PERFORMANCE EVALUATION OF KAU MANURE PULVERIZER

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PROJECT REPORT

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KELAPPAJI COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY
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KERALA, INDIA
2017

DECLARATION

We hereby declare that this project report entitled ''**Performance Evaluation of KAU Manure Pulverizer**'' is a bonafide record of project work done by us during the course of project and that the report has not previously formed the basis for the award of any degree, diploma, fellowship or other similar title of another University or Society.

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CERTIFICATE

Certified that this project work entitled "**Performance Evaluation of KAU Manure pulverizer**" is a record of project work done jointly by Mr. Amal Dev. J, Ms. Arya.K.T., Ms. Harsha.V. under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associate ship to them.

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Dedicated to

The Profession of

Agricultural

Engineering ….

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SYMBOLS AND ABBREVIATIONS

ANOVA	Analysis of variance
Cm	Centimeter
Dept.	Department
e.g.	for example
Er.	Engineer
et al.	and others
etc	et cetera
Fig.	Figure
g	Gram
G.I.	Galvanized iron
H	hour(s)
Hp	horse power
i.e.	that is
IS	Indian Standards
KAU	Kerala Agricultural University
KCAET	Kelappaji College of Agricultural Engineering and Technology
k cal	Kilo calorie
Kg	Kilo gram
kg h^{-1}	Kilo gram per hour
kW	Kilo watt
kW h^{-1}	Kilo watt per hour
l	Litre
m.c	Moisture content
Meq	milli equivalent
meq kg^{-1}	milli equivalent per kilo gram
Min	Minute(s)
Mm	millimeter(s)

M	Meter(s)
$m\ s^{-1}$	Meter per second
M.S.	Mild steel
No.	Number
No.s	Numbers
Pa.s	Pascal – second
Rpm	Revolutions per minute
Rs	Rupees
S	second(s)
Sl.No.	Serial Number
%	Percent
^0C	Degree Celsius
viz.	As follows
Wb	Wet basis

INTRODUCTION

CHAPTER I

INTRODUCTION

Agriculture has changed dramatically during the recent past, especially since the advent of green revolution. Although these changes have had many positive effects, there have also been significant negative effects. Several movements have emerged during the past four decades to question the role of the agriculture establishment in promoting practices which in the long run, will affect the sustainability of the farming system.

Modern technologies adopted in agriculture are entirely different from conventional methods. The sector is focusing on the production of high value commodities over the low quality products. In modern agriculture a cultivable field will be used more than two times for cultivation of different crops according to season. This will adversely affect the productivity of soil. In order to enhance these properties, we use different chemical fertilizers and organic manures which is a good fertilizer to increase soil properties without causing any damage to plant and other related things. However with the increased use of chemical fertilizers today, land is rapidly becoming infertile.

Organic fertilizers are carbon based compounds that increases the productivity and growth qualities of plants. They have various benefits over chemical fertilizers which include, improve soil physical properties such as granulation and good tilt, giving better aeration, easy root penetration and improved water holding capacity. It reduces soil pH and thus considered as complete plant good. There is an increasing consumer demand for agriculture produce which are free from toxic chemical residues. Also it helps in maintaining CN ratio in the soil and also increases soil fertility and productivity.

Manures are plant and chemical waste that are used as a source of plant nutrients. There are number of organic manures like farmyard manure, green manures, compost prepared from crop residues and other farm wastes, vermin compost, oil cakes and biological wastes – animal bones, slaughter, house refuse etc. there are 16 nutrients required to grow crops. Three essential nutrients carbon, hydrogen and oxygen are taken up from atmospheric carbon dioxide and water. The other 13 nutrients are taken up from the soil and are usually grouped as primary nutrients, secondary nutrients and micro nutrients. The primary nutrients viz, nitrogen, phosphorus and potassium are founded in blended fertilizers such as 10-10-10, or equivalent grades. For an optimum plant growth, the manures must contain 0.02-0.05% of nitrogen, 0.01-0.2% of phosphorus and 0.17-3.3% of potassium.

Jaiva krishi is one among the broad spectrum of production methods that are supportive of the environment. Organic production methods are based on specific standards precisely formulated for good production and aim to achieve an agro ecosystem, which are socially and ecologically sustainable. It is based on minimizing the use of external inputs through the use of on farm resources efficiently compared to industrial agriculture.

Water content is a major reason for nutrient content variation in manures. Fresh manures generally contain 70 to 80% of water. When manure dried to 10-17% of moisture and ground into a fine soil like texture, nutrients are more concentrated and the soluble salt level is probably higher in dehydrated manure than in locally available farm manure. As manure dries, nutrients not only concentrated on a weight basis, but also on a volume basis due to structural changes.

After dehydration the manure is ground. Compared to fresh manure, it is easier to handle and transport because of decreased volume and weight. Additionally dehydrated manure has a consistent texture and is easier to apply to gardens. Dehydrated manure has a lower pathogen and weed seed content than fresh manure.

Pulverized manure can be used more directly to fertilize individual plants. This would not have an immediate impact as chemical fertilizer but will provide nutrient over a longer period of time. Powdered manures can be used for plants grown in grow bags in homes or terrace garden cultivations, more over dried ground manure has less unpleasant odor.

By knowing the importance of Jaiva krishi and the need for powdering the dried manures, KAU has developed a machine “KAU Manure Pulverizer” to pulverize dried organic manures such as cow dung, neem cake, biogas slurry, goat and rabbit faecal pellets etc. Hence the study under this project is envisaged to evaluate the performance of the machine with following objectives:

- To study the machine and the material (dried manure) parameters
- To evaluate the performance of the pulverizer
- To optimize the machine parameters
- To workout cost economics

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

The past research works related to the relevant aspects of performance evaluation of KAU manure pulverizer have been reviewed in this chapter. Working of pulverizer resembles is somewhat related to the milling mchines. There are several milling machines developed in our country. To comprehend the research works towards the performance evaluation of KAU manure pulverizer, literature reviews were done and are grouped under the following headings.

1. Properties of organic manures
2. Performance of milling machines

2.1 Properties of organic manures

Dr. Surya Gunjal reported about the organic farming practices in cities which include terrace cultivation. He revealed that good textured and enriched soil contain most of the nutrients required for plant growth. For the better growth and yield, N, K, and P are primarily required in large quantities. He noted that application of manures and fertilizers depends on the essential nutrients already available in the soil and the action of organic manures are fairly low but long lasting than that of chemical fertilizers. Manures contain lower percent of plant nutrient than fertilizers, but are highly eco-friendly. Manures are generally applied at the root zone of growing plant; so that it could be easily absorbed.

Sankaranarayanan presented a paper on nutrient potential of organic sources for soil fertility management in organic cotton production. Organic cotton is grown in living soil fields which have been free from synthetic pesticides herbicides. Different organic manures and their compositions were discussed in the study. Manures can be grouped into bulky organic manures and concentrated organic manures based on concentration of the nutrients. Farmyard manure, compost and green manures are bulky manures whereas oilcakes, blood meal fish manure are concentrated manures. Also the effect of organic manures on different properties such as soil microbial population, soil chemical properties, effect on organic carbon, effect on micronutrients and soil physical properties were discussed.

Osuhor *et al*, (2002) conducted a study on manure production by goats grazing native pasture in Nigeria. The objective of the study was to determine the quantity and quality of overnight manure produced by Red Sokoto goats. The experiment was conducted at the Goat Breeding Project site of the National Animal Production Research Institute (NAPRI), Shika and fed a concentrate supplements to goats. They selected five bucks and five non-pregnant dry does and grazed as one group. They produced 0.38 and 0.37 kg of manure per head per night, respectively, during the wet season. Corresponding values were 0.35 and 0.34 kg during the dry season. Nutrient concentrations in the dry manure were: N – 2.8 percent; P – 0.42 percent; and K – 0.93 percent. An adult goat is capable of producing 138 kg dry manure per year which would contain 3.4 kg N, 0.5 kg P and 1.1 kg K. There is significant potential to reduce fertilizer costs for crop production by substituting goat manure for expensive inorganic fertilizer currently used.

