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Design, Modelling and Simulation of Feed Mixing Machine

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Abstract
The idea of mixing various feed materials such as grains, feed supplements and other animal feeds to produce a homogenous mix ready for dispensing for animal consumption had being part of man's activities since the creation of man. This has always been done using crude method such as hands, sticks etc. in this recent time, the advancement in technology has brought about the use of machines to perform the same function much faster, accurate and less energy consuming. It is for this purpose that the feed mixing machine has been designed. The objective of this project are to design a small feed fixing machine, to model and simulate the machine before production, to fabricate component of feed mixing machine based on design specifications and to test the machine after fabrication , while in designing and in material selection consideration was given to the tech-economic status of the micro scale industries who are intended users of the machine. Feed mixing machines are used in feed mills for the mixing of feed ingredients. The machine plays a vital role in the feed production process, with efficient mixing being key to good feed production. If feed is not mixed properly, ingredients and nutrients will not be properly distributed within a précised time. This means that the feed will not have even nutritional benefit would be bad for the birds that are feeding on the feed. Feed mixing machine comprises of a frame structure, the mixing chamber (a cylinder and cone structure) where other components such as electric motor, shaft and hopper are mounted on. The mixing of feed to form a uniform ration is a regular need on large stock poultry purposes. The mixing is performed by a vertical shaft which revolves continuously in a cylindrical cone suspended by an iron bar. The relative motion of the shaft about the frame (body) is achieved by the use of knuckle bearing. Mixing is done in the mixing chamber. The mixer is constructed to take a capacity of 30kg, but the excess capacity of 40kg was provided to take care of overloading .this machine was powered by 1hp power motor.

Keywords: traffic design innovation, sustainable apparel, coping strategies, capacity building, fashion designers

INTRODUCTION

The beginning of industrial scale production of animal feeds can be traced back to the late 1800s, this is around the time that advance in human and animal nutrition was able to identify the benefits of a balanced diet, and the importance or role the processing of certain raw materials played in this. Corn gluten feed mixer was first manufactured in 1882, while leading world feed producer Purina feeds was established in 1894 by William H Danforth. Cargill which was mainly dealing in grains from its beginning in 1865, started to deal in feed mixer production at about 1884. The feed industry expanded rapidly in the first quarter of the 1900s with "Purina" expanding its operations into Canada and opened its first feed mill in 1927.

In 1908 Herbert Johnson, an engineer for the Hobart manufacturing company, invents an electric standing mixer. His inspiration came from observing a baker mixing bread dough with a metal spoon; soon he was toying with a mechanical counterpart. By 1915, his 80-quart mixer was standard equipment. In 1908 the feed industry was revolutionized by the introduction of the first feed mixer used for mixing pelleted feeds.

It could be cited that the poor quality products of feed could be as a result of improper mixing of feed. Again, large quantities of feed will be very difficult to mix by hand if not impossible, thereby producing poor quality products and reducing production rate. This lowers the profits margin of the products. On the other hand, the cost of importation of foreign machine for mixing feed is very high compared to the producer's mega resources. Generally, this affects the country's foreign reverse. Also it tends to bring down the cost of the machine to the reach of the small scale producers. Besides it creates employment opportunities for the farmers, this design was chosen for reliabilities among other things discussed in the under the heading '' components and material selection''.

The cost of machine of this type could be high when produced under small scale production. But the other advantages are that it does not require any specialist

skill for its operation and it does not call for any elaborate production environment before it becomes operational and so many others.

The advantages of this design outweigh the disadvantages. In fact it can be used where mass production is necessary with high efficiency. Also by using software to determine the strength and simulation in our research is added advantage in which involve the following

- Long product development,
- Countless trial and error,
- Accountability
- Limited Profitability

COMPONENT AND MATERIAL SELECTION

Most machine and tools are constructed from metallic and non-metallic materials. The metals are divided into two groups' ferrous metals: are those which have the iron as their main constituent such as cast iron, wrought iron and steel. Non-ferrous metals: are those which have a metal other than iron as their main constituent such as copper, aluminium, brass, tin, zinc etc.

The selection of a proper material, for engineering purposes, is one of the most difficult problems for the designer. The best material is one which serves the desired objective at the minimum cost. The following factors are considered while selecting the material:

- Availability of the materials.
- Suitability of the materials for the working conditions in service.
- The cost of the materials.

