SOUTH ASIAN JOURNAL OF ENGINEERING AND TECHNOLOGY

Full Length Article

Design and Analysis of Sugarcane Cultivator

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ABSTRACT: The manual sugarcane cultivation involves maximum labour, time and wages. In this scenario, the unavailability or demand for labour become a very big issue for farmer. Slowly, the labour population is migrating from agricultural work to other new emergency sectors like textiles factories. Example, the emergency of other sectors in and around village areas slowly depletory the resource of agriculture. In this solution, our project has been done in a way to reduce the human needs, time and expenses in sugarcane cultivator. Use of machinery helps saving the labor work and time of operations, reduces drudgery, helps in improving quality of work, reduces cost of operation and ensures effective utilization of resources. In this project different operations of sugarcane cultivation along with the mechanizations are discussing.

Keywords: sugarcane and cultivator

1 Introduction

Sugarcane is rightly called as 'wonder cane' owing to its versatile utility and the vast capability to meet the demands of the burgeoning population. It is utilized in manufacturing of sugar, bio-fuels, spirit besides generation of electricity. This particular sector has attained the most privileged status as one of the pivotal agriculture based industries. In addition, these agro based industries provide raw materials for papers, fertilizers, substantially higher in tropical and sub-tropical regions compared to rest of the globe. Sugarcane cultivation requires a tropical or temperate climate, with a minimum of 60 cm (24”) of annual rainfall/irrigation. It is one of the most efficient photosynthesizes in the plant kingdom. It is a C4 plant, able to convert up to one percent of incident solar energy into biomass. In prime growing regions, such as Mauritius, Dominican Republic, Puerto Rico, India, Indonesia, Pakistan, Peru, Brazil, Bolivia, Colombia, Australia, Ecuador, Cuba, the Philippines, El Salvador and Hawaii, sugarcane crop can produce over 15 kg of cane per square meter of sunshine.

2.

2. LITERATURE REVIEW

2.1 SUGARCANE AGRICULTURE

Mukherjee, 1957; Daniels and Roach, 1987.Sugarcane is any of six to thirty-seven species (depending on taxonomic system) of tall perennial grasses of the genus Saccharum (Family Poaceae, tribe Andropogoneae). Native to warm temperate to tropical regions of Asia, they havestout, jointed, fibrous stalks that are rich in sugar, and measure two to six meters (six to nineteen feet) tall. All sugarcane species are inter-breed and the major commercial cultivars are complex hybrids.

2.2 CULTIVATION AND USES

(Sharpe and Peter, 1998),(Daniels et al., 1975; Sharpe and Peter, 1998). Sugarcane is grown in over 110 countries with an estimated total production of 1,557 million metric tons in 2008, more than six times the output of sugar beet. Today, about 50 percent of world sugarcane production occurs in Brazil and India. Sugarcane products include table sugar, molasses, rum, cachaça (the national spirit of Brazil), and ethanol. The bagasse that remains after sugarcane crushing may be burned to provide heat and electricity. It may also, because of its high cellulose content, serve as raw material for paper, cardboard and eating utensils that, because they are by-products, may be branded as “environmentally friendly”

Sugarcane is indigenous to tropical south asia and southeast asia Different species likely originated in different locations with Saccharin barber originating in

India and Saccharin module and Saccharin office in arum coming from New Guinea Crystallized sugar was reported 5,000 years ago in India

Around the eighth century A.D., Arabs introduced sugar to the Mediterranean, Mesopotamia, Egypt, North Africa, and Andalusia. By the tenth century, sources state, there was no village in Mesopotamia that did not grow sugarcane.

Sugarcane is still extensively grown in the Caribbean. Christopher Columbus first brought it during his second voyage to the Americas, initially to the island of Hispaniola (modern day Haiti and the Dominican Republic). It was among the early crops brought to the Americas by the Andalusians (from their fields in the Canary Islands), and the Portuguese.

