CONCEPTUAL PROJECT OF A MACHINE TO DEFIBER COCONUT SEPARATING THE FIBER OF THE SUBSTRATUM (powder)

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It is common to develop efficient technologies that extract from the natural resources, new materials and products that benefit mankind. This extraction is important because it contributes to the solution of socioeconomic problems in areas less favored like northeast Brazil. There is a lot of industrial waste such as coconut shells. It takes eight years for it to decompose. This causes a serious environmental problem. This paper proposes the development of a conceptual project about a coconut shredder. It was made and inspired by the "Quality Gates System" method and was adapted to the reality of Brazil. This machine will help the environment by recycling the coconut shell. This conceptual proposal consists in shredding. It presents a semiautomatic feeding system with feeder rolls. They should squeeze the coconut shell to remove part of the humidity. After this, a rotor beater composed of six modules with rectangular bars, spaced equally, will receive the squeezed coconut to promote the shredding. Those fibers will go by a small "hedgehog" type rotor which is integrated in the system beater and the fibers will come out clean, being this the final product. It is possible that the conception of this prototype can contribute in the development of clean technologies for the environment, and minimize the impacts caused by mankind.

Keywords*: clean Technology; Coconut extraction fiber; Manufacture products.*

1. INTRODUCTION

In the world, the waste of manufacture products is a big environmental problem, mainly waste of product of vegetable origin. The exploration of these industrial residues, assume fundamental importance to possible solutions for socio-economic problems, especially in the poorest regions.

The vegetable fibers have advantages as: abundant source and renewable, low cost, low specific gravity or density, they are much less abrasive, no poisonous and are biodegradable, disadvantages as low processing temperature, limited to 200 ºC, no uniformity of properties and low humidity absorption that causes degradation (Bledzki and Gassan, 1999).

The fiber of young coconut can be used in production of agricultural substratum for the tomato production and bell pepper without soil, rugs, substitution of the other fiber, cover for cars, organic fertilizers, pressed wood, production of blankets for contain soil erosion, acoustic and thermal insulation, elements filter and numerous other applications.

Front the environmental questions and development of clean technologies that contributes to the scientific progress, the coconut shell is a product that be in evidence, thinking about it the Industry Laboremus Ind. and Com. Ltda, has identified the need of an equipment that facilitate the use of coconut shell by small scale industries. To development of equipment was elaborated a project conceptual of the coconut fiber extraction machine, with the objective of accomplishing the extraction fiber process in a single machine.

2. METHODOLOGICAL PROCEDURE

The methodological procedure used to project was QGS -Quality Gates System- that was developed by the University of Aachen, in Germany, and adapted for Brazilian reality through an agreement between SEBRAE and SENAI. This method is a tool destined to administration of projects, optimize and synchronize the stages, development processes that follow timeline, directly linked to quality of activities, consequent impact on cost. The methodology QGS includes all stages of project development; this work is limited identification of the problem and concept generation.

In the development of this equipment it was necessary to use system decomposition in subsystem and subsystem in components. Therefore, it tried to establish the functions of each component in the subsystem and, consequently, of the subsystem in the system. This will generate the links global functions and the other partial functions with the establishment of these junctions, is formed the system like new characteristics, it is described in the figure 1.

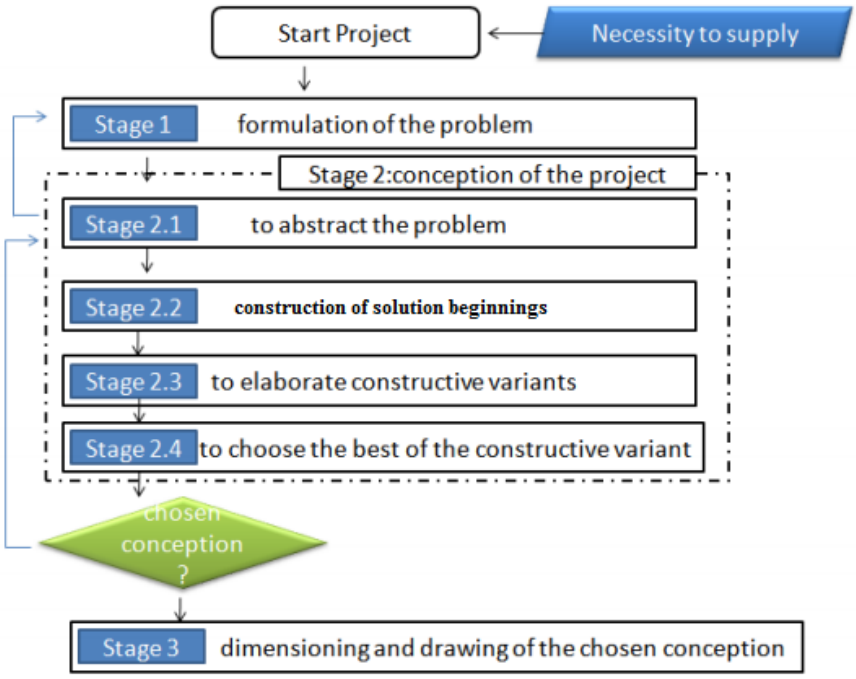


Figure 1: Methodology flowchart conception adopted in the work.
Source: Adaptation of the model of Pahl and Beitz, 1996.

