

Design, Development and Performance Evaluations of Mini Rice Mill for Domestic Purpose

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Abstract- In rural areas electric are unavailable or expensive. So performing many activities human muscle power can be good alternative energy requirement. Bicycle is the most efficient mechanical devices developed by man and pedaling is the key to the most efficient use of leg power. Milling is most important aspect of post-harvest operation of paddy. The traditional method of paddy dehulling is laborious, time consuming and low output. So improve milling efficiency mini rice mill for domestic purpose design and developed. The mini rice mill consists of chain drive and gear amplification mechanism that turn huller shaft in housing filled with paddy. In this system is to remove the husk and the brain layers from paddy rice to produce whole white rice kernels. They free the user from rising energy costs, and can be used anywhere, and are easy to maintain, produce no pollution and provide healthy exercise.

Keywords:- Milling, Chain Drive, Gear, Huller, Paddy.

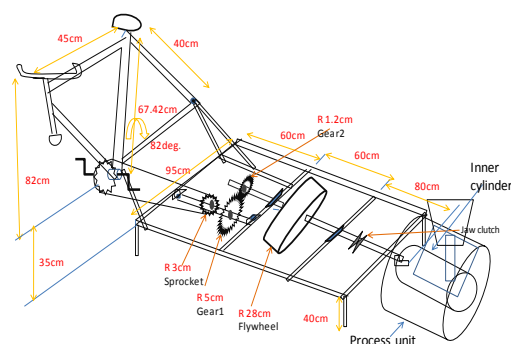
INTRODUCTION

Rice is the staple food of India .so production of rice is considered as one of the important Industry in India. For rice production require fuel or electricity supply that unnecessary increase the cost which leads to the evolution of mini rice mill for domestic purpose so that use of fuel and electricity supply as well as high horse powered engine can be eliminated and hence cost can be reduced. The mini rice mill consists of three sub system (1) The Energy unit (2) Transmission unit (3) The processing unit. The energy unit mainly uses the simple concept of bicycle pedaling .The transmission unit consist of chain drive mechanism running over a pair of speed increasing gear and process unit consist of huller shaft ,hopper, and housing. By using hopper paddy fall on to the spiral portion of the huller shaft .the paddy is thrust forward into the distributor section which distributed the paddy into the plurality of longitudinal flutes of huller shaft .As the huller shaft rotats, paddy falls through the adjustable gap formed between the longitudinal raised edges of the huller shaft and the edge of the end plate. Paddy is subjected to pressure and shearing action between the two edges and the husk is removed.

I. NEED OF DEVELOPMENT OF MACHINE

In rural areas spend considerable amount of time managing their daily energy requirements. Rural communities have

been using traditional rice milling process to dehusk the paddy. but they have get low efficiency. They continue to spend about 2-3 hours every two day at home busy with paddy hulling. Pedal operated mini rice mill whereas mill with electric motor are faster but that are costly as well as required electricity. The unit consist a simple bicycle mechanism and pair of speed increasing gear. The schematic of flywheel motor is as shown in figure. A rider pedals the mechanism converting the oscillatory motion of thighs into rotational motion of counter shaft. This countershaft connected to flywheel shaft with speed increasing transmission consisting of pair of speed gears. In this way, the human muscular energy



is converted into kinetic energy of flywheel by this man machine and for its efficient use it is necessary to do work. From above diagram of conceptual design.

II BASIC CONCEPT OF MACHINE

A person can generate four times more power (1/4 horsepower (hp)) by pedaling than by hand-cranking. At the rate of 1/4hp, continuous pedaling can be done for only short periods, about 10 minutes. However, pedaling at half this power (1/8 hp) can be sustained for around 60 minutes.

Pedal power enables a person to drive devices at the same rate as that achieved by hand-cranking, but with far less effort and fatigue. Pedal power also lets one drive devices at a faster rate than before (e.g. winnower), or operate devices that require too much power for hand-cranking

(e.g. thresher). Most people engage in delivering power continuously for an hour or more will be most efficient when pedaling in the range of 50 to 70 rpm and an average power produced a man is approximately 75 watt (0.10 hp) (Alexandrove 1981) If any operation, process required more than 75 watt (0.10 hp) that can also be possible with human power by applying "HUMAN POWERFLYWHEEL MOTOR CONCEPT". These system consist following unit.

