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ECO INNOVATION; COMPUTER SIMULATION IN CASSAVA GRATING MACHINE

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ABSTRACT

Closer attention has been paid recently to innovations in mechanical engineering as a way to motivate industrial owners and policy makers to work towards more radical and systemic improvements in environmental performance and. eco innovation. The positive contribution that industry can make to sustainable development and a competitive economy hinges on a radical change from old and moribund method of production to modern invocation using computer tools like simulations mechanisms. Computer simulations have become a useful tool for the design and modeling of many industrial systems in field of physics (computational physics), astrophysics, climatology, chemistry, biology and manufacturing, human systems in economics, psychology, social science, healthcare and engineering. Simulation of a system is represented as the running of the system's model. Computer simulation is used to explore and gain new and wider insights into the modern technology and to evaluate the performance of systems too complex for analytical solution. Improvement of nutritional values of processed products also requires special attention from policymakers and researchers. The application of computer simulation model in designing and construction of industrial tools, processing plants, etc. has become very essential because of its flexibility and its economical usefulness in achieving a better result in given environment and time. Cassava is frequently denigrated because its roots are low in protein. However, protein may be supplemented from other sources, particularly legumes; for example, fortification of cassava flour or garri with protein-rich soy flour can be achieved. Such fortified products will be nutritionally advantageous, and thus economical and acceptable to consumers. Cassava is a major source of carbohydrates in human diet. It is widely cultivated and serves as a major source of income in countries like Brazil, India and most West African countries including Nigeria. The tubers of cassava cannot be stored longer after harvest before decaying. Due to this short storage period of the tubers, cassava tubers are further processed into other forms to enhance its storage and to serve other purposes. In Nigeria, the major uses of cassava tubers are to process it into garri for consumption and commercial purposes. The rate of garri consumption in Nigeria and West Africa, in general, increases due to its low cost and availability to the poor, and can be measured in small cups. The growing demand for this root crop by the majority of population and the strenuous processing method actually instigated the interest of industrial engineers and business sector to device means to get cassava processed in a very short time at low cost and environmentally friends to. And this has become an issue of great concern not only to the end users but also to those that cultivate cassava in a commercial quantity. Processing of cassava tubers into garri after harvesting involves different stages starting with the peeling, washing, grating into cassava pulp, dehydrating the pulp, sieving the cake and finally frying. One of these processes which is the grating led to the development of various types of cassava grating machines. A faster means of achieving this objective, economically, environmentally friendly and in a specific time frame is what this design project is set to achieve using the eco-innovations through computer simulation.

KEYWORDS: Eco-Innovation, Design, Simulation, Cassava Grating and Computer Simulation.

INTRODUCTION

The eco-innovation concept is fairly a recent.[1] One of the early works on this concept appeared in a work done by Claude Fussler and Peter James.[2] In a subsequent article, Peter James defines eco-innovation as "new products and processes which provide customer and business value but significantly decrease environmental impacts".[3] But Klaus.[4] introduces the term eco-innovation addressing specifically three kinds of changes towards sustainable development, namely: technological, social and institutional innovation. Eco-innovations simply mean positive and sustainable changes in economic activities in a given environment. It is closely linked to a varieties of related concepts. It is often used interchangeably with "environmental innovation", and is also often linked with environmental technology, Eco-efficiency, eco-design, environmental design, sustainable design, or sustainable innovation.

Also the term "environmental innovation" is used in similar contexts to "eco-innovation", while other terms are mostly used when referring to products or processes in designing, and therefore focus more on the technological aspects of eco-innovation rather than the societal or political. Ecovation is an integration process or ideas by which responsible capitalism aligns with ecological innovation to construct products which have a generative nature and are recyclable back into the environment for usage in other industries.

Following the growing global economic realignment, eco-changes, close attention has been paid to innovations in recent times, as a way out for industrial operators and policy makers to work towards achieving more radical and noticeable improvements in industrial and environmental performances.

The term eco-innovation calls attention to the helpful contribution that industrial sector can make towards reliable improvement in a competitive environment. Again, relying on the definition of eco-innovation in the,[5] and on the existing works on this terms, eco-innovation can be understood and analyzed according to its targets (the main focus) its mechanisms (methods of bringing about improvements in a given environment) and its impacts (the effects on environmental conditions in general). OECD countries have addressed sustainable manufacturing and eco-innovation mainly through environmental policies. Though these innovation policies have not, radically, so far, addressed environmental issues. Closer integration of innovation and environmental policies could benefit both policy areas and accelerate policy and corporate efforts towards sustainable development.

The OECD Oslo Manual for the collection and interpretation of innovation data describes innovation as “the implementation of a new or significantly improved product (goods or services), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations”.[6] According to Rennings,[7] the above definition applies, generally, to eco-innovation - eco-innovation has two further significant, distinguishing characteristics:

- “It is innovation that reflects the concept’s explicit emphasis on a reduction of environmental impact, whether such an effect is intended or not.
- It is not limited to innovation in products, processes, marketing methods and organizational methods, but also includes innovation in social and institutional structures. Eco-innovation and its environmental benefits go beyond the conventional organizational boundaries of the innovator to enter the broader societal context through changes in social

norms, cultural values and institutional structures. Building upon existing innovation and eco-innovation literature.[8,9] maintain that "eco-innovation can be understood and analyzed in terms of:

1) Target,
2) Mechanism,
3) Impact, and
4) Its typology.