Satyanarayana *et al*, (2002) performed a study on influence of integrated use of farmyard manure and inorganic fertilizers on yield. They conducted a field experiment at the farm having sandy loam with ph 7.8, to study the influence of combined application of farm manures, growth and yield. Different plant samples were analyzed for N by micro-kjeldahl method, phosphorous by Vanadomolybo Phoshoric Yellow Color method using spectrophotometer and K by flame photometry. The data collected were statistically analyzed by standard analysis of variance technique. The critical difference were calculated at 5 percent level of probability of the treatment difference were found significant based on the results of F-test. The results showed that application of farmyard manure at 10 tha^{-1}, increased grain yield of rice by 25 percent compared to no farmyard manure applications.

Maheshbabu *et al*, (2007) conducted an experiment on the effect of organic manures on plant growth, seed yield and quality of soya bean. The field experiment was conducted on black soil having organic carbon 0.6 percent, available nitrogen 182.3 $kg.h^{-1}$ and ph 7.5 and there were 8 treatments and was laid out in randomized block design with 3 replications. Mainly farmyard manure, vermicompost, and Greenleaf manures were incorporated three weeks before sowing as per the treatments. It was concluded that all the growth, seed yield and yield components were differed significantly due to the application of organic manures and the seed quality. Application of recommended dose of fertilizers with recommended dose of farmyard manure ($4t.ha^{-1}$) recorded significantly higher seed yield (22.45 $q.ha^{-1}$) and yield components. The application of farmyard manure recorded higher seed quality parameters, germination (96.76 percent) and field emergence of 93.33 percent.

Adeniyan *et al*, (2011) conducted a comparative study of different organic manures and NPK fertilizer for improvement of soil chemical properties and dry matter yield of maize in two different soils.The aim of the experiment was to compare different organic manures with NPK fertilizer for improvement of chemical properties of acid soil from farmer's field in coastal area of Epe and nutrient depleted soil from research field of Institute of Agricultural Research and Training, Moor Plantation. Five different organic manures (cow dung, cassava peelings compost, poultry manure, rabbit droppings and cane rat droppings) and NPK 15: 15: 15 inorganic fertilizer were applied. It was reported that the application of 5 $ton.ha^{-1}$ of each of the evaluated organic manures and 100 $kg.ha^{-1}$ NPK 15-15-15 fertilizer improved chemical properties of both the soils. Also the application of different types of organic manures reduced the acidic levels of both the soils. The study indicated that among the organic manures evaluated, cane rat droppings improved soil chemical properties best.

Sarwarul *et al*, (2011) performed a study on the effect of organic manures on growth, yield and nutrient uptake in maize. The experiment was conducted to evaluate the effects of different sources of organic nitrogen viz, urea, household wastes, poultry manure and cow dung on growth, yield and nutrient uptake in maize. The soil used was silt clay loam. The highest grain yield of maize (7.70 $t.ha^{-1}$) was recorded in the treatment receiving 75 percent N from urea and 25 percent N from poultry. The effect of Poultry manure was most pronounced than that of cow dung and household wastes.

Sharma *et al*, (2012) performed a study on the effect of combinations of organic materials and bio fertilizers on productivity, grain quality, nutrient uptake and economics in organic farming of wheat. They conducted a field experiment on the research farm of Indian Agricultural Research Institute (IARI), New Delhi. They adopted six fertilizer treatments, namely, farmyard manure, vermin compost, farmyard manure and rice residue, vermin compost and rice residue, farmyard manure, rice residue and bio fertilizers, and vermin compost, rice residue and bio fertilizers. Farmyard manure contains primary, secondary and micronutrients, thus its application significantly increased grain and straw yield of wheat. For bio fertilizers, *Azotobacter*, cellulolytic culture and phosphate solubilizing bacteria were used. The result showed that combination of vermin compost, rice residue and bio fertilizers was the most productive treatment while combination of farmyard manure, rice residue and bio fertilizers was the most economical treatment with respect to the net profit. They analyzed the collected data using analysis of variance.

2.2 performance of milling machine

Anonymous presented an economical analysis on spice grinding. The study described the net profit, percentage of profit on sales, return on investment and breakeven point. Total project was established as rupees 466,700 (per annum). It was observed that a net profit of rupees 197,222, percentage of profit on sales of 8 percent, return on investment 42 percent and breakeven point of 44 percent were reported for all costs of production and other aspects.

Anonymous presented an economical analysis of a mini wheat mill developed by CFTRI, Mysore, which has produced baker flour (maida), atta and suji from wheat. The study aimed at the influence of different construction aspects and basic requirements on cost analysis. In order to report a better evaluation, the study carried about to land, building details and cost, plant and machinery, electrification and installation, misc fixed assets and so on. It also reported that the mills would work 300 days per annum with labour as much required and workout the cost and other profits based on market rate with a working capital of 12 percent.

Al-mogahwi and Baker (2005) conducted a process engineering study on commercial wheat mill to determine the performance of the break and reduction rolls and plansifters. The milling line consisted of four break rolls, ten reduction rolls and plansifters and purifiers. Measurement were taken on first, second, third and breaks and first, second and fifth reduction mill plansifter combinations. They could measure the details of roll dimensions, flute dimensions and angles and speed of rolls with respect to various feed rate. The process study mainly aimed to measure flow rate ash content, moisture content and particle size distribution of the product obtained from each streams. It was reported that the purity of the flour collected progressively decreased from first break rolls to third break rolls. The size distribution and flow rates decreased from first break roll-plansifter combination to the third. The cumulative size distribution of the outlet flour becomes normalize with respect to roll gap.It was found out that there was excellent size distribution pattern before and after the fifth reduction plansifter. Hence it was concluded that the plansifters had significant role in determining particle milling.

Anonymous (2011) presented a project profile on mini flour mill. They analyzed the market potential of the product, implementation schedule, technical aspects about machinery and financial aspects. Financial apects consisted of the calculation of cost of production, turn over (per year), net profit per year, net profit ratio, rate of return and breakeven point. The process of milling was described according to the size of the hopper, grinding chamber and the space between the grinding plates. Corrugated rollers (break rolls) were used for the grinding purpose. Power requirement of the unit was 300 hp. A net profit ratio of 6.12 percent, rate of return of 29.45 percent and breakeven point of 41.85 percent were obtained.

Anonymous (2011) presented an economical cost analysis of a mini pulverizer. The analysis was based on total turnover with the proposed plant and machinery utilities such as power and water, wages of authorities and labour wages, and commercial production. Total cost requirement was described according to the working of pulveriser . It had worked for 18,000 hours per annum at minimum efficiency of 75 percent. It was established that the working capital required for 3 months was rupees 1,257,000 and net profit per year was rupees 1,856,760. Interest on fixed and working capital has been calculated at an average of 12 percent per annum. The breakeven point was calculated as 45 days. Market and demand aspects of pulverizer were also evaluated.

Nwaigwe *et al*, (2012) performed a study on design construction and performance evaluation of a modified cassava milling machine. In this study they developed a modified machine which combines both impact and shearing milling action with a pneumatic conveying and clarifying action. They conducted a fineness and efficiency test for its evaluation procedures. The components of the machine consisted of a shaft, pulley, belt, electric motor, bearing, mild steel plates, mild steel angle bar and mild steel cylindrical tube with the modified cassava flourmill operated by an electric motor of 5 hp and rotor speed of 1880 rpm; a milling efficiency of 82.3 percent was obtained. The machine was found to be dust free and beaters do not wear when run freely. From the fineness test, the fineness modulus was obtained as 0.31, the uniformity index as 0:1:9 (coarse: medium: fine) and effective size (D10) as 0.075 mm. The results indicated a better performance than that produced by the existing mill of fineness modulus 2.32 and effective size of 0.085 mm. They obtained a grain size distribution curve which inferred that the uniformity coefficient and coefficient of curvature were obtained as 1.7 and 0.28 respectively. The uniformity coefficient of 1.7 indicated that the flour is uniform.

Dharmasena *et al*, (2013) conducted a study on fabrication, testing and evaluation of a dust filtration system for small scale spice grinding mills. The study aimed at developing an appropriate low cost air purification system for the dust and odor filtration in spice grinding mills. The filtration unit consisted of plastic barrel, centrifugal type blower, nylon and PVC fiber filter, axial flow pump, steel frame work and a detergent reservoir. The centrifugal blower was operated using a 0.5 hp electric motor. The dust filtration system was designed based on similar principle as in the existing spry tower filter but high pressure for fluid atomization was not required. Dust removal rates were determined with different concentrations of a foaming shampoo and a non-foaming detergent. A graph was plotted illustrating the relationship between the soap concentrations and filtering efficiency. Filtering efficiency of foaming soap was greater than the non-foaming soaps. Efficiency of filtration increased with concentration of detergent and the maximum efficiency achieved was 91 percent. The initial dust load of 150 $mg.m^{-3}$ was reduced to 9.6 $mg.m^{-3}$ with the foaming detergent and to 32 $mg.m^{-3}$ with the non foaming detergent. The dust filtration system was found to be more efficient when foaming detergent was used. The cost analysis of the filtration system was also carried out in this study.