I. Energy Unit: It consists of human being as energy source who will operate bicycle mechanism. An average human being can pedal at the rate of 50-60 pedals per minute.

It consists of bicycle mechanism, chain and sprocket can give speed increasing ratio using bicycle rear sprocket. A speed increasing gear pair.

II. TRANSMISSION UNIT:

The transmission mechanism consists of shafts, two pairs of spur gears, a flywheel (50kg) and clutch plate. The bigger sprocket of the driving unit is mounted on a shaft (shaft number 1) containing a pair of spur gears. The shaft (shaft number 2) located directly above this contains the flywheel. This shaft contains the pinion of the spur gear assembly as speed amplification is required to store energy at the flywheel.

III. Processing Unit

The processing unit mainly consists huller shaft inside the housing and hoppers are attached above the housing. Paddy is fed from the top opening of the hopper which is directed to the meshing area of the huller shaft and edge of end plate. Paddy, coming in contact with the meshing area is separated from the husk and rice grain is obtained from the outgoing channel of the hopper.

According to this concept machine system

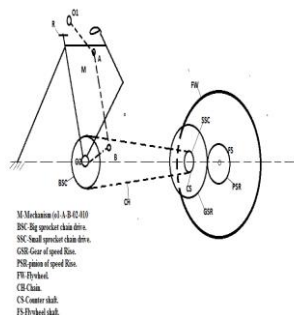


Figure. Side view for Human Powered Flywheel Motor divided in to three subsystem (i) Energy Unit: Comprising of a suitable peddling mechanism, speed rise gear pair and Flywheel conceptualized as Human Powered Flywheel Motor (HPFM) (ii) Suitable torsionally flexible clutch and torque amplification gear pair and (iii) a process unit. Essentially the flywheel motor consists of flywheel, which is being driven by a human

III. OBJECTIVE OF THE STUDY

The study was undertaken with following objectives:

- (1) To evolve anew design for proposed mini rice mill for domestic purpose.
- (2) The selection of mechanism for transmission of motion and power required.
- (3) The machine should be capable to paddy de-husking at home instead to sending to rice mill.
- (4) Maximize the total milled rice recovery out of paddy, minimize grain breakage.

IV. WORKING PRINCIPLE:

The principle of operation of mini rice mill is that when power supply by bicycle through chain as well as gear drive to the conventional paddy dehussing mechanism, then the huller shaft revolves in a particular direction says clockwise or anticlockwise direction. the shearing force between huller shaft and fixed plate is responsible for rice milling.

There being provided a cover plate on the top of the said housing having a paddy feeding chute to the rest edges of the aid flutes inside the housing. The person sitting on the seat then iterates the pedal thereby causing the flywheel to rotate and also the huller shaft rotate. The closed plate is slowly withdrawn to allow paddy to fall through the spiral portion of the huller shaft. The paddy is thrust forwarded into the distributor section which distributed the paddy into plurality of longitudinal fluids of the huller shaft. As the huller shaft rotates the paddy falls through adjustable gap formed between the longitudinal raised edges of the huller shaft and the edges of end plate. Paddy is subjected to pressure and shearing action between the huller shaft and fixed plate and the husk is removed.



FIGURE -MINI RICE MILL FOR DOMESTIC PURPOSE

V. RESULT AND DISCUSSION:

The main objective of the project is to process paddy with the help of human effort. But as the flywheel used in the mechanism is of heavy weight, human fatigue or strain to human leg muscle is quite obvious.

For example if any man has to operate the machine for more than one hour the result obtained after half an hour will be much less as compared to the initial result.

Also rice obtained from this mechanism will not be of superior quality as compared to products obtained at modern rice mills.

In modern rice mills the rice obtained after processing is polished and after that it is made to pass through various stages thus increasing the quality of the rice. But this is not possible by pedal operated rice milling machines.