Computer Simulation: Concepts and Applications

Computer simulation activities help the user create or recreate an image, object scenario, environment, functions, or processing that either helps to improve the lot of the user or group of users, or a particular target. It functions as an innovative instrument that aids in remodeling, that is, improving the existing or introducing better methods of usage of a machine, engine, tools, etc. in a given environment. Its target, mainly, is to improve the existing operational methods or functional quality of a system using mathematical logics associated with the object, to arrive at a better result or outcome.

It has been found that computer simulation method allows the user to check the reliability of chosen mathematical models, and therefore, it is fast becoming a useful tool for the mathematical modeling of many natural systems in physics (computational physics, astrophysics, climatology, chemistry, biology and manufacturing, human systems, economics psychology, social science, health care, agro and mechanical engineering.

Simulation mechanism are programmed soft wares that aid designers to carry out any work intended to improve functions of engines, machines, facilities which are used in processing industries, manufacturing of goods aid in varieties of services in a given economy. Computer simulation programs can be used to explore and gain new insights into new technology and to evaluate the performance or usefulness of systems too complex for analytical solution.[10] Simulations facilities can be a low, medium or large scale models that can be very conveniently in a PC instantly, or large-scale programs that run for hours or days on network-based groups of computers. From all indication, so far, the large scale functions of simulation activities being run simultaneously online these days has far exceeded anything possible (or perhaps even imaginable) using traditional paper-and-pencil mathematical modeling. For instance, in Kuwait, over 10 years ago, a desert-storm, where a simulation of one force invading another involved the use of over 66,239 tanks, trucks and other vehicles on simulated terrain around Kuwait, using multiple supercomputers in the DoD High Performance Computer Modernization Program.[11]

Cassava: A Tropical Friendly Root Crop

Cassava, *Manihotes culantacrantz*, a ***dicotyledonous*** perennial plant belonging to the ***botananical*** family ***Euphorbiaceous,*** is a tropical friendly root crop. It is a high dependable root crop like yam, in many developing tropical regions of Africa, West India, Brazil, Malagasy, Indonesia, Philippines, Malay, Thailand and China.[12] For instance, in tropical Africa, cassava and other tubers like yam form the most staple food crops which form basic and reliable main stay and major sources of carbohydrate in the diets of these regions of the work, as mentioned above.[9] In the sub-Saharan region of Africa, like Nigeria, its high yield in poor soil and the ability to stay in the soil for long periods after maturity make it a very important source of food-security crop. Olukunle.[13] reported that “as a result of development in technologies, cassava production was needed in several areas in order to boost its utilization in oil and gas sector, for enhanced food security and sources of foreign exchange and tools and raw material for rapid industrialization.” He further stated “that as a result of improvements in use of technologies, cassava production was needed in several sectors of the economy to boost its utilization.” He however, asserted that “the manual hard work in post-harvest processing can be minimized or eliminated through improved processing mechanism. Although, the cassava crop has relatively few problems in production, its major problem seems to multiply at the post-harvest stage, like the storage of fresh tuber, unskillful handling of mechanized processing machine, drying and frying, are difficult areas.

In all these processes, peeling is a major problem, when it involves preparation of the cassava tubers for industrial or human use. The effectiveness of peeling determines the quality of the resultant product especially as regards unwanted contents. In some cases, especially when the cassava is being used for animal feed, peeling may be unnecessary.[14]

According to Adetan et al.[15] “the cassava peel has two layers; the outer layer called periderm and the inner layer called cortex. The problems encountered in peeling cassava root tuber arise from the fact that cassava roots exhibit appreciable differences in weight, size and shape. There are also differences in the properties of the cassava peel which varies in thickness, texture and strength of adhesion to the root flesh. Thus, it is difficult to design a cassava peeling machine that is capable of efficiently peeling all roots due to the wide differences in properties of roots from various sources.”

Apparently, this is where this work emphasizes most, considering the use of computer simulation method to design a more efficient and sustainable processing machine that can take care of all these processes without much loss in value and time. This research effort therefore seeks an uncomplicated design to make it cheap to produce and easy to use (ergometry) for post-harvest workers just like the grinding machines. This work focuses on designing and construction of a machine that can peel a particular size of cut-to-size cassava tubers using computer simulation package to achieve the aim.

Garri is a fermented and gelatinized dry coarse flour from cassava. It is very common in West Africa and serves as one of the staples food in Nigeria, Ghana, Benin and Togo. Its ability to store well and its acceptance as a "convenience food" is responsible for its increasing popularity in the urban areas in the sub-Sahara. It is often consumed as the main meal in the form of a dough or a thin porridge.

It is prepared in the household by mixing dry garri with hot water to form a dough and are served with soup or stew. It can be soaked watery with ordinary or cold water, adding sugar, honey and roasted groundnuts or cocoanut, or milk and consumed/served as a snack and an appetizer. It swells three to four times its volume when mixed with cold water.

The local method of garri production is a long and tedious one. The method passes through five distinct operations: peeling, grating, fermentation and pressing, sieving, frying and drying. These operations are manually carried out entirely by women, with few men assisting, usually starting very early in the morning, harvesting, peeling and washing the roots in the field, then carrying the cleaned roots to the village where the rest of the operations are carried out.