The machine (feed mixing machine) which has been produced from the assembly of various components were designed based on the properties of materials, including the frame, shaft, knuckle bearing, pulley and belt, mixing chamber (cylinder and cone structure) and electric motor. The design considerations for each component are discussed below:-

FRAME: This component is the primary made up of mild steel fig; 16. The reason for this is that the material possessed the required properties as ductility, plasticity and also considerable strength which are capable of being fabricated to the required degree of functional tolerance. Also the selection factors are being cheap and most abundant in the market in case of replacement, machine ability or workable are other consideration.

BELT AND PULLEY: they exist as standard components. The pulley can be made up of aluminium, cast iron and mild steel etc owing to the weight consideration of these materials mentioned above; we selected the cast iron pulley. This would help to reduce vibration of the shaft. On the other hand, the belt will be Vee-shaped fig5&,11. We choose the Vee-belt for our design with the following consideration:-

It is because of the pulley groove. It does not jump out while in motion. The vee-belt drive gives due to the distance between centres of pulleys. It provides longer life, 3 to 5 years. It can be easily installed and removed. The operation of the pulley and v-belt is quiet. Also, we prefer belt to chain because of alignment.

MIXING CHAMBER (CYLINDER AND CONE STRUCTURE): This is the mixing chamber of the machine. Fig 13 It is required to use mild steel metal sheet which are of considerable strength and which are capable of being fabricated to the required degree of functional tolerance are preferable used for reliability of operation and lessened frequency maintenance. Another reason for its use is because of its abundant in the market and weld ability.

ELECTRIC MOTOR: This is the source of power for the design. It exists in a standard component. It has single phase and three phase but for our design, we use the three phase. It has a three horse power (3hp) and the speed of the electric motor is 1500 rpm fig3.

SHAFT: this is also made of mild steel besides the considerations mentioned above, we consider its toughness properties which can be improved through heat treatment.fig;8

BEARING: It exists as a standard component, it is of various types- cone bearing, roller, knuckle bearing and from steels-chromium steel. Among these types mention above, some are sealed while some are not. For our design, we opt for the knuckle bearing with sealed ball bearing to avoid grease contamination on the feed fig.12. The selection of knuckle bearing is that it balances itself and possesses the required hardness and toughness.

RESULTS AND DISCUSSION

Design Process

Engineers use CAD to create two− and three− dimensional drawings, such as those for automobile and airplane parts, floor plans, and maps and machine assembly fig; 2

While it may be faster for an engineer to create an initial drawing by hand, it is much more efficient to change and adjust drawings by computer. In the design stage, drafting and computer graphics techniques are combined to produce models of different parts. i. Using a computer to perform the six−step 'art−to−part' process: The first two steps in this process are the use of sketching software to capture the initial design ideas and to produce accurate engineering drawings. Next, engineers use analysis software to ensure that the part is strong enough. Step five is the production of a prototype, or model.fig 15 shows multiply views of the machines

In the final step the CAM software controls the machine that produces the part, during the design of the machine and the drafting, software was used to draw the orthogonal views, Isometric views, exploded drawings fig 14 shows the detailed drawing of the machine, modeling and simulation was done

before the commencement of the fabrication processes.

Modeling

Modeling is the process of producing a model; a model is a representation of the construction and working of some system of interest fig 2. A model is similar to but simpler than the system it represents. One purpose of a model is to enable the analyst to predict the effect of changes to the system. On the one hand, a model should be a close approximation to the real system and incorporate most of its salient features. On the other hand, it should not be so complex that it is impossible to understand and experiment with it. A good model is a judicious tradeoff between realism and simplicity. Simulation practitioners recommend increasing the complexity of a model iteratively. An important issue in modeling is model validity. Model validation techniques include simulating the model under known input conditions and comparing model output with system output.

Generally, a model intended for a simulation study is a mathematical model developed with the help of simulation software. Mathematical model classifications include deterministic (input and output variables are fixed values) or stochastic (at least one of the input or output variables is probabilistic); static (time is not taken into account) or dynamic (time-varying interactions among variables are taken into account). Typically, simulation models are stochastic and dynamic