Nwogu *et al*, (2013) conducted a study on improved design of a flour milling machine. The study aimed at milling of flour to a higher degree for food production without damaging the nutrients. The major components of the milling machine are main frame, rollers, gears, table, electric motor mounting frame, smooth rods, drive shaft, pulley drive, motor, belts, key, ball bearing, nuts and bolts. It was reported that the old design didn’t have the pinion drive gear and the speed reduction was done with an auxiliary gear box which was driven by an automotive engine of 60 hp. The modified machine was designed to use the main drive shaft as means of speed reduction. The cost analysis of the improved design of machine was also made. The performance of the machine was reported as satisfactory.

Ravi (2013) presented an economic analysis of a mini wheat flour mill. The analysis consisted of the calculation of turnover (per annum), net profit (per annum), net profit ratio, rate of return and breakeven point. The process of milling was described according to the size of the hopper, grinding chamber and the space between the grinding plates. The space between the rotating grinding plates were adjusted to get the consistency (coarse or fine) limits. Its service capacity was about a flour of 280T per year. Dust collectors were provided to control air pollution. A net profit ratio of 34.6 percent, rate of return of 93 percent and breakeven point of 48.3 percent were obtained. The market potential and technical aspects of the mini wheat flour mill were also evaluated.

Shankar *et al*, (2013) conducted an experiment to evaluate the performance of an attrition mill used in the finger millet processing industry. The experiment showed that the processing of millet for the product manufacturing reduced anti-nutritional factors, which in turn resulted in bioavailability of nutrients. The attrition mill used by the industry consisted of a stationary and a rotating cast steel plate positioned vertically and operated by 2 hp electric motor. The treatment included three plate clearances (0.3, 0.5, and 0.7mm), three plate speeds (450, 600 and 700 rpm) and three feed rates (90, 100 and 115 $kg.h^{-1}$). GPU-28 variety of finger millet at 10 percent moisture was used as feed material. The experiment was statistically analyzed using Factorial Completely Randomized Design (FCRD). The samples of 250g each were oven dried at 105°C. Using a set of 9 British Standard Sieves, different fractions retained on sieves were noted. A graph was plotted showing fineness of flour obtained against plate clearance, plate speed, feed rate. It was reported that the milling loss increased with increase in plate clearance irrespective of feed rates and plate speeds. The milling loss was found out as minimum 15 percent at 0.3 mm plate clearance, 100 $kg.h^{-1}$ feed rate and 600 rpm plate speed combinations. The milling efficiency of the attrition mill was about 85 percent when 0.3 mm plate clearance, 100 $kg.h^{-1}$ feed rate and 600 rpm plate speed were provided. The least fineness modulus of 2.04 was recorded.

Etoamaihe and Iwe (2014) conducted a study on development and performance evaluation of a reciprocating motion cassava shredder. Reciprocating motion of shredding plates helped to shred the roots and leaves of peeled cassava. The machine consisted of a hopper where peeled cassava roots were put. It was then shredded due to reciprocating motion of shredding plates placed beneath the hopper. An electric motor was used as prime mover of the machine. A rugged framework was provided for mounting the machine and electric motor. The capacity of the machine was found to be $320kg.hr^{-1}$. Experimental evaluation results showed that the size of the shredding aperture of the machine significantly affected the shredding efficiency of the machine. The shredding efficiency of the machine decreased with increasing shredding aperture, but increased with shredding speed. Maximum shredding efficiency of 92 percent was obtained when the shred aperture was 3mm and the shredding speed was 975rpm. Also the throughput capacity of the machine increased with speed of shredding with a maximum value of $319.89kg.hr^{-1}$ at 975rpm and a minimum value of $301.54kg.hr^{-1}$ at 325rpm.

Gbabo and Ndagi (2014) developed a rice mill in NCRI, consisted of a hopper, milling chamber, husk aspirator, blower, drive and machine frame. Hopper had the shape of frustum, made up of mild steel. The husk aspirator is made up of a suction fan enclosed in a circular casing, the drive and driven assembly with an electric motor of 15 hp. The machine frame is made up of angle iron. The tests conducted on milling recovery, head rice recovery, broken rice and machine capacity using standard test procedures. They examined grain of short, medium, and long rice samples at three different levels of feed rate (0.088, 0.033 and $0.014kg.s^{-1}$) and moisture content (15-16, 12-13 and 10-11 percent). Milling recovery at the feed rate of $0.088kg.s^{-1}$ and $0.033kg.s^{-1}$ at 10-11 percent moisture content are 71.43 percent and 69.25 percent respectively. At the feed rate of 0.088

kg.s^{-1} medium grain type had the highest percentage breakage at 15-16 percent moisture content and the same medium grain type were obtained at a lowest percentage broken rice at 10-11 percent moisture content. The performance test showed that the significant effect on increasing feed rate on the machine capacity of rice milled at all levels of moisture content and with different grain type. The input and output capacity of the machine decreased with decreasing feed rate. Also the whiteness of rice milled increased with decreasing federate at all levels of moisture content.

Shakiru *et al*, (2014) performed a study on assessment of dry and wet milling using fabricated burr mill. The reductions in the size of agri-products during wet and dry milling were analyzed. They conducted a survey in three markets for evaluating the burr mill used in reduction process of agro materials. They fabricated a pepper grinding machine which had a burr plate with thickness of about 9.47 mm. tests were also carried out to find the milling effect of beans, maize, pepper, vegetables like tomatoes etc. with or without adding water. Power source used for the burr mill was either petrol or diesel engine in which 65 percent of diesel was used for wet milling while 35 percent for dry milling. The analysis indicated that the level of wear and tear of the machine varied with the age of machine and frequency of usage. The thickness of the plate after the successive usage was found to be 4.69 mm.

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHODS

This chapter deals with complete description of the KAU manure pulverizer and methodology adopted for its performance analysis. It also deals with the statistical method for analyzing the performance data and a brief description of cost economics. The methods followed to determine the physical properties of different manures are also detailed.

3.1 KAU manure pulverizer

The manure pulverizer is used for pulverizing dried cow dung, neem cake, vermin compost, biogas slurry, poultry waste, goat and rabbit faecal pellets and other dried organic manures. The machine consisted of a prime mover, pulverizing drum, feeding chute, power transmission unit, pulverizing blade, sieve and supporting stand.

Plate.3.1 KAU MANURE PULVERIZER

3.11 Prime mover

A single phase electric motor having 1.5hp with 1440rpm, 230v, 10A and 50Hz was used as a prime mover. Two double V-belt pulleys were used for power transmission from electric motor to the shaft.

3.1.2 Pulverizing drum

The pulverizing drum is the main part of the machine in which the dried manures are pulverized by impact and cutting forces of rotating blades. It is made up of 5mm thick M.S sheet. Its diameter is 52cm and height 30cm. The total capacity of the drum is 64 liters (63700cm^3). The pulverizing drum houses the blades welded at the bottom of the shaft, bearings and a sieve at the bottom. Drum has a top cover, 2/3rd of this top cover is fixed and 1/3rd facilitates an opening for feeding the manures. It is hinged to the fixed sector (75*20mm). Top cover is made up of M.S sheet of 1mm thickness.

3.1.3 Transmission unit

This unit is used to transmit power from electric motor to the rotating blades. The transmission unit consists of two double V-belts pulley of size 10cm.Tthe V-belts used are B39. A M.S shaft of ϕ35 was used as a major shaft. The length of the shaft is 40cm. The shaft is fixed by two plummer blocks with ball bearings, which is fitted with angle frames. Two Plummer blocks at a distance of 14cm are fixed at this angle iron frame. The end of the shaft is supported on the frame on bush bearing welded on the angle bar provided just above the sieve. A square key of length 6.3cm is inserted to restrict the relative motion of the pulley and shaft. A lock screw is provided at the bottom to hold the shaft in erect position.