Design Scope

The scope of the work is to simulate, design, model, a functional, reliable, economically sustainable and environmentally friendly cassava grating machine.

LITERATURE REVIEW

In the early 1970s a cassava grater was developed in the Intermediate Technology Development Group's workshop in Nigeria made from simple workshop spare parts and using hacksaw blades mounted on a vertical disc. It was driven by somebody peddling. The "Wadwha" disc grater was developed in Ghana and consisted of a disc shaped wooden block to which a perforated metal sheet was nailed. The disc was driven by a 5 hp diesel engine and a through put of one tonne of cassava was claimed. The Tikonko Agricultural Extension Centre in Sierra Leone developed a vertical drum grate. The outer surface of the drum was covered with a sheet of perforated metal and as it rotated the cassava was pressed against the grating surface by a wooden block. The drum was powered by a 5 hp electric motor or diesel engine. In general capacities range between 300kg to 1,000kg per hour.[16] In Cameroon many of the cylindrical power graters used in villages are based on the design of CENEEMA which has some unique design features intended to improve grating efficiency and output without necessarily increasing the power requirement.

Grating

The grating operation is usually carried out manually, but power-operated graters of various makes and models are being more widely used.

Traditional method

Hand grating is invariably considered the most tedious and painful operation of the whole process. The women who still grate the cassava manually, when asked about the problems of garri processing, will simply show the palms of their hands. To hand grate one tonne of fresh peeled cassava roots generally requires 10-15 man days of effort.[17] The cassava is usually grated at least one hour after washing in order that excess water can drain off the peeled and washed cassava, otherwise the roots are too slippery and too difficult hold during grating. The manual grater is usually only a piece of galvanized metal sheet or even a piece of flattened can or tin, punched with about 3mm diameter nails leaving a raised jagged flange on the underside. This grating surface is fixed on a wooden frame and the cassava pieces are pressed against the jagged side of the metal and rubbed vigorously with strong downward movements. Particular care has to be taken and some skill is required "not to also grate the fingers" but still accidents sometimes happen. This traditional technology can be improved by mounting the grating surface on a wooden table at a convenient height so the rubbing action is horizontal rather than in a downward slant when the grating surface is supported against the operators legs It is not possible to completely grate a whole cassava piece, 3% to 5% of the cassava has to be left ungrated.[18,16] A skillful person is able to produce only about 20 kg/hour. In 1990 manual graters were sold for US$2 to $3 each in village markets of the north-west province of Cameroon.[18]

Mechanized grating

Sometimes a group of processors will purchase their own mechanically powered rasping or grating machine or a private contractor will travel within a group of villages grating cassava for a fee. There are two types in common use: i) modified hammer mills and ii) graters using an abrasive disc. The abrasive surface can be either cylindrical or a flat disc and is frequently a galvanized metal sheet with nail-punched holes, as in the hand grater, and attached to a wooden frame. It is said the grating surface normally wears out with six months of regular use and must be replaced otherwise the output of the machine is significantly reduced. One further disadvantage with this rudimentary grating surface is the difficulty of cleaning it after use. Debris becomes lodged in the holes and within the torn flanges and becomes a substrate for microbial growth and the possible subsequent contamination of the grated cassava which could affect the subsequent fermentation. Many of the simple graters in use have been developed by local institutions. In Cameroon many of the cylindrical power graters used in villages are based on the design of CENEEMA which has some unique design features intended to improve grating efficiency and output.[19]

Theoretical Analysis

Shafts Design

A shaft is a rotating machine element which is used to transmit power from one place to another. The power is transmitted by some tangential force and the resultant torque (or twisting moment) setup within the shafts permits the power to be transferred to various machine or its elements linked up to the shaft. In order to transfer the power from the shaft, the various members such as pulleys, bearings, drum etc are mounted on it. These members along with the force exerted upon them causes the shaft to bending. Therefore, we may say the shaft in this case is exposed to bending moment and torsional forces.[19] since it is utilized for torque transmission and bending moment (Figure 1).

Determination of the Bending Moment at each point of Loading

This involves the preparation of the bending moment diagram for the two perpendicular planes: vertically and horizontally (Figure 2).

Force Exerted on Shafts (Vertical Force)

The machine element that exerts force on the shaft is the belt pulley driven electric motor and grating drum:

Weight of Pulley,

W p =Mp g **(i)**

Where

= Mass of the pulley in Kg = 1.5kg

g = Acceleration due to gravity = 9.81m/s

Wp = 9.81 x 1.5kg = 14.715N

Weight of Drum, Wd =ρ V g **(ii)**

= ρ V g of [Volume of The Two Circular plates + Volume of the Rolled Steel Sheet + Volume of Perforated Mesh]