Simulation

A simulation of a system is the operation of a model of the system. The model can be reconfigured and experimented with; usually, this is impossible, too expensive or impractical to do in the system it represents. The operation of the model can be studied, and hence, properties concerning the behavior of the actual system or its subsystem can be inferred. In its broadest sense, simulation is a tool to evaluate the performance of a system, existing or proposed, under different configurations of interest and over long periods of real time. Simulation is used before an existing system is altered or a new system built, to reduce the chances of failure to meet specifications, to eliminate unforeseen bottlenecks, to prevent under or over-utilization of resources, and to optimize system performance. For instance, simulation can be used to answer questions like: What is the best design for a new network? What are the associated resource requirements? How will a telecommunication network perform when the traffic load increases by 50%? How will a new routing algorithm affect its performance? Which network protocol optimizes network performance? What will be the impact of a link failure? The subject of this tutorial is *discrete event simulation* in which the central assumption is that the system changes instantaneously in response to certain discrete events. For instance, in an M/M/1 queue - a single server queuing process in which time between arrivals and service time are exponential - an arrival causes the system to change instantaneously. On the other hand, continuous simulators, like flight simulators and weather simulators, attempt to quantify the changes in a system continuously over time in response to controls. Discrete event simulation is less detailed (coarser in its smallest time unit) than continuous simulation but it is much simpler to implement, and hence, is used in a wide variety of situations.

Figure 1, 6-10 is a schematic of a simulation study. The iterative nature of the process is indicated by the system under study becoming the altered system which then becomes the system under study and the cycle repeats. In a simulation study, human decision making is required at all stages, namely, model development, experiment design, output analysis, conclusion formulation, and making decisions to alter the system under study. The only stage where human intervention is not required is the running of the simulations, which most simulation software packages perform efficiently. The important point is that powerful simulation software is merely a hygiene factor - its absence can hurt a simulation study but its presence will not ensure success. Experienced problem formulators and simulation modelers and analysts are indispensable for a successful simulation study.

The steps involved in developing a simulation model, designing a simulation experiment, and performing simulation analysis are:

- Step 1. Identify the problem.
- Step 2. Formulate the problem.
- Step 3. Collect and process real system data.
- Step 4. Formulate and develop a model.
- Step 5. Validate the model.
- Step 6. Document model for future use.
- Step 7. Select appropriate experimental design. Step 8. Establish experimental conditions for.
- Step 9. Perform simulation runs.
- Step 10. Interpret and present results.
- Step 11. Recommend further course of action. Although this is a logical ordering of steps in a simulation study, many iterations at various sub-stages may be required before the objectives of a simulation study are achieved. Not all the steps may be possible and/or required. On the other hand, additional steps may have to be performed. The next three sections describe these steps in detail.