I. PHYSICAL PROPERTIES OF PADDY: Physical and engineering properties of agricultural grains are necessary for the design of storage, handling and processing equipment. In this study, some physical properties of raw paddy are discussed briefly. At moisture content of 10% (wet basis), the average grain length, width and thickness were 8.54, 2.47 and 1.83 mm, respectively while the equivalent mean diameter, surface area and volume were 3.4 mm, 32.58 mm² and 21.06 mm³, respectively. This part of study was carried out in Fars province to evaluate the effect of paddy moisture content on rice breakage during the milling process. Three levels of paddy energizes the huller. These samples of paddy were fed into the huller via a hopper. Time taken to dehusk the sample was recorded with the help of real time clock integrated circuit DS1307 and microcontroller 89V51RD2. This data is saved in Personal computer connecting microcontroller through USB connector. Thus time was recorded at all gear ratio and speed, for loading and unloading condition. The dehusk paddy was collected in a container and weighted to determine output.

a) The milling efficiency was determined as-

$$M_e = \frac{W_p}{W_m} \times 100$$

Where, M_e = Milling efficiency

W_p = Total weight of paddy in.

W_m = Total weight of dehusk paddy. Out.

b) The milling rate was determined as-

$$M_r = \frac{W_m}{t_m}$$

Have efficiency of well over 85%. Some modifications were suggested to improve the efficiency of the machine.

Table 1. Experimental Data for mini rice mill for domestic purpose

Paddy	Milled grains	Unmilled grains	Broken grains	% milled
500gm	430gm	20gm	50gm	86
1000gm	850gm	50gm	100gm	85
1500gm	1275gm	90gm	135gm	85
2000gm	1625gm	150gm	225gm	81.3
2500gm	1925gm	225gm	350gm	77
Average	1221gm	107gm	172gm	82.86

moisture content (8 to 10%, 10 to 12%, and 12 to 14%) were considered.

II. PERFORMANCE TEST: For conducting trials five (05) persons from age group 20- 35 were selected. The mean (+_ SD) of age, weight, height were 26 +_ 3.5 years, 68.62 +_ 21 kg, 176.30+_13 cm. Respectively. All the trials started at 10 AM in the morning in our workshop where the room temperature varied from 25 - 30^o c and relative humidity was 50-60% during the experimentation. During the trials, gear ratio 1:2, 1:3, 1:4. The speed of the flywheel for each gear ratio will be 300, 400, 500rpm. The operates the system similar to bicycle by pedals and spinning the flywheel to the desired speed in duration of one minutes thereby storing energy to the flywheel. After one minute peddling is stopped and flywheel shaft is connected to huller shaft through spiral jaw clutch and

Where, M_r = Milling rate

t_m = Milling time in seconds.

III. FEEDING RATE AND PERCENTAGE MILLED

The machine is made up of three basic units: the power transmission unit, which is made up of a compound gear train system consisting of two spur gear sets; the milling unit, which consist of the milling cylinder, a sieve and a milling house; the support, which is made up of 40mm x 40mm square pipe bar. The materials for the fabrication were sourced locally. The test was carried out by feeding 500gm, 1000gm, 1500gm and 2000gm grains into the dehuller. The result of different feeding rates is given in Table. on present reading we can observed the average output of milling machine is 25kg/hr. The results of the performance tests show that rice paddy was milled fairly satisfactorily when compared to existing rice milling machine. The machine has a milling efficiency of 82.86% while most modern mills.

IV. FIELD PERFORMANCE DATA OF MACHINE:

Table 2. Field Performance Data from Machine

Parameters	machine energized with HFM
Material processed	25 Kg
Operating time	60 min
Capacity	25 kg / Hr.
Labor requirement	1
Overall performance	Satisfactory
Remark	Useful for those people they are living in rural area

Machine takes 60 minute to milling the paddy of 25 kg to achieve zero percentage of weight loss. The huller was rotated below the critical speed of 600 rpm to avoid centrifuging effect. The field test data for mini rice mill machine energized with Human Powered Flywheel Motor are given in Table.

VI.CONCLUSION:

The main objective behind development of pedal operated rice milling machine was to process rice grains at low cost without application of any electronic device.

Thus this machine can be used at rural areas where there is no supply of electricity. Further the operation of the machine does not claim any requirement of high skilled operator thus can be used by any normal human being. The design is kept simple so that fabrication can be done without any problem. By providing the proposed solution of the mini rice mill for domestic purpose energized by Human Power Flywheel Motor to the small sector businessmen those who want earning source in rural areas. The model suggested will be fabricated in low cost which can be easily affordable for small scale business sector.

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