Where ρ = Density of the Material

= For Stainless, 7930kg/m3

= For Mild steel, 7860kg/m3

V = Volume of the Material

Volume of pipe

= πΔr2h

= π (0.25″ x 0.245)2 x 0.35

= 4.1251 x 10-3 m3

Volume of Circular Plate

= 5.94x 10-5 m3 g

= Acceleration due to gravity

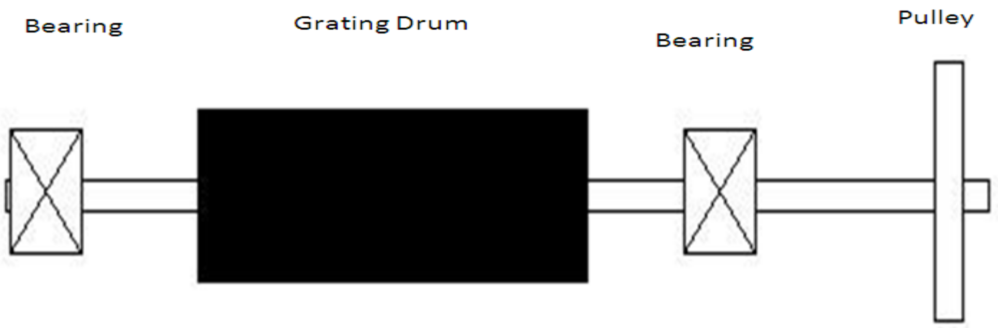
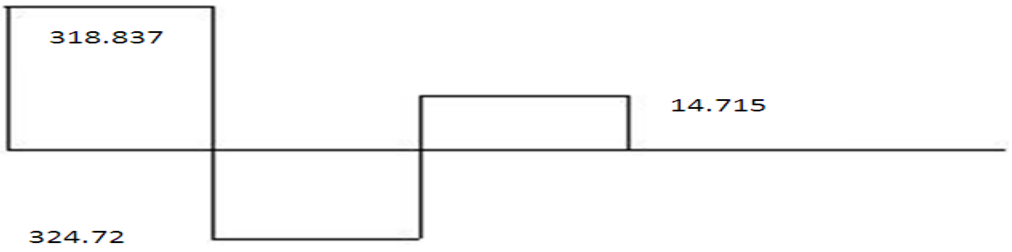


Fig 1 shaft bending moment determination



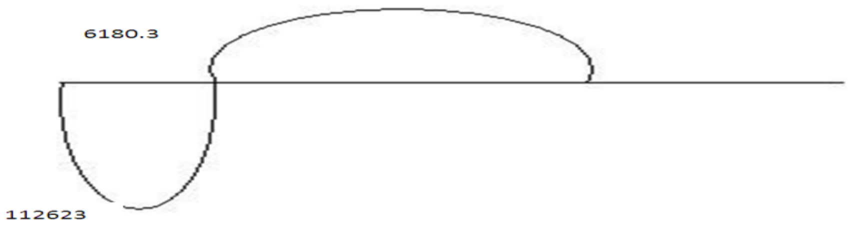


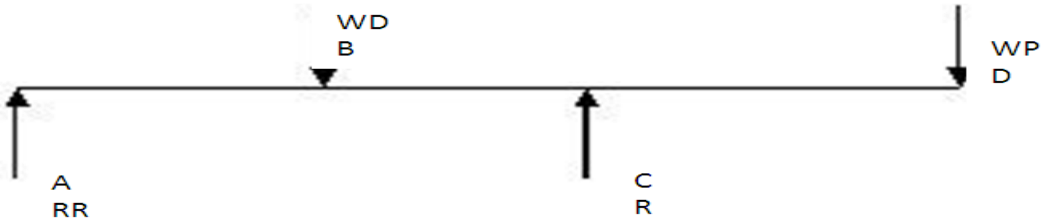
Fig 2, shear force and bending moment Diagram.

Point Loading of Shaft Due to Drum,-3 Wd = 9.81[({4.125 + 0.0594}10 + (7930 x 4.125 x 10)] = 643.56N

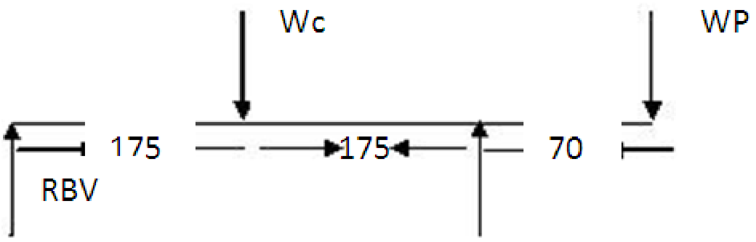
Distributed Loading Due to Drum = 643.56/350 = 1.839N/mm

Reaction at the bearing due to vertical loading

Below is represented the expected free body diagram of vertical forces acting on the shaft:



To obtain the reactions at each bearing, we will have to take moment about the two expected bearing points independently.



V Taking moment about point A,

-RCV (350) + Wp (420) + 643.56(175) =0

RCV = 339.438N

Taking moment about point B,

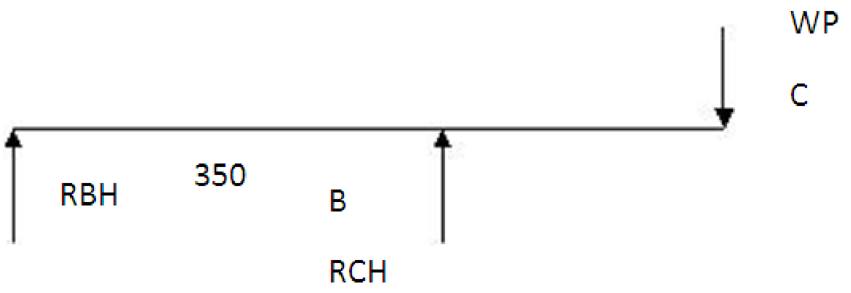
-643.56(175) + RBV (350) + Wp (70) = 0

RBV =318.837N

From the results of the calculations, we obtained the shear force and bending moment diagrams required.