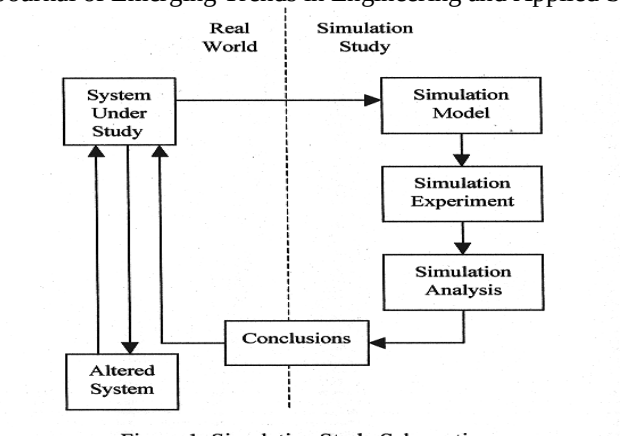


Fig 1: Simulation Study Schematic

MODELLING AND SIMULATION OF THE MACHINE / THE COMPONENTS

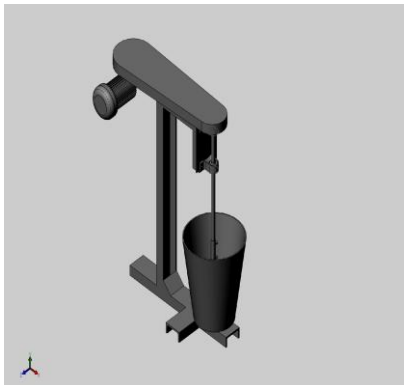


Fig.2 Final Design



Fig 3 Electric motor

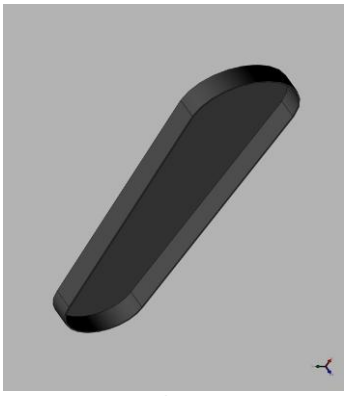


Fig 4 Cover

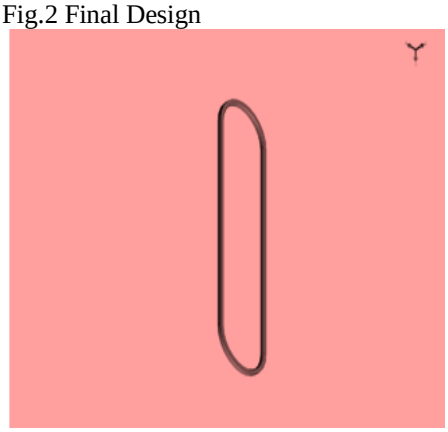


Fig 5 Pulley

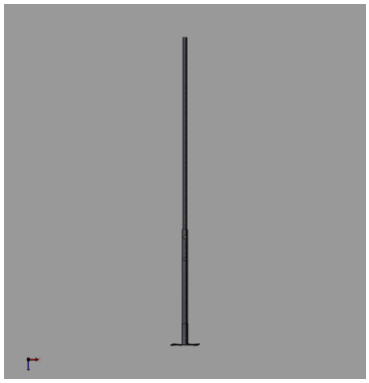


Fig 6 Shaft



Fig 7 Shaft Under Stress

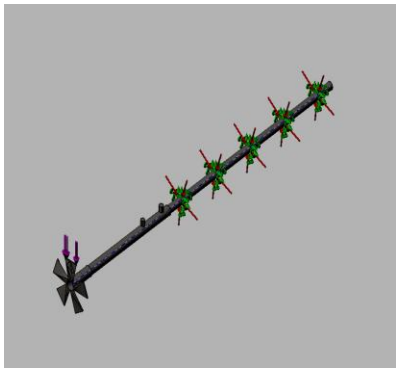


Fig.8: Simulation Process

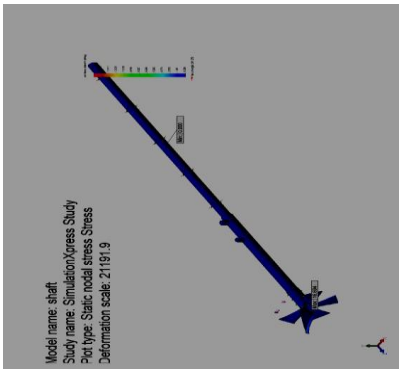


Fig .9 Deform Shape

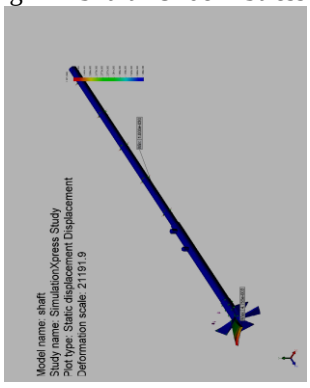


Fig 10 Factor Of Safety

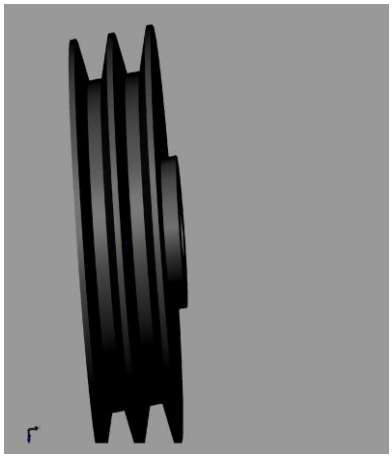


Fig.11 pulley

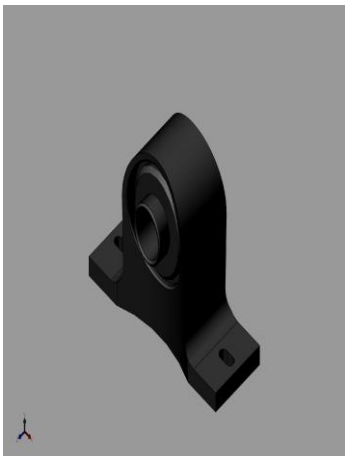


Fig.12 Bearing

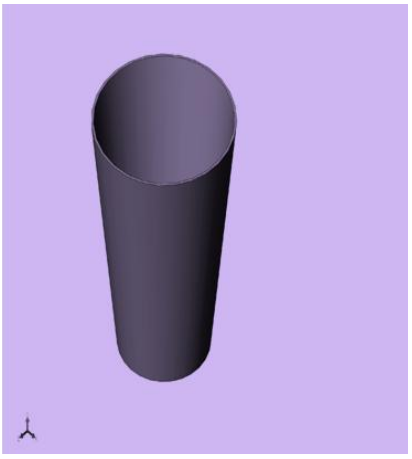


Fig 13 bucket

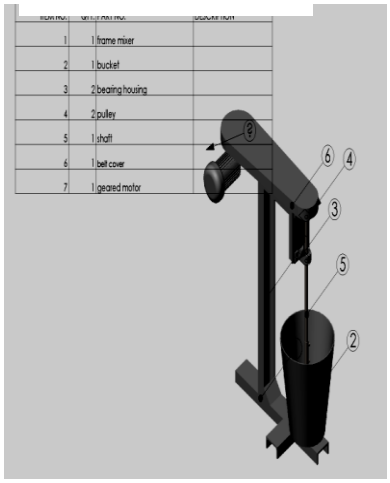


Fig 14.Detailed

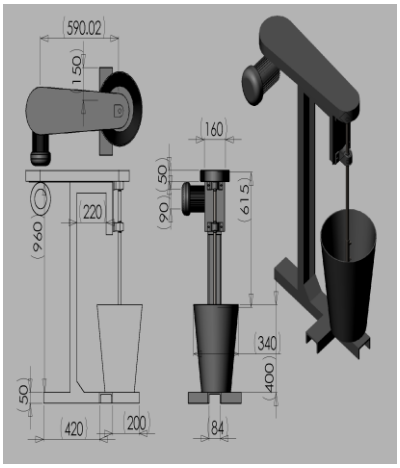


Fig 15 Multiply Views

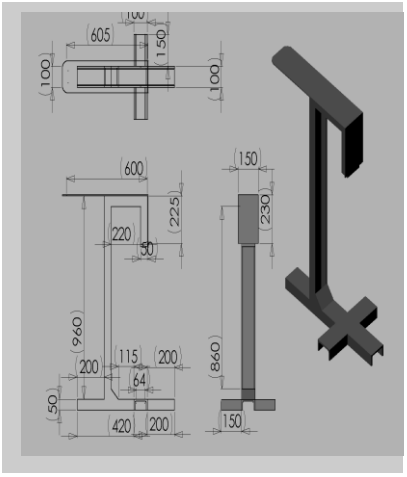


Fig 16 Frame

CONCLUSION AND RECOMMENDATION

Design consideration are base on the ease of handling and probability of the device, hence the simplicity employed in the assembling of the parts in line with the design drawing, the facilicity comprises mainly of the three members, namely, the table-like frame, the power unit (electric motor) and the mixing chamber. The table-like frame which is a rigid member bears the entire load of the system on which it stands. The electric motor mounted on it with the aid of bracket, bolt and nuts. At the opposite side is the bigger pulley mounted and keyed to the main shaft carrying the conveyor such that it could be detached easily. . The belt is best adjusted to a taunt position simply by beating the best position with the aid of the bracket upon which the electric motor is attached until the desired position is obtained. The machine is fabricated and design in such a way that it will withstands some failures like bulking and sagging. The fabrication involves the utilization of the available local raw materials, the selection of the materials were based on physical and mechanical properties of materials and cost of materials.

Detail construction include welding, grinding of weld joint to make it smooth, fabrication of components and painting as well as the fixing to make the whole component complete.

The components that require servicing mainly are the bearing, belt and the mixing chamber which has an opening for easy maintenance. The key must be checked from time to time to ensure that they are well seated in their grooves. Inspection of bolts are very necessary to ensure that it is not overdue for changing, the machine on the other hand should be cleaned thoroughly after usage to make it dry and free from rusting. The designed output and hence the efficiency can be enhanced by varying any of these factors- speed, weight of the feed or the maximum tension in the belt. For very safe and smooth operation, it is recommended that proper adjustment be carried out on the belt tension and key before operation.,

The machine must be securely bolted to the basement to reduce vibration and embrace rigidity of the machine. However, preventive maintenance should be adopted as an alternative to breakdown maintenance. Also software design should be encouraged in our institution of higher learning base on the following facts, long product development, countless trial and error, and accountability and limited profitability

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