3.1.4 Feeding chute

The dried manures were fed through the feeding chute to the pulverizing drum. The feeding chute is trapezoidal in shape having 5605cm length and top and bottom width respective as 72cm and 30cm. It is made up of a M.S plate of thickness 6mm. A M.S angle iron 20*20*2mm is welded at top of the chute and 25*25*5mm at the bottom to hold the plate in firm condition.

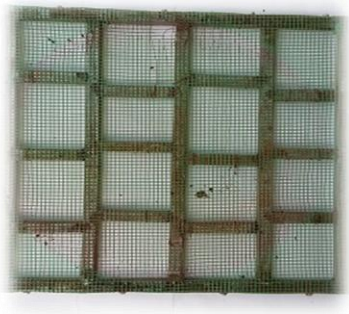
3.1.5 Pulverizing blade

It is used for pulverizing the dried manures. The rotary shaft is fitted with fair blades which are fixed inside the pulverizing drum. It has a length of 22cm and width 4cm and is made up of EN8 flat of 6mm thick. The blades are fitted at the bottom of the shaft with the help of a nut. It is sharpened on one side at an angle 45°.

Plate.3.2 pulverizing blade

3.1.6 Sieve

A 5mm square mesh or 10mm hole mesh were provided at the bottom of the pulverizing drum. It was supported by sheet of size 52*2*0.4cm and was welded on the supporting frame and just below the rotating blades. A clearance of 1.5cm is provided between sieve and pulverizing blade to get the manures pulverized easily.



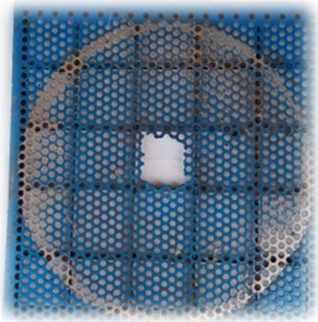


Plate.3.3 5mm IS sieve

Plate.3.4 10 mm IS sieve

3.1.7 Supporting stand

In order to support the entire pulverizing unit viz. electric motor, pulverizing drum, driving members, the supporting stand was made with four iron angles of size 5*5*0.6cm at a height of 65cm.

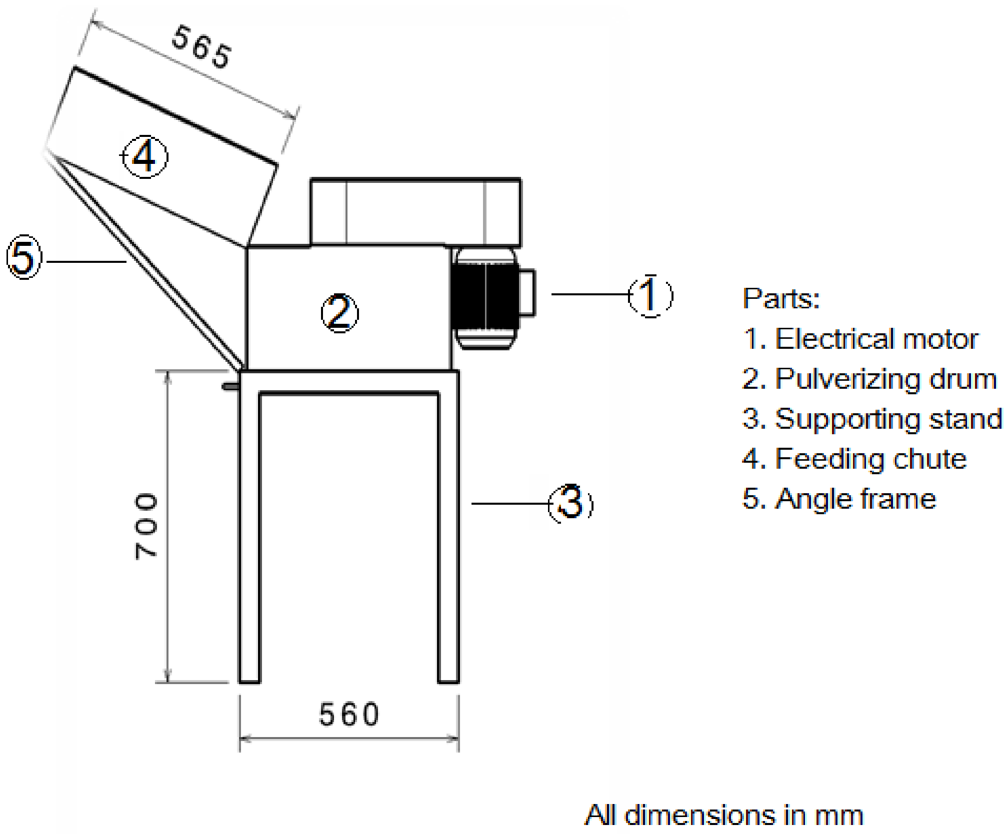


Fig:3.1 KAUmanure pulverizer

3.2 Working of KAU manure pulverizer

The dried farmyard manures are filled in the drum through feeding chute. Feed rate was controlled by means of a cap provided at the top cover. On starting the motor, the shaft rotates along with the blades inside the drum. Due to the rotation of blade, the dried manure gets crushed in the clearance between sieve and blade. Power from the motor was transmitted to the shaft by means of double V-belt pulley. Effective crushing is achieved by providing a tapering at one side of the blade. The powdered manures pass through the sieve and collected at the bottom. The dried manures will remain inside the drum until it attains a size smaller than the size of holes in the sieve.

3.3 Study of the physical characteristics of manures

The physical characteristics of the manures which affect the output and efficiency of the machine are moisture content, weight and bulk density.

3.3.1 Determination of moisture content

Moisture content is the percentage of water present in a given manure sample. The oven dry method is used for the determination of moisture content. Pulverizing manure is collected in a clean container and placed in an oven under controlled temperature conditions of 105-110° for a period of 24hrs. The initial and final weights of sample are measured by using an electronic weighing balance having a sensitivity of 0.01g. The moisture content is determined by using the equation,

$$\text{Moisture content} = \frac{[M_1 - M_2]}{M_2}$$

Where, M_1= initial weight of the manure in g

M_2= final weight of the manure in g

3.3.2 Determination of weight

Weight of manure is measured using a digital weighing machine of sensitivity of 0.01 g.

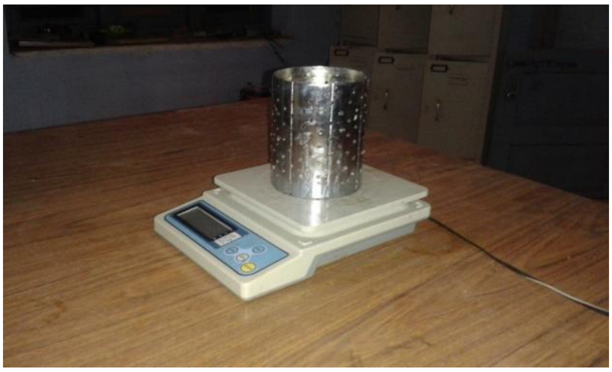


Plate.3.5 Weighing balance

3.3.3 Determination of bulk density

Bulk density is defined as the ratio of mass of the manure including the volume of voids. It is expressed in g/cm^3 and is found out by standard procedures. It is determined by using standard test method. The pulverized manure sample is filled in a graduated cylinder and the volume to the nearest graduation unit is noted. The mass of this known volume of sample is measured using a weighing balance. Bulk density of manure is found out by using the formula,

$$\rho = m/v$$

Where, ρ = bulk density in g/cm3

m = weight of sample in g

v = volume of sample in $1m^3$.

3.4 Determination of machine parameters

The machine parameters such as speed of blade, clearance between sieve and blade and sieve size are determined as follows.

3.4.1 Determination of speed of blade

The rotational speed of the blade fitted on the shaft which is driven by a prime mover is determined by a DT 1236L laser type tachometer. Manures are pulverized due to rotations of the blade which causes the cutting and shearing actions. This tachometer features both the ability to measure rpm in rotational equipment and surface speed with included contact adapters. The built in laser for non-contact measurement provides accurate measurement up to 2m away from target. The measurement is carried out by attaching a reflector on a fixed blade. After starting the machine keep tachometer at a desired height and directed the laser to the reflector. Tthe measurement displayed on the tachometer was noted.