Due to Horizontal Loading

Below is represented the expected free body diagram of horizontal forces acting on the shaft.



Where…… (iii)

Angular Acceleration, w in rad/s=2πN/60 ……. (IV)

Torque= 746x60 = 4.95nm

2πx1440

Horizontal weight on the pulley,w^1 p= 4.95

3^{ii}x0.0245

= 67.35N

Using the w^1_p horizontal force, we then obtained the horizontal reactions at the bearings by taking the moments about the two bearing points.

RBH + RCH = $_{W1p}$

Taking moment about Point A,

RCH (350) = 67.35(420)

RCH = 80.82N

RBH = -13.47N

From these results of the calculations obtained the shear force and bending moment diagrams required.

Considering the horizontal, vertical forces, and the bearing reactions, the maximum bending moment then obtained from the resultant bendin moment.

(v) = 113958.08N

Then, the equivalent twist moment from the torque.

=113958.0895N

The diameter of the shaft can be determined by: equivalent twist moment, $Te = \pi/16 x t x Ds^3$ ……. (vi)

Where

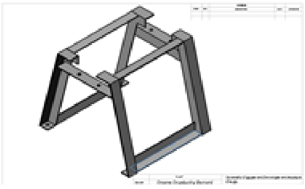
t = Permissible Shear Stress of the Shaft

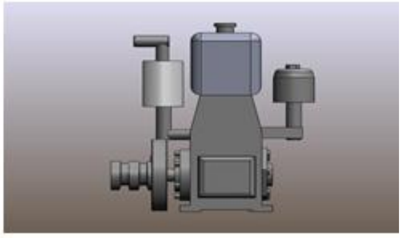
Material, 42MPa

Ds = Diameter of Shaft

$113958.0895 = \pi/16 \text{ x} 42 \text{x} 10^6 \text{x} Ds^3$

Modeling of Machine Components





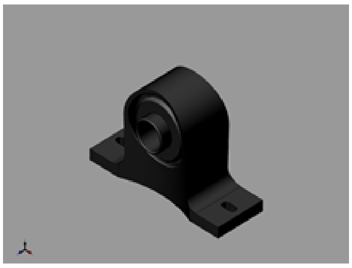
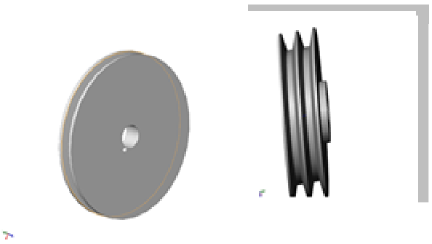
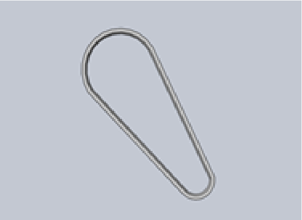


Figure 3: The frame. Figure: 4 Prime mover. Figure 5: Bearing





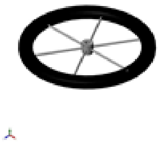
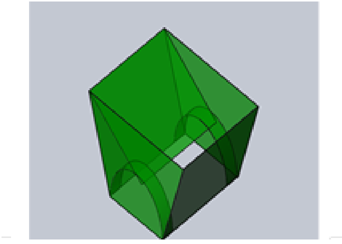


Figure 6: A set of pulley. Figure 7: V-Belt. Figure 8: wheel.



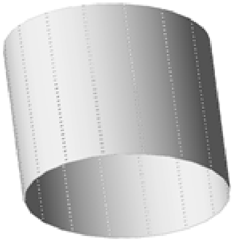


Figure 9: Hoper. Figure 10: Perforated mesh. Figure 11: Inserted wood.

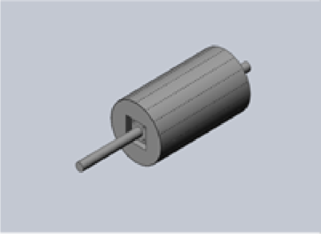
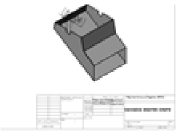
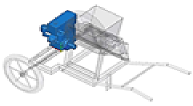




Figure 12: Grater Unit.   Figure 13: Outlet.   Figure 14 Handle.