The phase of project conceptions (phase 2) it was unfolded in four stages: stage 2.1, identification of the problem; stage 2.2, construction of solution beginnings; stage 2.3, elaboration of constructive variants and stage 2.4, choose of the best constructive variant. Chosen the conception, the next phase is conception sizing and the elaboration of the constructive drawings that will help in prototype assembly.

3. PROJECT CONCEPTIONS

This project conception, it was necessary preliminary study of several coconut fiber extraction machines to choice development appropriate for conception. In the table1 studied equipments are shown.

Table 1. Methods of extraction of fibers of the coconut.

Equipment	Extraction method	Used potency	Production
PHILIPPINE	Wetting/ mechanics for defiber	Electric motor 20cv	157 kg/h of fiber + 328 kg/h of powder
R1- LABOREMUS	Mechanics for defiber	Electric motor 20cv	205 kg/h of fiber + 350 kg/h of powder
FORTALMAG	Mechanical crush /mechanics for defiber	Electric motor 20cv (three motor)	Up to 1200kg/h of fiber + 1800 kg/h of powder
MIRDC	Mechanics for defiber	Diesel motor 22HP	5000 coconuts/day 625 kg/h

The conceptual project defibering proposed needs to have these characteristics:

1. Material to be processed: young coconut (high humidity), ripe coconut and dry coconut. The flow and transport of material, needs to be continually by the own machine.

2. Geometry: the defibering feeder should allow the passage of one or two coconuts, second reason L/D presented in the Table 3. The rotor of beating should not provoke the fiber cut.

3. Cinematic: The coconut should be put on rotor in perpendicular direction.

4. Forces: the rotor should have little inertia for not suffering variation of abrupt speed.

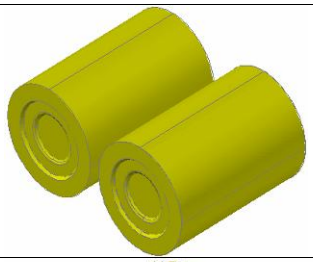
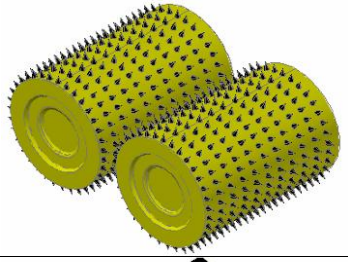
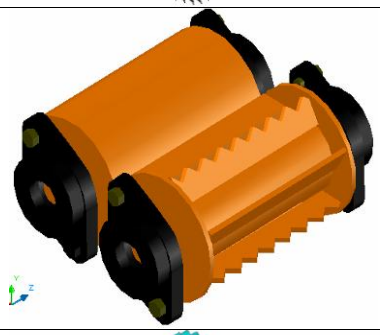
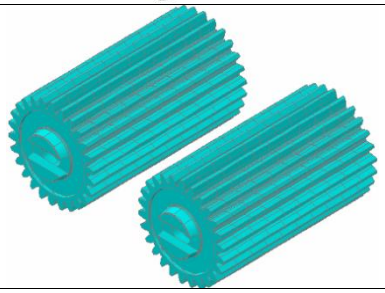
5. Cost: it is necessary the product has low cost that justifies production cost.

6. Safety: to attend safety minimum requirements.

3.1 Solution Destined to Attending the Initial Demand

For a better understanding, the table shows the main functions of the defibering proposed.

Table 2. kinds of rolls proposed

CODE	CONCEPTION	DESCRIPTION
RE 1		Conception of slick rolls, they possess low attrition coefficient, because the coconut possesses surface slick, so it doesn't attend the necessity.
RE 2		It is a form more interesting conception for the defibering machine. But disadvantage is: it is difficult to manufacture.
RE 3		It is also a conception of rolls that doesn't attend the necessity, but it would be a possible solution for the problem. It is relatively simple of manufacturing.
RE 4		These rolls present profile of gear of straight teeth, would give a very good solution for the problem. It can be manufactured easily.