3.4.2 Determination of clearance between blade and sieve

Clearance is provided between sieve and pulverizing blade to get the manures pulverized easily. It is maintained by providing bushes of 5mm thick each. And it is measured by using a meter scale. Evaluation was conducted with 15, 20, 25 mm clearance respectively.

3.4.3 Determination of sieve size

The size of the sieve was measured by using an inside calipers with an accuracy of 0.01mm. A 5mm size square mesh and 10mm diameter hole mesh were used for conducting the evaluation of the machine.

3.5 Performance evaluation of KAU manure pulverizer

The KAU manure pulverizer was tested in field conditions to evaluate capacity, efficiency of operations, time of operation, fineness and cost of operation as follows.

3.5.1 Capacity of the machine

The capacity of the machine is considered as the amount of pulverized manure per unit time. For calculating the capacity, manure is fed to the machine for six known period of time viz. 10, 20, 40, 50 and 60 seconds. The time taken is observed using stowatch and weight of the pulverized manure in each period is recorded. Knowing the time required and weight of the pulverized manure, the capacity where calculated as,

$$\text{Capacity, Kg h}^{-1} = \frac{weight\ of\ pulverized\ manure,\ Kg}{time\ of\ operation,\ hr}$$

3.5.2 Efficiency of operation

Efficiency of operation is the ratio of output to the input manure. For calculating efficiency a known weight of manure is fed into the machine and corresponding weight of pulverized manure were taken. The experiment is repeated thrice with each manures with different moisture content, clearance and sieve size.

3.5.2 Time of operation

Time of operation of the pulverizer depends upon moisture content, clearance and sieve size. It is the time required ton pulverize a known amount of manure. For calculating time of operation, 10 Kg of manure at different moisture content is fed into the machine and time required to pulverize that much quantity is recorded using a stop watch. The experiment is repeated by varying moisture content, clearance and sieve size.

3.5.3 Finess modulus

Finess modulus is an index number which represents the mean size of particles in pulverized manure. It is calculated by performing sieve analysis with standard sieves. The sieves used for the fine sieve analysis are 2 mm, 1 mm, 600, 425, 300, 212, 150 and 75 μm IS sieves. Select the sieves and arrange them in descending order with the largest sieve on top on a mechanical shaker. Pour the samples in the top sieve and close it with sieve plate and shaking od sieve is done for at least 5 minutes. Record the sample weights retained on each sieve. Then find the cumulative weight retained. Finally the cumulative percentage retained on each sieve is determined. Adding all cumulative percentage values and dividing with 100 will give the value of finess modulus.

3.5.4 Cost of operation

Cost operation of the KAU manure pulverizer is calculated following the standard procedure and assumption and the same is given in Appendix- IV.

RESULTS AND DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

Results of the test conducted with the KAU Manure Pulverizer are presented and discussed in this chapter. The moisture content, clearance between sieve and pulverizing blade and sieve size are the major factors affecting the pulverization of the manure. The performance of the machine by varying physical properties of manure and machine parameters for pulverizing cow dung, goat faecal pellets and neem cake are evaluated and summarized.

4.1 Determination of physical properties of manures

Physical properties such as moisture content, bulk density and weight of different manures which influence the performance of the Manure Pulverizer were determined.

4.1.1 Moisture Content

Moisture content was determined as percentage by weight by hot air oven dry method. Three samples from each type of manure at different moisture content were collected and determined as explained in the section 3.3.1. The recorded values and its calculated percentage of moisture content are presented in Table 4.1.

Table 4.1.Moisture content of different samples

Item	Sample	Initial weight, M_1 (gm)	Final weight, M_2 (gm)	Moisture content (%) $MC = \frac{[M_1 - M_2]}{M_2} \times 100$
Cow dung	1	6.40	5.00	28.00
	2	19.20	16.50	16.36
	3	17.45	14.43	20.93
Goat faecal pellet	1	17.33	14.84	16.70
	2	13.93	11.19	24.48
	3	11.67	10.53	10.82
Neem cake	1	20.02	17.53	14.20
	2	19.54	15.39	26.96
	3	22.40	18.56	20.70

4.1.2 Weight

The weight of the samples of cow dung, goat faecal pellet and neem cake were taken by using a digital weighing machine of sensitivity 50 g.

4.1.3 Bulk density

The bulk density is the total mass of the sample per unit volume and it was determined as explained in section 3.3.3. Bulk densities of both raw and powdered manure from different sieve size were calculated. The result of the study is presented in Table 4.2.

Bulk density of raw material differs from the bulk density of pulverized material. It is observed that bulk density increases when it get pulverized. Bulk density also depends upon sieve size. The powder obtained from 5 mm sieve size had greater bulk density than the powder from 10 mm sieve.

Table 4.2.Bulk densities of manures

Sl No:	Item	Sample	Weight of sample (gm)	Volume (cm^3)	Bulk density ($g\ cm^{-3}$)
1	Cow dung	Raw material	155.5	500	0.311
		Sample from 5 mm	203.5	500	0.407
		Sample from 10 mm	186.5	500	0.373
2	Goat faecal pellet	Raw material	201.5	500	0.403
		Sample from 5 mm	278.5	500	0.557
		Sample from 10 mm	209.0	500	0.418
3	Neem cake	Raw material	198.5	500	0.397
		Sample from 5 mm	219.5	500	0.439
		Sample from 10 mm	209.5	500	0.419

4.2 Determination of machine parameters

The machine parameters such as speed of blade, clearance between sieve and blade and sieve size were found out as explained in chapter III. These parameters are important in evaluating the performance of pulverizer.

4.2.1 Speed of the blade

Manures are pulverized due to the cutting and shearing action of blade. The rotational speed of the pulverizing blade was determined by a tachometer as explained in sec.3.4.1. Speed of the blade found out was 1442 rpm.

4.2.2 Clearance between sieve and blade

Clearance is maintained by providing bushes of 5 mm thick each. Clearance is an important parameter for the pulverizing of the manures. Clearance was measured using meter scale and those are of 1.5, 2 and 2.5 cm respectively.

4.2.3 Sieve size

The size of the sieve was measured using an inside calipers. The sieve sizes are measured as explained in the sec 3.4.3. Sieve sizes are 5 mm and 10 mm.

4.3 Performance evaluation of KAU Manure Pulverizer

The pulverizer was tested for determining its efficiency, capacity, time of operation and finess modulus of the output. Testing was conducted by varying sieve size, moisture content and clearance between the sieve and the blade. Three clearances such as 1.5, 2 and 2.5 cm and 5 mm and 10 mm sieve size were selected for the performance evaluation of the pulverizer. Capacity, efficiency, time of operation and finess modulus as a result of testing are presented and discussed below.

4.3.1 Capacity of the pulverizer

The machine capacity that is the amount of manure pulverized in unit time was found by following the procedure explained in the section 3.5.1. The results of the calculations done to determine the capacity is presented in Table 4.3. It is observed that on an average, the KAU Manure Pulverizer is capable of powdering 500.00 Kg of manure per hour.

Table 4.3.Capacity of pulverizer

Time (Sec)	Weight of manure (Kg)	Capacity (Kg hr^{-1})
10	1.39	500.50
20	2.77	498.60
30	4.16	499.20
40	5.55	499.50
50	6.94	499.68
60	8.32	499.20
Average Capacity (Kg hr^{-1})		499.44~ 500.00

4.3.2 Efficiency of the pulverizer

Efficiency of the pulverizer under various parameters such as sieve size, clearance between blade and sieve and moisture content of the manure was determined as explained in sec.3.5.2. Results are presented and discussed below.

4.3.2.1Efficiency under various moisture content

Efficiency of the pulverizer varies with moisture content of the manure. Three samples of each manure at different moisture content were taken and corresponding efficiencies are determined using 5 mm sieve size. Moisture content corresponding to maximum efficiency is selected as the most suited one. Cow dung with 20.93 per cent had the highest efficiency of 98.10 per cent among the samples. Goat faecal pellets with 16.70 per cent had the highest efficiency of 98.50 per cent among the samples. Similarly neem cake with moisture content 14.20 per cent had the highest efficiency of 98.5 per cent among the samples. Results of the test were presented in the Table 4.4.