Simulation of the Machine Processes

Simulation of the Components

Double Click Icon

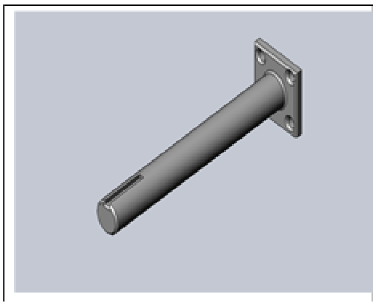
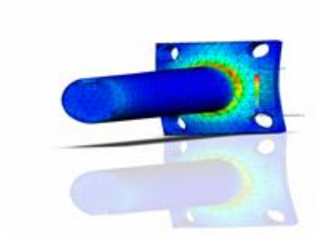
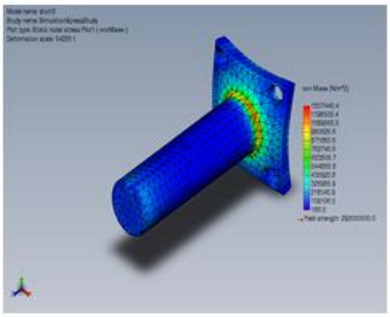




Figure 16: Shaft.   Figure 17: Shaft under stress.   Figure 19: Deformed shape.

Sustainability Analysis of Cassava Grating Machine Proceses

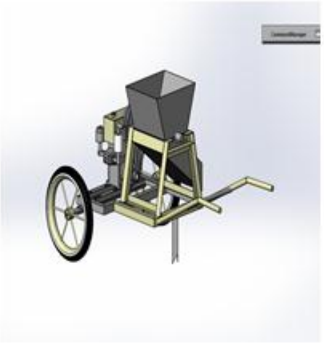
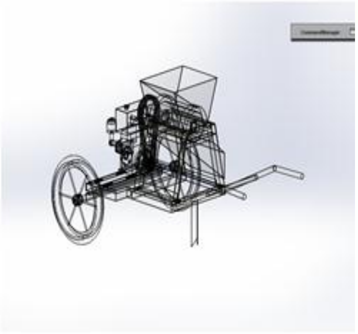
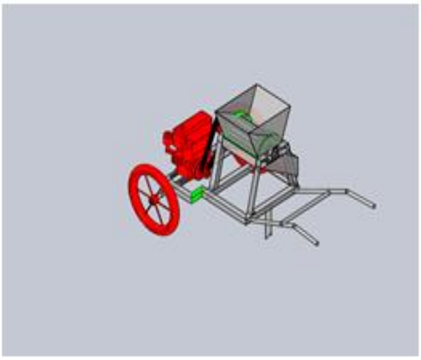




Figure 20: grater model. Figure 21: Material selection process. Figure 22: the Result of the analysis.

Eco-innovation

Is a new business approach which promotes sustainability throughout the entire life cycle of a product, while also boosting a company’s performance and competitiveness? It can help small- and medium-sized enterprises (SMEs) access new and expanding markets, increase productivity, attract new investment into the business, increase profitability across the value chain, and help SMEs stay ahead of regulations and standards – notably those related to the environment. UN Environment, with funding from the European Commission and the support of DTU (Technical University of Denmark), has created a fresh, informative website to introduce eco-innovation and encourage businesses in developing countries and emerging economies to embark on the eco-innovation journey

United Nations Environment Programme Terms of Use.[20]

The world market of environmental products and services is growing. According to a OECD study, in the EU-25 alone, goods and services provided by eco-industries is estimated to represent around 2.2% of the EU-25 GDP. Clearly, eco-innovation represents a key opportunity to establish Europe's leading role to overcoming the world's sustainability challenges, and a sizeable business opportunity that can make Europe's economy even stronger and more competitive in the future.

Eco-Innovation 2009 Call Priority Areas

This call supports Eco-innovative projects in different sectors which aim at the prevention or reduction of environmental impacts or which contribute to the optimal use of resources.

However, more specific priorities have been set up considering its important environmental impact. They are summarized hereafter

In the field of materials recycling

- Improved sorting processes for waste materials such as construction, industrial, household, electrical and electronic waste;
- Eco-friendly design and production of high quality consumer goods, innovative recycling processes;
- Business innovations that strengthen the competitiveness of the recycling industries illustrated in figure20-22

In the food & drink sector

Innovative products including packaging methods and material that reduce environmental impact and maximize the use of raw materials in the food sector;

- ❖ Cleaner and more efficient processing of food and drink products so as to reduce waste and increase material recycling and recovery;
- ❖ Improved efficiency water management processes that reduce the use of water across the food & drink supply chain;
- ❖ Innovative products, processes and services reducing environmental impacts of consumption including packaging, distribution and purchasing decision

In the building & construction sector

Innovative building products that reduce environmental impact and/or support a rational use of natural resources;

- ✓ Innovative sorting, reuse and recycling of construction and demolition waste;
- ✓ Innovative water systems including water saving, re-use of natural waters, rainwater collection and re-use, green roofs, illustrated in figure 20-22.

In the area of greening business & 'smart' purchasing

Products and services that follow the principles of Integrated Product Policy and the life-cycle approach and in line with the various policies documented in the Action Plan on Sustainable Consumption and Production and Sustainable Industrial Policy;

- ❖ Implementation and promotion of environmental criteria for purchasing decisions of enterprises;
- ❖ Innovative approaches to EMAS (Eco-Management and Audit Scheme) including increased resource and energy efficiency and biodiversity aspects or simplifications (Cluster approach.[21]

Computer Simulations in Engineering

Computer simulations, or models, are computer programs that can predict or create a theoretical reality based on algorithms and statistical probabilities. The algorithms are designed to predict the most likely outcome/interactions and can be a useful tool in many engineering industries to determine the optimal working procedures. Computer simulations in their most basic sense are a step-by-step mathematical approximation applied to a real-world or theoretical environment. A simulation process generally proceeds through a logical series of operations. Once a model is chosen, a method to implement the model can be performed on a computer which calculates the algorithm output and allows for visualisation of the data.