Sugarcane production greatly influenced many tropical Pacific islands, including Okinawa and, most particularly, Hawaii and Fiji. In these islands, sugarcane came to dominate the economic and political landscape after the arrival of powerful European and American agricultural businesses, which promoted immigration of workers from various Asian countries to tend and harvest the crop. Sugar was the dominant factor in diversifying the island's ethnic makeup, profoundly affecting their politics and society.

3. PROBLEM IDENTIFICATION

3.1 FACTORS AFFECTING OF SUGARCANE PRODUCTION

Sugarcane production is a complex process and can be conceived as a function of several variables. The knowledge of the relative importance of the resource inputs influencing sugarcane production is essential for the sugarcane growers for introducing desirable changes in their operation at the micro level, and for the policy makers for formulating plans for improvements in agricultural sector productivity based on sound economic principles at the macro level.

Production practices such as, soil type, planting time, varieties, inputs use and availability of irrigation water; they all have considerable impact on sugarcane production. While analyzing the input costs and net returns relationship of sugarcane production, the important input costs such as, urea, DAP, FYM, irrigation, seed and weeding were considered. To assess the on-farm production efficiency, production function analysis had been carried out. This had been examined through cost of inputs and net returns relationships of the sugarcane producers in Pakistan.

Thus a Cobb-Douglas type or double log production function was used to estimate the production function from a data set from the sugarcane producers survey carried out during, 2007-08. This approach was commonly used to assess input and output relationships (Upton, 1979; Heady and Dillon, 1961; Chennareddy, 1967).This method has easy to interpret results also provides a sufficient degree of freedom for statistical testing (Heady and Dillon, 1961; Griliches, 1963).It has been argued that there are various problems in estimating input output relationship using survey data, because of the variables are not controlled as they are in an experiment (Upton, 1996).

The environmental conditions and managerial ability vary from one to another farm. Ultimately, these factors affect the crop output. In order to achieve maximum income from sugarcane cultivation, the precise estimation of resources productivity and examination of allocation efficiency of various factors affecting sugarcane production would help the producers to allocate their resources optimally.

Therefore, both inputs and output factors analysis has been carried out. For this assessment ordinary least squares regression method is widely used to estimate input and output relationships. This method enables not only to find the line of best fit, but also to measure how good a fit it is (Upton, 1996). The factors were highly significant at 5% level for the sugarcane production cost. The cost of land preparation, FYM, seed, irrigation, urea, DAP, seed and its application, and weeding were set in the econometric model.

4. SPECIFICATION OF COMPONENTS

- Cultivator
- Bearing
- Shaft
- Hopper

4.1 CULTIVATOR

All time man has tried to find ways to work farmlands in better conditions with an increasingly higher speed and with maximum efficiency. Thereby agricultural machines have appeared through which work on the fields has become an easier task for humans, thus contributing to the development of human communities based on the increasing harvests obtained. Today's agricultural machines belong to the special mechanical equipment category intended to perform mechanized works in farmlands, in order to obtain the optimal harvests. The continuous evolution of these equipment was mainly aimed at the development of specific technological processes, constant increasing of speed in operation mode and also increasing of engine power.

In order to well perform the proposed technological process, they should have high resources of reliability, durability and stability in execution in spite of external conditions in which their operation is carried out.

Mechanization technologies of agricultural works shall be determined so as to achieve minimum energy consumption, low production costs, with minimum labor required, using a limited number of agricultural machine units, while ensuring the maximum level of agricultural production,

4.2 BEARING

Figure 5.2 Bearing

Due to early industrial necessity for bearings, many thrust pad bearings were theoretically studied in the 1950s by investigators for design and development of good performing bearings. It has been observed that in the past many researchers have analyzed thrust bearings having various surface profiles on the pads have reported higher load carrying capacity with stepped pad thrust bearing in comparison to the conventional plane inclined thrust bearing.