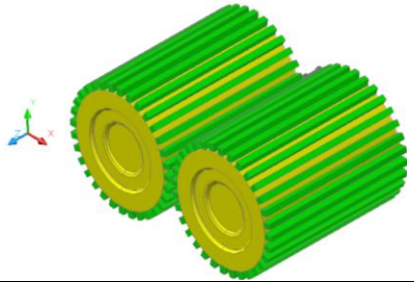
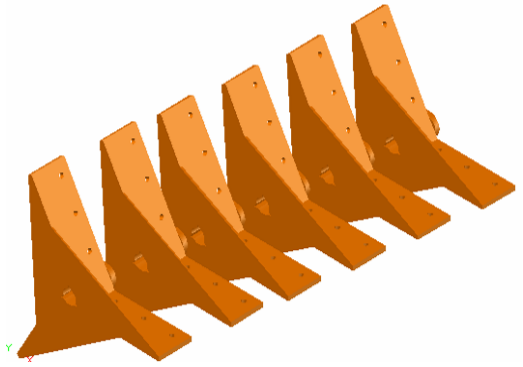
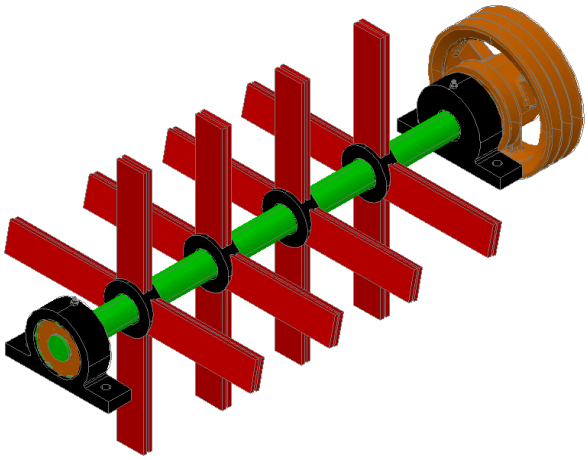
RE 5		This is a very appropriate conception. Easy production. Also offers great drags.

Table 3. Possible solutions for the partial problem: Rotor defibering - RD.

CODE	CONCEPTION	DESCRIPTION
RD 1		This conception assists the function of supplying impact of coconut, however it is a rotor very difficult of being manufactured and joins a lot of mass, increasing like this the production cost.
RD 2		This rotor presents the ideal conception, because it is very simple of manufacturing, besides for the that was studied in the machines defibering it is the most employed rotor for that purpose, it guarantees a good inertia and easy to balance. The hammers possess an angle of inclination of 12nd so that the fiber is pumped until the end of the rotor.

The principles solution guessed in conception and research to attend project needs is was necessary Rotor beater (RD) and Roll (RE5). They are presented in the Table 2 and Table 3.

3.2 Integral Mechanisms Conception of the Defibering Machine

In the morphologic table (tab. 4), stand out the components of the integral mechanisms, and the principle solutions generated and researched to attend the initial needs. However it is necessary to attentive the project established specifications in the Stage 1. The flow and transport material continually by defibering machine, the rotor beater should not provoke the cut of the fiber but just extract it. The rotor should has low inertia and it should attend safety minimum requirements.

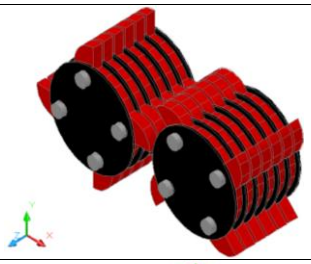
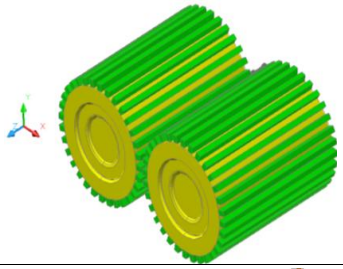
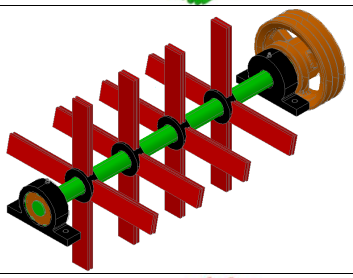
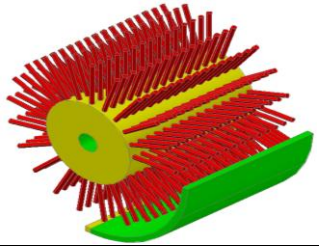
Table 4. Morphologic table

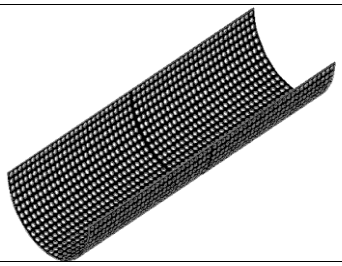
System	Subsystem	Component	solution principle (P.S.) developed or found				
Defibering	Rotor	Crusher Rolls	P.S.1	P.S.2	P.S.3	P.S.4	P.S.5
			RE.1	RE.2	RE.3	RE.4	RE.5
		Beater Rolls	RD.1			RD.2	

3.3 Solutions Proposed for the identified Partial Problems in the Tests

In the analysis of the problems identification, the conception was elaborated and is being shown in the table 5. The elaborated conception determines in decisive way the main components generated for the project.