This complete series of steps provides the best theoretical result possible for a real-world example. Real-world examples can be unpredictable, depending on the environment, so the theoretical is not always colloquial with the actual.

The most common types of simulation are equation-based, agent-based, Monte Carlo and multiscale simulations. Even within these areas there are many sub-sets depending on the attributes that the simulations enforce. These can be stochastic or deterministic, discrete or continuous, local or distributed dynamic systems. The difference between these types of simulation produce drastically different operating functions. Stochastic simulations use random number generation to model events, whereas deterministic simulations follow determined parameters and conditions. Continuous simulations produce numerical models based around differential and algebraic equations, but discrete simulations are known for their rotational degrees-of-freedom and complex geometries. Distributed models run on a series of connected computers, whereas local distributions are limited to one machine.

Modelling is the process of representing a model which includes its construction and working. This model is similar to a real system, which helps the analyst predict the effect of changes to the system. In other words, modelling is creating a model which represents a system including their properties. It is an act of building a model. shown in figure 3-14.

Simulation of a system is the operation of a model in terms of time or space, which helps analyze the performance of an existing or a proposed system. In other words, simulation is the process of using a model to study the performance of a system. It is an act of using a model for simulation. shown in figure 16-19.

History of Simulation

The historical perspective of simulation is as enumerated in a chronological order.

1940: A method named ‘Monte Carlo’ was developed by researchers (John von Neumann, Stanislaw Ulan, Edward Teller, Herman Kahn) and physicists working on a Manhattan project to study neutron scattering.

1960: The first special-purpose simulation languages were developed, such as SIMSCRIPT by Harry Markowitz at the RAND Corporation.

1970: During this period, research was initiated on mathematical foundations of simulation.

1980: During this period, PC-based simulation software, graphical user interfaces and object-oriented programming were developed.

1990: During this period, web-based simulation, fancy animated graphics, simulation-based optimization, Markov-chain Monte Carlo methods were developed.

Developing Simulation Models

Simulation models consist of the following components: system entities, input variables, performance measures, and functional relationships. Following are the steps to develop a simulation model.

Step 1: Identify the problem with an existing system or set requirements of a proposed system.

Step 2: Design the problem while taking care of the existing system factors and limitations.

Step 3: Collect and start processing the system data, observing its performance and result.

Step 4: Develop the model using network diagrams and verify it using various verifications techniques.

Step 5: Validate the model by comparing its performance under various conditions with the real system.

Step 6: Create a document of the model for future use, which includes objectives, assumptions, input variables and performance in detail. illustrated in figure 3-18

Step 7: Select an appropriate experimental design as per requirement.

Step 8: Induce experimental conditions on the model and observe the result Illustrated in figure, 3.

Performing Simulation Analysis

Following are the steps to perform simulation analysis.

Step 1: Prepare a problem statement.

Step 2: Choose input variables and create entities for the simulation process. There are two types of variables - decision variables and uncontrollable variables. Decision variables are controlled by the programmer, whereas uncontrollable variables are the random variables.

Step 3: Create constraints on the decision variables by assigning it to the simulation process.

Step 4: Determine the output variables.

Step 5: Collect data from the real-life system to input into the simulation.

Step 6: Develop a flowchart showing the progress of the simulation process.

Step 7: Choose an appropriate simulation software to run the model.

Step 8: Verify the simulation model by comparing its result with the real-time system.

Step 9: Perform an experiment on the model by changing the variable values to find the best solution. Illustrated in figure; 16-19 and 15 A,B,C.

Step 10: Finally, apply these results into the real-time system

Tutorial point simply easy learning

www.toturialspoint.com,[23]

Eco Innovation; Computer Simulation In Cassava Grating Machine.

It was observed that, for the mechanization of agriculture in Nigeria to succeed. It must be based on indigenous design, development, and manufacture of most of the required machines and equipment, to ensure their suitability for the crops as well as for the farmers' technical and financial capabilities. The above illustration shows how theme of our research project was derived. For the United Nation Sustainable development goals, to be reached, everyone needs to do their part: governments, the private sector, civil society and people like you, that is why we are making our contributions,[22] Do you know that the Average Nigerian Farmer is still making use of only the same Out-dated Manual Farm Tools - like Cutlass and Hoe - as their Fore-fathers used since many Centuries ago?. Do you also know that instead of using some Affordable Modern Agricultural Techniques or Simple Machines; the Farmers in that part of the World Have Changelessly, adhered to various Archaic Agricultural Methods and Practices that were Copied from their Ancestors? In short, their use of these kinds of Archaic and Out-dated Tools and Techniques, constitutes a very great set-back in the Country's Food and Agricultural Out-puts,[23]

Investment in agricultural science and technology, generally in the form of research and extension services, has proved to be highly valuable for improving crop yields and lessening poverty in developing countries. Nevertheless, such investments should reflect all the parties' needs for knowledge (World Bank 2007b). There is broad consensus that innovation is critically important for meeting the challenges race, including the need to improve competitiveness, sustainability and equality in agriculture.