Table 4.4.Efficiency of the manure under various moisture content

Item	Sample	Moisture content (%)	Input (Kg)	Output (Kg)	Time (sec)	Efficiency (%)
Cow dung	1	28.00	10.00	9.67	86.30	96.70
	2	16.36	10.00	9.71	78.80	97.10
	3	20.93	10.00	9,81	67.60	98.10
Goat faecal pellet	1	16.70	10.00	9.85	71.00	98.50
	2	24.48	10.00	9.75	84.33	97.50
	3	10.82	10.00	9.65	56.32	96.50
Neem cake	1	14.20	10.00	9.85	61.31	98.50
	2	26.90	10.00	9.79	120.80	97.90
	3	20.70	10.00	9.61	84.32	96.10

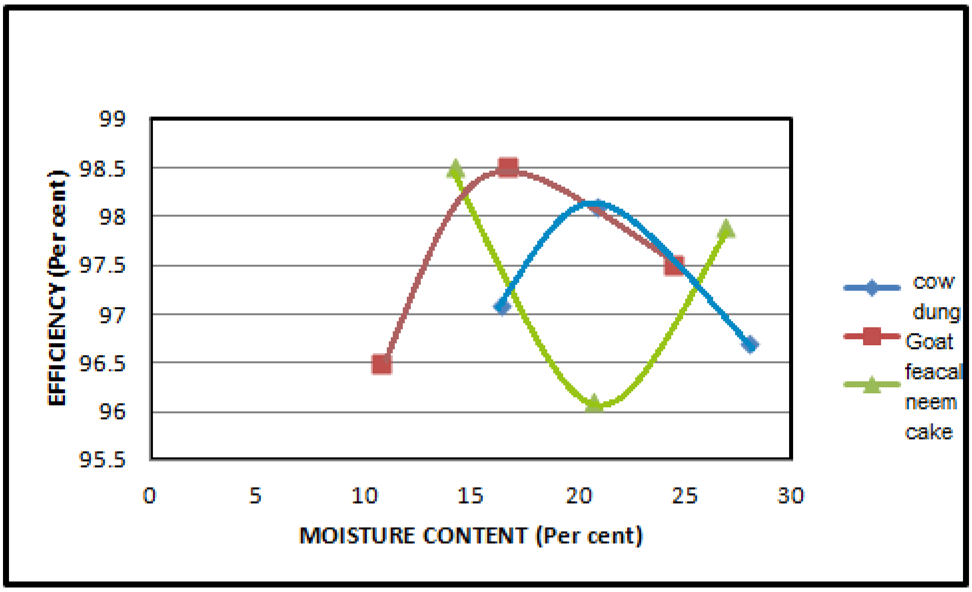


Fig 4.1. Efficiency – Moisture content relationship for sieve size 5 mm

Increase in moisture content of cow dung increases the efficiency. However increase in moisture content beyond an optimum limit causes further decrease in efficiency due to adhering nature of manure. Similarly efficiency during pulverizing of goat faecal pellet increases to a limit as increase in moisture. Where as in the case of pulverizing of neem cake efficiency decreases with increase in moisture content to a limit and then increases as further increase in moisture content.

Efficiency - moisture content relationship for 10 mm sieve size at the same moisture content was calculated and presented in Appendix I. The variations of efficiency with moisture content for 10 mm sieve are shown in the Fig. 4.2.

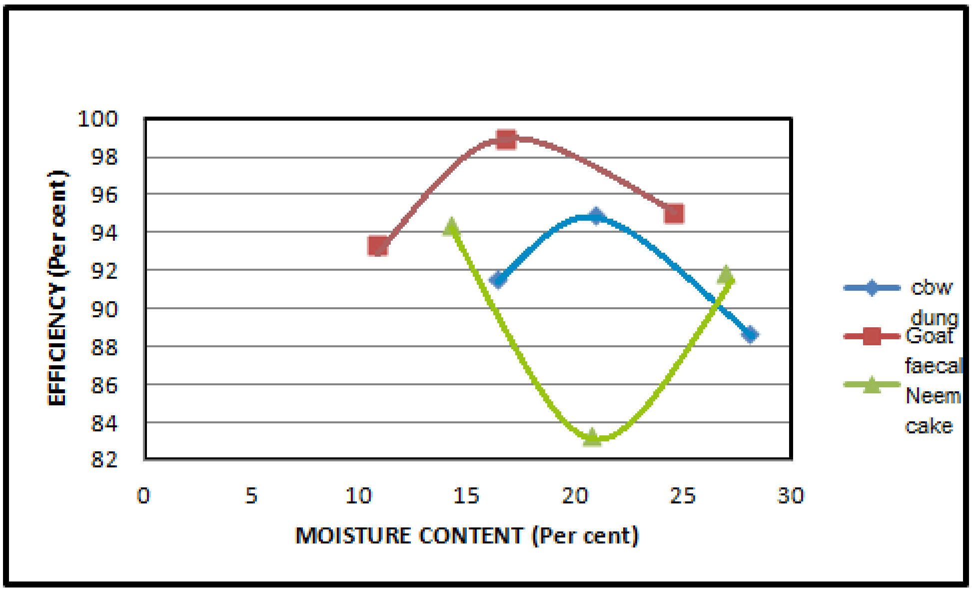


Fig.4.2.Efficiency – moisture content relationship for sieve size 10 mm

Increase in moisture content of cow dung increases the efficiency. However increase in moisture content beyond an optimum limit causes further decrease in efficiency due to adhering nature of manure. Similarly efficiency during pulverizing of goat faecal pellet increases to a limit as increase in moisture. Where as in the case of pulverizing of neem cake efficiency decreases with increase in moisture content to a limit and then increases as further increase in moisture content.

4.3.2.2 Variation of efficiency with clearance

Efficiency of the pulverizer varies with clearance between the sieve and blade. Variation is illustrated in Fig 4.3 and Fig 4.4. Testing was carried out in both 5 mm and 10 mm sieves at 1.5, 2.0, 2.5 cm clearance respectively.

In 5 mm sieve size most efficiency was obtained at 1.5 cm clearance for all manures where as in 10 mm sieve variations are found out with respect to type of manure and clearance.