Table 5. final conception

CODE	CONCEPTION	DESCRIPTION
RA		The objective of this ROTOR FEEDER (RA) it is to promote enough deformation in the coconut, so the smashing rolls can "pull" the coconut and to avoid the material reflux.
RE5		The SMASHING ROLLS (RE5): Its function is to remove spare humidity of the young coconut.
RD2		The function of BEATER'S ROTOR (RD) is to provoke the extraction of the coconut fiber through impact forces.
RS		The ROTOR OF EXIT (RS) has the function cleaner fiber.

TL		The SCREEN (TL) allows the separation of the powder and fiber.

RA, RS and TL are conceptions already available in the market defibering machine.

3.4 Defibering Machine Geometric Descriptions

Based in the accomplished studies, the figure 2 shows the conceptual project coconut fiber extraction machine that separates the fiber and substratum, which was developed in paper.

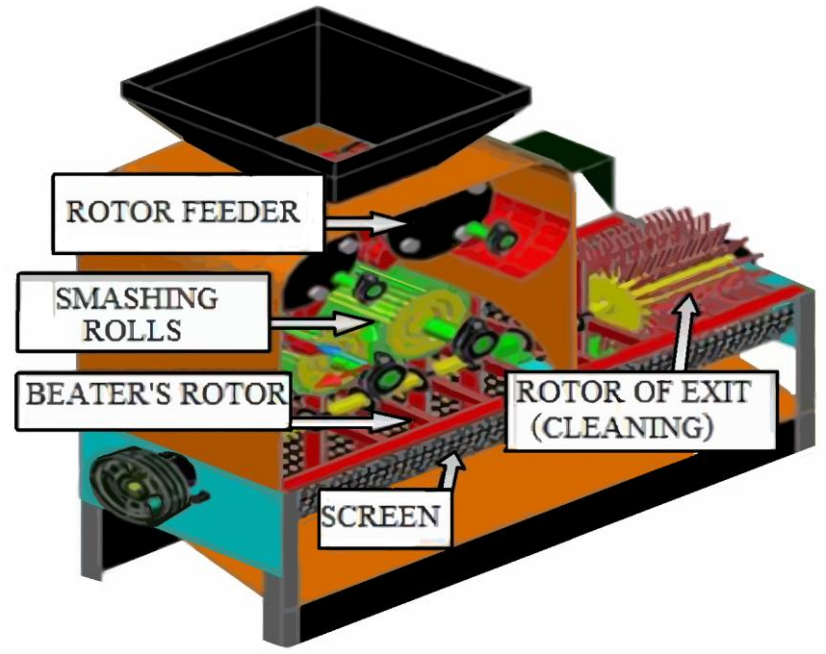


Figure 2: Defibering machine visual isometric without protections.
Source: Prototype drawn through the software Auto Cad 2009.

The conceptual project of the machine defibering proposed to show a semiautomatic feeding system with two rolls feeders that should squeeze young coconut, with intention of removing part of humidity. Those rolls will be worked by a reducer of speeds, like crowns and endless. It presents a semiautomatic feeding system with feeder rolls. They should squeeze the coconut shell to remove part of the humidity. After this, a rotor beater composed of six modules with rectangular bars, spaced equally, will receive the squeezed coconut to promote the shredding. Those fibers will go by a small "hedgehog" type rotor which is integrated in the system beater and the fibers will come out clean. This system will work with single electric motor and transmission.

4. CONCLUSION

The objective of this paper is conception coconut fiber extraction machine which separating the fiber and substratum. For so much it was necessary a lot of knowledge in the area of defibering machines. After, established the paper methodology and obtained the results is possible to conclude that the presented conception possibility the construction of a machine that attend the initial necessity of the project.

5. BIBLIOGRAPHY

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6. RESPONSIBILITY NOTICE

The Authors Luciano Leite de Sousa, Renato Carlos Batista, Juscelino de Farias Maribondo, Wanderley Ferreira Amorim Junior are the only responsible for the printed material included in this paper.