Agriculture also needs to produce more food for a growing population, using a limited amount of farmland, while at the same time reducing its greenhouse gas emissions to avoid worsening climate change. This suggests that agricultural production needs to use more intensively, which means it must innovate.[24]

The benefit of topic is summarized below

Benefits of Eco-innovation

Eco-innovations help to reduce environmental burden or to reduce the costs of doing so. There is no guaranteed that the use of eco-innovations will improve the quality of the air and the quality of other receiving media (water, soil). Environmental quality is often viewed in relation to growth. When the quality of the environment improves we speak of an absolute decoupling, when the quality of the air or water deteriorates despite the use of environmental technologies we speak of a relative decoupling. For the eco-innovator there are both direct and indirect indirect benefits.

The direct benefits for the innovator consist of: operational advantages such as cost savings from greater resource productivity and better logistics; Sales from commercialization.

The indirect benefits for the innovating company consist of: The indirect benefits for the innovating company consist of: better image, better relations with suppliers, customers and authorities, an enhanced innovation capability overall - thanks to contacts with knowledge holders, Health and safety benefits, greater worker satisfaction. These benefits must be weighed against costs for the company. Surveys show that the majority of companies know very little of either the costs or benefits of their environmental activities. Of course, eco-innovations should be valued from a societal point of view, not just a business point of view. From a social welfare point of view, Eco-innovations better image, better relations with suppliers, customers and authorities, an enhanced innovation capability overall - thanks to contacts with knowledge holders, Health and safety benefits, greater worker satisfaction. These benefits must be weighed against costs for the company. Surveys show that the majority of companies know very little of either the costs or benefits of their environmental activities. Of course, eco-innovations should be valued from a societal point of view, not just a business point of view. From a social welfare point of view, eco-innovations are desirable if it contributes to overall welfare in the sense of wellbeing (not economic growth). An Eco-innovation is ‘‘any form of innovation resulting in or aiming at significant and demonstrable progress towards the goal of sustainable development’’ through reducing environmental impacts, enhancing resilience to environmental pressures or achieving a more efficient and responsible use of natural resource. The European Commission estimates the annual turnover of ‘‘European eco-industries’’ at 319 billion euro. This corresponds to 2.5% of EU gross domestic product (GDP). In the past two years, 45% of the European companies operating in manufacturing, agriculture, and food services have eco-innovated. Apart from in the energy and climate protection sectors, eco-innovation has been promoted ‘‘relatively slowly’’. According to the Commission, eco-innovation needs to be accelerated in order to boost resource productivity, efficiency and environmental protection. Eco innovations can benefit both the producers and the consumers in different manner.

Benefits of Eco-innovations for Producers

As it was said above, the eco-innovations have a lot of direct positive effects on environment. In advance it was not possible to estimate the relation between economic level of the country and preferred effects of eco-innovations; nevertheless, we assumed that at least one effect of eco-innovations will be related to economic level of the country.[25]

CONCLUSION

Most countries seem to recognize the broad nature of design and hence its wide spectrum of benefits, from economic to cultural, social and environmental. Recent design policies, however, tend to be more ambitious and focused than previously, and to emphasis design as a strategic tool for economic progress, improved competitiveness and job creation.

Simulation tools enable us to be creative and to quickly test new ideas that would be much more difficult, time-consuming, and expensive to test in the lab. (Jeffrey D. Wilson, Nasa Glenn Research Center) It also help us reduce cost and time-to-market by testing our designs on the computer rather than in the field. Many of the individual tasks within the overall design process can be performed using a computer. Computers function in the design process through geometric modeling capabilities, engineering analysis calculations, testing procedures, and automated drafting.

It's a known fact that whoever does it will have an added advantage over their competitors driving many to seek a Model Based approach towards solving that challenge, In the absence of analysis tools, these questions can only be answered by performing expensive and time-consuming product development cycles. A product development cycle typically includes the following steps:

1. Build your model in the CAD system.
2. Prototype the design.
3. Test the prototype in the field.

4. Evaluate the results of the field tests.
5. Modify the design based on the field test results.

This process continues until a satisfactory solution is reached. Analysis can help you accomplish the following tasks:

Reduce cost by testing your model using the computer instead of expensive field tests.

Reduce time to market by reducing the number of product development cycles.

Optimize your designs by quickly simulating many concepts and scenarios before production.[26]

Simulation models designed for training make learning possible without the cost disruption, Informational, organizational and environmental changes can be simulated and find their effects. New hardware designs, physical layouts, systems and… can be tested without committing resources for their acquisition. Introduction to simulation, banks car son, Nelson and Nicol Discrete-Event System Simulation

"Eco-innovation is the introduction of any product (good or service), process, organizational modification or marketing solution to help reduce the use of natural resources (including materials, energy, water and land) and allows reducing the release of hazardous substances along the entire life cycle." [European Monitoring Centre for Eco-innovation]

"Eco-innovation is the development and application of a business model built on a new business strategy that includes sustainability in all business operations, based on life cycle thinking in cooperation with partners in the value chain. It involves a coordinated set of changes or new solutions for products (goods/services), processes, marketing and organizational structure, leading to increased company performance and competitiveness." [UNEP & DTU: Manual Eco-innovation] In the work coming in the future, there will be exhaustive experiment on the cassava grating machine.

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