with mind set of project development regarding design and manufacturing. The research papers were gave us the domains and works which were already completed and provided lots of information regarding banana fiber machine.

B. Collection of Data

From research papers and resources we were collect the data for actual machine design and to overcome the bugs and challenges. The all collected data was used for getting proper path for development.

C. Numerical Calculation And CATIA design for Arrangement

For our project the next step to design actual model to banana fiber machine with calculations of different shaft used in machine as well as selection of component like bearing, belt pulley, etc.

For selection of component we were gone through different reference books and research papers.

Further the data which were we collected was gave us idea for design and component arrangement for banana fiber machine and we developed the tentative 3D model of our machine in CATIA v5 software

D. Develop Prototype of model

In this step we'll going to manufacture the prototype model of banana fiber machine with proper material selection.

For this step we will go too used following methods:

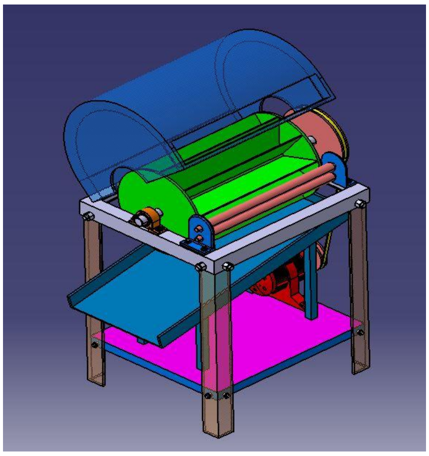
a. Welding
b. Cutting
c. Bending
d. Drilling
e. Assembly

E. Testing

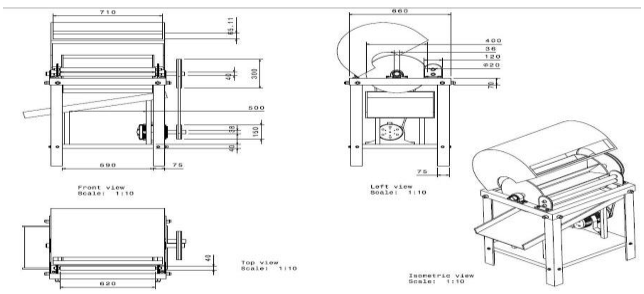
In this step we will to the testing of banana fiber machine for leaf this will give us idea about manufacturing problems i.e we'll come to know that whether the machine will work or not and what changes we have to made to Proper working of machine

IV. CATIA DESIGN

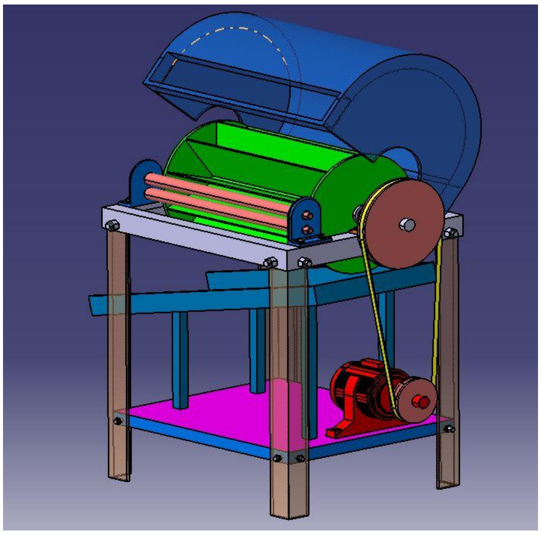
ISOMETRIC VIEW 1



DRAFTING



ISOMETRIC VIEW 2



V. CONCLUSION

It is simple machine consisting of fixed roller which fixed support. The roller is provided with horizontal stainless steel blades with blunt edges. Generally, 27 blades are used. 2hp motor is used to provide input power to machine. The machine reduces labor work and increases fiber production by 20-25 times as compared to manual process. In this process, natural plant stems/stalks/leaves are crushed between two drum rollers. Due to crushing the pulpy part is removed and fiber is obtained. Our next task was to give some framework such that moveable roller can be manually operated. For this purpose spring load mechanism was used.

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