Authors performed adiabatic analysis and have reported reduction in temperature with stepped pad thrust bearing in comparison to plane thrust bearing. Abramowitz studied the effects of pad curvatures on thrust bearing performances. Bagri and Singh and Getting have reported that the film shapes have considerable influence on the bearing performances.

Anent Pal Singh has investigated effects of continuous circumferential surface profiles on the performance characteristics of a sector-type thrust bearing. A computer-aided finite difference numerical solution of the Reynolds equation in polar form is used to determine pressure distributions for an optimum inclination of a sector pad. He reported that As compared with conventional taper fluid film shape, new surface profile (cyclical, adenoidal, exponential, polynomial) are found to offer a significant increase in the load-carrying capacity as well as a considerable reduction in the coefficient of friction.

4.3.1 Type of Bearings

The sliding contact bearings, according to the thickness of layer of the lubricant between the sliding surfaces are classified as follows:

- Thick Film Bearings
- Thin Film Bearings
- Zero Film Bearings
- Hydrostatic or Externally Pressurized Lubricated Bearings

4.3.2 Thick Film Bearings

The thick film bearings are those in which the working surfaces are completely separated from each other by the lubricant. Such type of bearings is also called as hydrodynamic lubricated bearings.

5.3.3 Thin Film Bearings

The thin film bearings are those in which, although lubricant is present; the working surfaces partially contact each other at least part of the time. Such type of bearings is also called boundary lubricated bearings.

4.3.4 Zero Film Bearings

The zero film bearings are those which operate without any lubricant present.

4.3.5 Hydrostatic or Externally Pressurized Lubricated Bearings

The hydrostatic bearings are those which can support steady loads without any relative motion between the journal and the bearing. This is achieved by forcing externally pressurized lubricant between the members.

4.4 SHAFT

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a set of gears or pulleys for the purpose of power transmission. The shaft is generally acted upon by bending moment, torsion and axial force. Design of shaft primarily involves in determining stresses at critical point in the shaft that is arising due to aforementioned loading. Other two similar forms of a shaft are axle and spindle. Axle is a non-rotating member used for supporting rotating wheels etc. and do not transmit any torque. Spindle is simply defined as a short shaft.

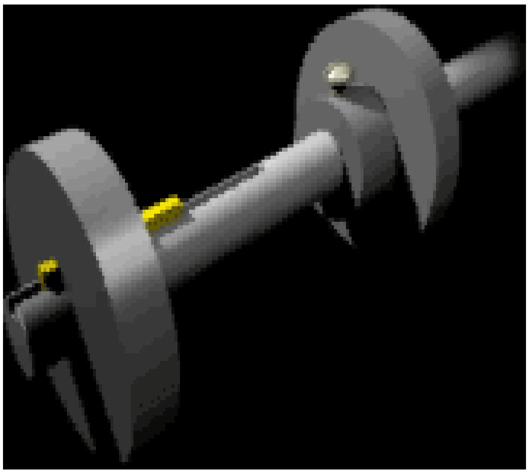


Figure 4.3 Shaft

4.4.1 Standard sizes of Shafts

Typical sizes of solid shaft that are available in the market are,

- Up to 25 mm 0.5 mm increments,
- 25 to 50 mm 1.0 mm increments,
- 50 to 100 mm 2.0 mm increments,
- 100 to 200 mm 5.0 mm increments.

4.4.2 Material for Shafts

The ferrous, non-ferrous materials and non metals are used as shaft material depending on the application. Some of the common ferrous materials used for shaft are discussed below. These materials are least expensive. Since it is hot rolled, scaling is always present on the surface and machining is required to make the surface smooth. Since it is cold drawn it has got its inherent characteristics of smooth bright finish. Amount of machining therefore is minimal. Better yield strength is also obtained. This is widely used for general purpose transmission shaft.

4.4.3Alloy steels

Alloy steel as one can understand is a mixture of various elements with the parent steel to improve certain physical properties. To retain the total advantage of alloying materials one requires heat treatment of the machine components after it has been manufactured. Nickel, chromium and vanadium are some of the common alloying materials. However, alloy steel is expensive.