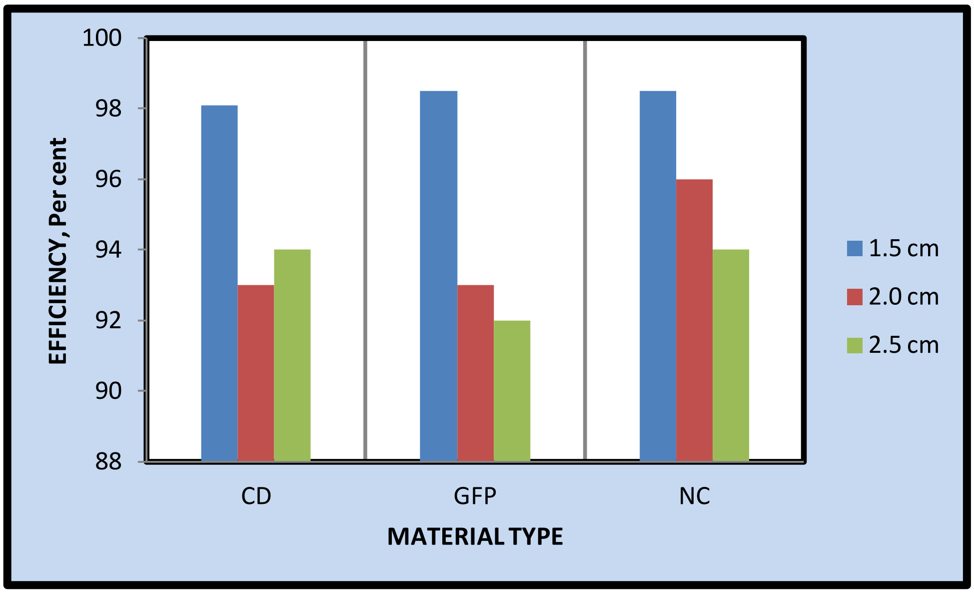


Fig 4.3 Variation of efficiency with clearance at 5 mm sieve

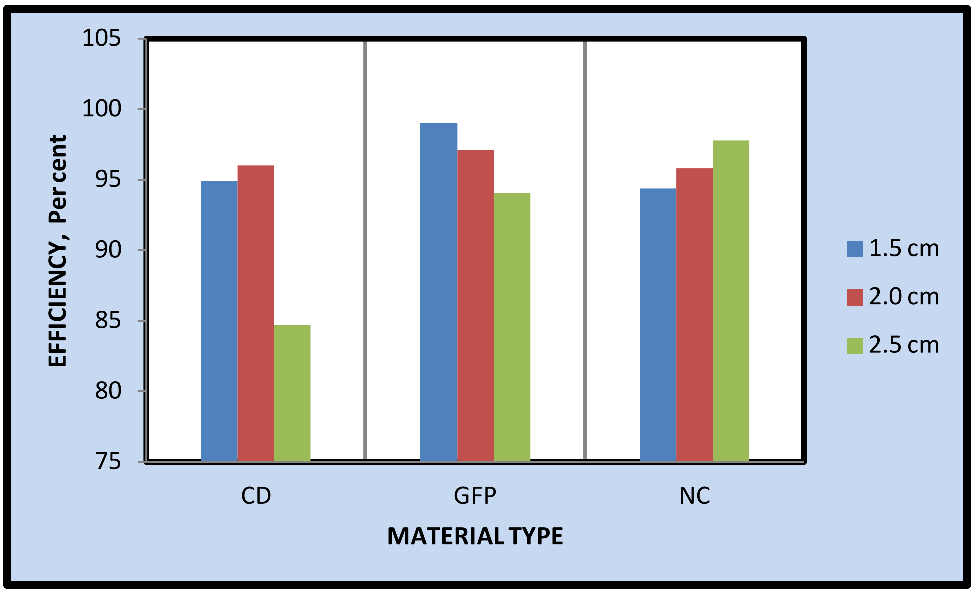


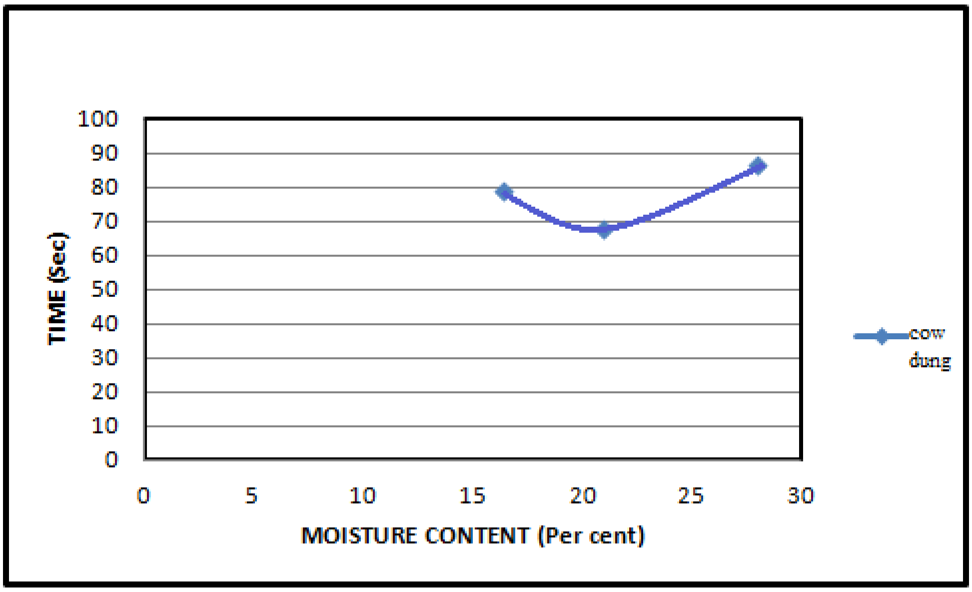
Fig 4.4 Variation of efficiency with clearance at 10 mm sieve

4.3.3 Time of operation

Time required for pulverizing 10 Kg of each manure were recorded using a stopwatch. Time of operation depends upon moisture content, sieve size and clearance between the blade and sieve.

4.3.3.1 Variation of time with moisture content

Variation of time with moisture content of different manures is illustrated in Fig 4.5 to Fig 4.7. In the case of cow dung at 5 mm sieve size least time taken by the sample having moisture content of 20.93 per cent. Since it is having larger size and hardness compared to other samples the time increases as decrease in moisture content. Goat faecal pellet and neem cake with moisture content of 10.82 per cent and 14.20 per cent respectively take least time to get pulverized.



Fig, 4.5.Time – Moisture content relationship of Cow dung powder

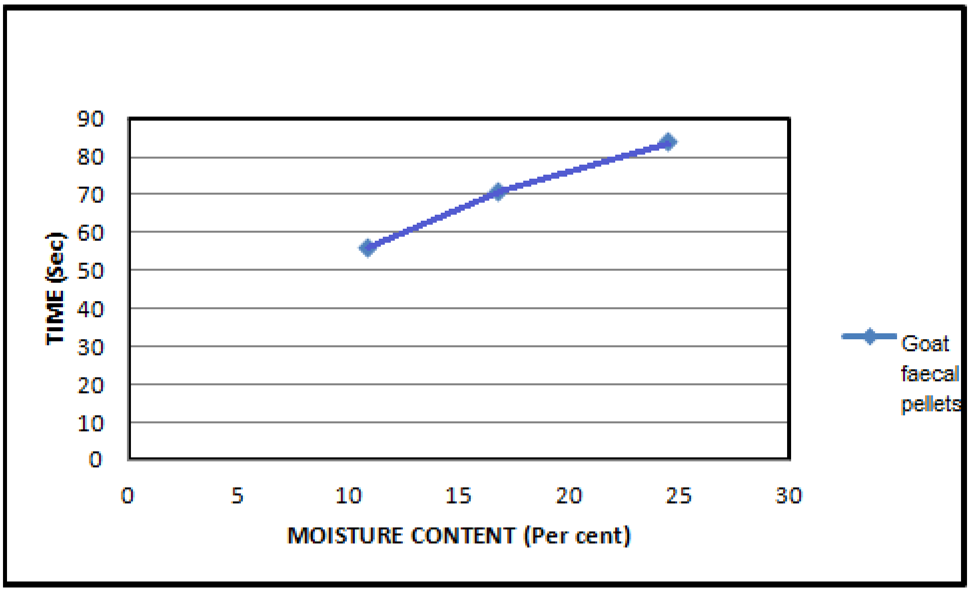


Fig.4.6. Time – Moisture relationship of Goat faecal pellet powder

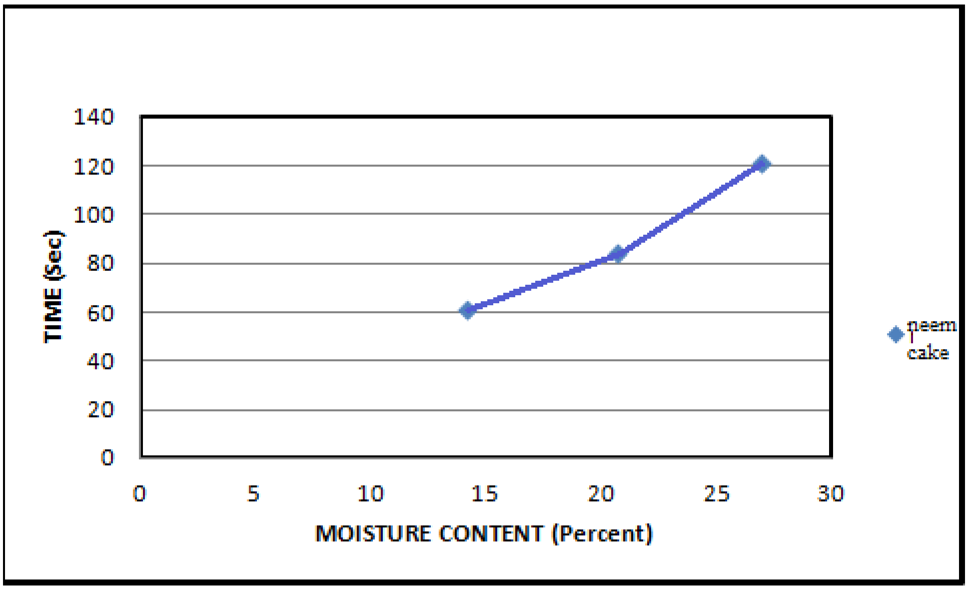


Fig.4.7. Time – Moisture content relationship of Neem cake powder

4.3.3.2 Variation of time with clearance

Variation of time with different clearance such as 1.5, 2.0 and 2.5 cm at 5 mm and 10 mm sieve size of different manures with efficient moisture content were analyzed. The various results are illustrated in the Fig.4.8 and Fig.4.9. In the case of cow dung at 5 mm sieve size least time taken at 2.5 cm clearance. Since it is having larger size and hardness compared to other samples the time increases as decrease in clearance. Goat faecal pellet and neem cake take least time at 1.5 cm clearance for pulverizing. Similarly cow dung at 10 mm sieve size least time taken at 2.0 cm clearance. Since it is having larger size and hardness compared to other samples the time increases as decrease in clearance. Goat faecal pellet and neem cake take least time at 1.5 cm clearance for pulverizing.