These materials are used for relatively severe service conditions. When the situation demands great strength then alloy steels are used. They have fewer tendencies to crack, warp or distort in heat treatment. Residual stresses are also less compared to CS (Carbon Steel).

In certain cases the shaft needs to be wear resistant, and then more attention has to be paid to make the surface of the shaft to be wear resistant.

4.5 HOPPER

The rational method for hopper design is based on a model of stress distribution in the hopper, informed by measurements of the flow properties of the material being handled, that predicts the flow pattern that will occur and whether or not flow will be reliable. The details can be found in any standard text of powder technology so will not be repeated here.

Figure 4.4 Hopper

Though difficult to derive, it is easy to use. The key point to understand is that if you wish to use the method, you need to get a sample of the powder(s) that will go through the plant, and undertake some measurements of the flow properties. It recognizes that every different powder is unique in its flow properties, which is a fundamental trait of bulk solids.

4.6 POWER SOURCE

In recent years, with the increase in standard of living, the per capita energy consumption has increased substantially. The world energy consumption is expected to increase multifold by 2025 with much of the energy growth occurring in rapidly expanding economies. Fossil fuels such as coal, oil and natural gas currently supply 86% of the world's energy, and that will be used up in the foreseeable future. So the only way is to increase the energy availability through alternate sources of energy.

Photosynthesis is the process that green plants use to convert solar energy into chemical energy. Photosynthesis relies on the synthesis of sugars from atmospheric $CO_2$and water from the soil. When plants are harvested and processed, the energy stored in the chemical bonds will be released and converted to other forms of energy. During this process, CO_2 is released but unlike the burning of fossil fuels, the use of bio-energy does not contribute to a net emission of CO_2, because the carbon was only recently fixed. The production of bio-energy, however, does result in CO_2 emissions during harvesting, transportation and processing of the feed stocks.

Bio-energy is currently the only alternative and potential energy source able to supply liquid transportation fuels. Plants can be used as a source of fermentable sugars for the production of ethanol and other low molecular weight alcohols. The fermentable sugars needed for the production of ethanol can be obtained from soluble sugars in the juice of sweet sorghums, sugar cane, or crops such as sugar beets or sweet potatoes or alternatively can be generated via hydrolysis of starch (from maize, sorghum or wheat grain), or from the hydrolysis of cellulose and hemi cellulose present in the plant cell wall.

Sugarcane is one of the most promising agricultural sources of biomass energy in the world. It is the most appropriate agricultural energy crop in most sugarcane producing countries due to its resistance to cyclonic winds, drought, pests and diseases, and its geographically widespread cultivation. Due to its high energy-to-volume ratio, it is considered one of nature's most effective storage devices for solar energy and the most economically significant energy crop.

The climatic and physiological factors that limit its cultivation to tropical and sub-tropical regions have resulted in its concentration in developing countries, and this, in turn, gives these countries a particular role in the world's transition to sustainable use of natural resources. According to the International Sugar Organization (ISO), Sugarcane is a highly efficient converter of solar energy, and has the highest energy-to-volume ratio among energy crops. Indeed, it gives the highest annual yield of biomass of all species. Roughly, 1 ton of Sugarcane biomass-based on Biogases, foliage and ethanol output – has an energy content equivalent to one barrel of crude oil.

Sugarcane produces mainly two types of biomass, Cane Trash and Biogases. Cane Trash is the field residue remaining after harvesting the Cane stalk and Biogases is the milling by-product which remains after extracting sugar from the stalk. The potential energy value of these residues has traditionally been ignored by policy-makers and masses in developing countries. However, with rising fossil fuel prices and dwindling firewood supplies, this material is increasingly viewed as a valuable renewable energy resource.

Around the world, a portion of the Cane Trash is collected for sale to feed mills, while freshly cut green tops are sometimes collected for farm animals. In most cases, however, the residues are burned or left in the fields to decompose.

Cane Trash, consisting of Sugarcane tops and leaves can potentially be converted into around 1kWh/kg, but is mostly burned in the field due to its bulkiness and its related high cost for collection/transportation.

On the other hand, Biogases has been traditionally used as a fuel in the Sugar mill itself, to produce steam for the process and electricity for its own use. In general, for every ton of Sugarcane processed in the mill, around 190 kg Biogases is produced.

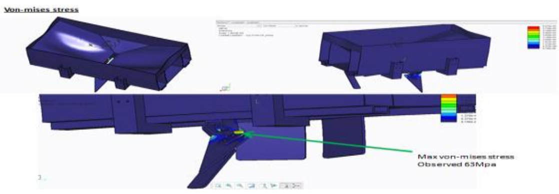
Low pressure boilers and low efficiency steam turbines are commonly used in developing countries. It would be a good business proposition to upgrade the present cogeneration systems to highly efficient, high pressure systems with higher capacities to ensure utilization of surplus Biogases.

5. WORKING PRINCIPLE AND MODEL

The sugarcane cultivator mainly focused on agriculture field this project can be running on agriculture land. This one of the equipment it is attached on tractor.In the sugarcane cultivator is first of all the spit the soil in agriculture land by using the cultivator. Then the already in pieces of sugarcane in hopper. That sugarcane are one by one feeding to the land. Then spited soil in closes of sugarcane by using in two plates. Then finally another cultivator is used to spit the soil in purpose of circulating the water. The equipment was designed by using creo3.0 and analysis in FEA software.

.6. FEA ANALYSIS

6.1 VON-MISES STRESS



7. CONCLUSION

Our project will be a solution to the issues faced by the farmer in terms of unavailability of form labours. This equipment will be reduced the need of labour time and expenses of cultivation. It will be helpful to farmer and make them to complete their works with very less efforts which in turn reduces cost of cultivation, income and profit.

REFERENCES

1. Alam, G. M. M., Alam, M. M., Alam, M. J., Zahan, W. A. &Alam, M. S. (2007). Profitability of Intercropping with Sugarcane in Some Selected Mills Zones. Bangladesh Journal of Sugarcane, 29, 64-67.
2. Alam, M. M. &Haque, M. I. (2005). Market Effects on the Production and Profitability of Sugarcane, sugar and Gur in Bangladesh, Bangladesh Journal of Sugarcane, 24-27, 47-56.
3. Alam, M. M., Haque, M. I. &Alam, G. M. M. (2005). Economics of Sugar Industries Performance in Bangladesh, Bangladesh Journal of Sugarcane, 24-27, 28-34.
4. Ali, M. Y. (1986). Sugarcane Research in Bangladesh, In Sugar Industry in Bangladesh, Bangladesh Sugar and Food Industries Corporation, Dhaka.
5. Avasthy, P. N. (1983). Insect Pest Management for Sugarcane in India. In: Sugarcane Pest Management in India (Eds. M. Balasubramanian and A.R. Solayappan). Tamil Nadu Cooperative Sugar Federation, Madras. pp. 71-77.
6. BBS (2012). Statistical Year Book of Bangladesh. Bangladesh Bureau of Statistics, Planning Division, Ministry of Planning, Bangladesh.
7. BBS (2013). Statistical Year Book of Bangladesh. Bangladesh Bureau of Statistics, Planning Division, Ministry of Planning, Bangladesh.
8. BER (2013). Bangladesh Economic Review 2013, Ministry of Finance, Bangladesh.
9. KA (1996). Bench Mark Survey on Sugarcane, Kranti Associates, Dhaka, Bangladesh.
10. Kabir, M. H. &Alam, M. M. (2000). Sugarcane cultivation practices: Input-output relationship of sugarcane and its intercropping of Bangladesh, BSRI-BARC contract research project under ARMP.