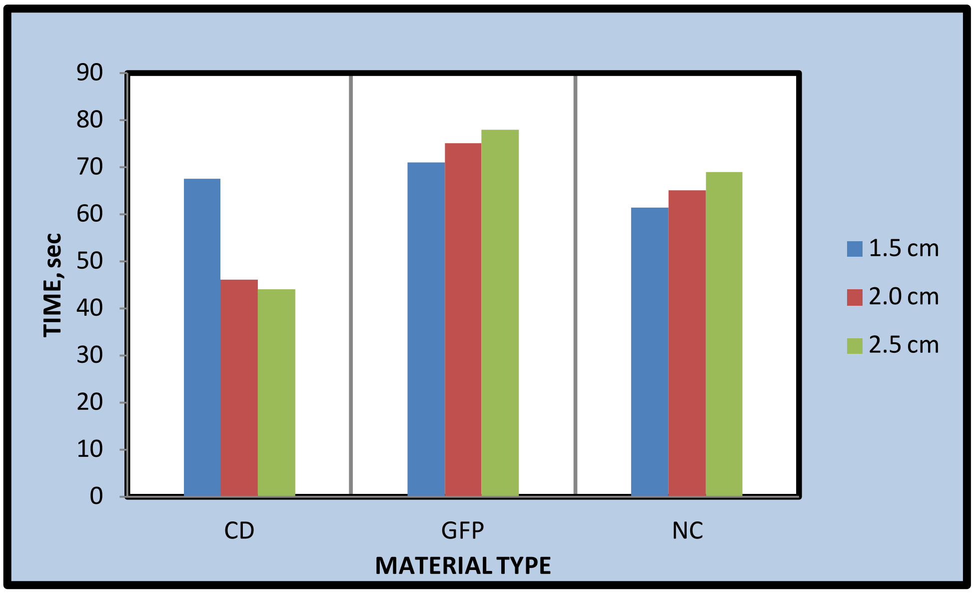


Fig.4.8 Variation of time with clearance at 5 mm sieve

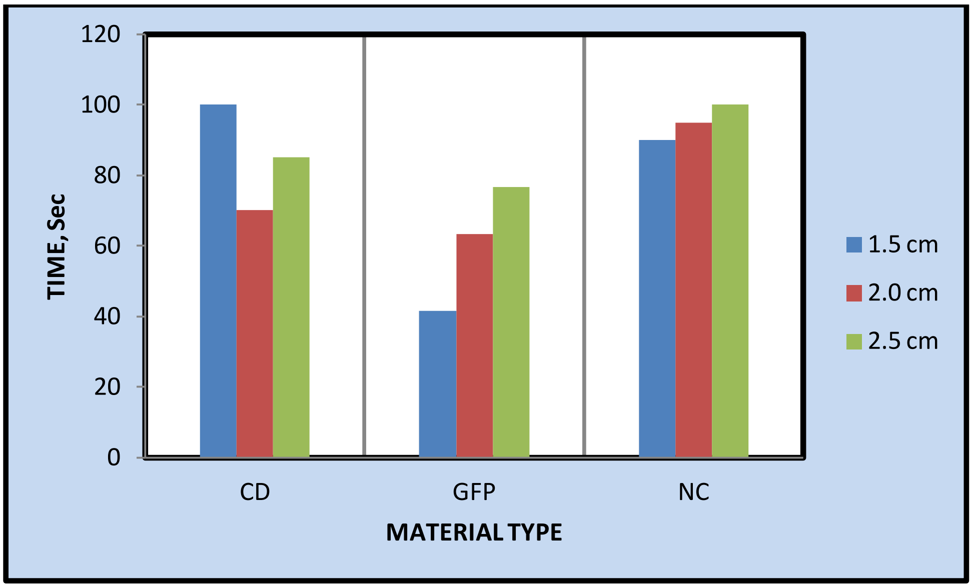


Fig.4.9 Variation of time with clearance at 10 mm sieve

4.4 Determination of finess modulus

For the determination of finess modulus, different pulverized manures with different moisture content from different sieve sizes and clearances were collected and it was carried out in the laboratory. Finess modulus was found out by sieve analysis. Variation of finess modulus is shown in the Fig 4.10 and Fig 4.11.

Plate.4.1 cow dung powder observed from 5 mm and 10 mm IS seives

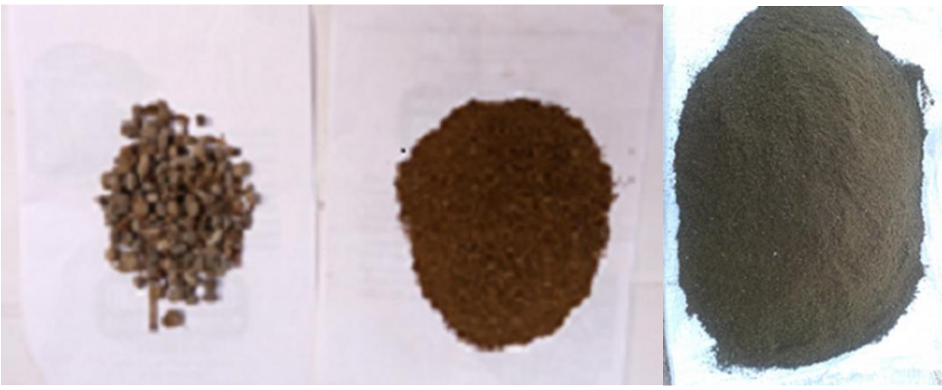


Plate.4.2 goat faecal pellet powder observed from 5 mm and 10 mm IS sieves

Plate.4.3 Neem cake powder observed from 5 mm and 10 mm IS seives

4.4.1 Sieve analysis

Pulverized manure retained on each sieve (2 mm, 1 mm, 600 µm, 425 µm, 300 µm, 212 µm, 150 µm, 75 µm) sizes arranged one below the other were collected and weighed and the process was repeated for each manure at different conditions. Calculations were done as per the section 3.4. The calculations are shown in the Appendix II.

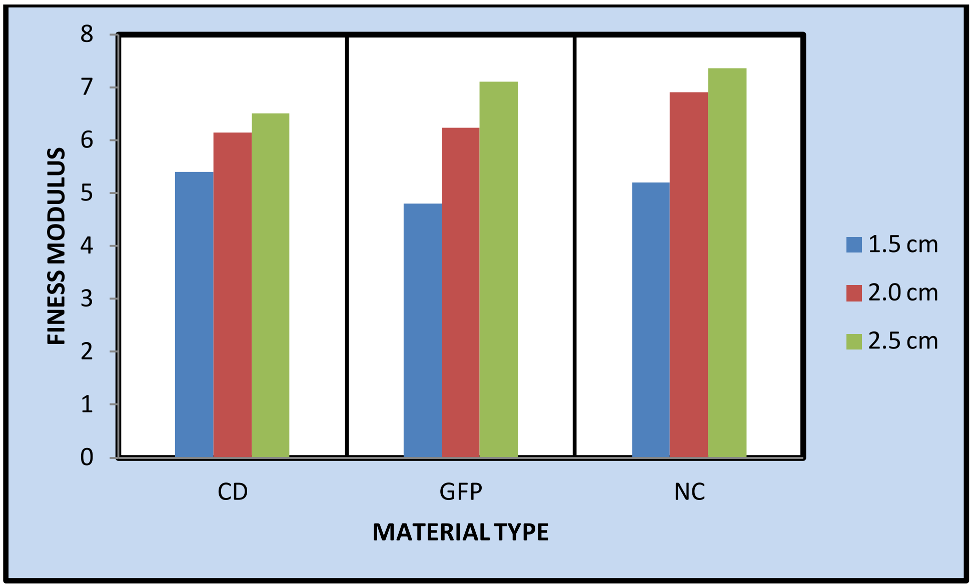


Fig 4.10 Variation of finess modulus with clearance at 5 mm sieve

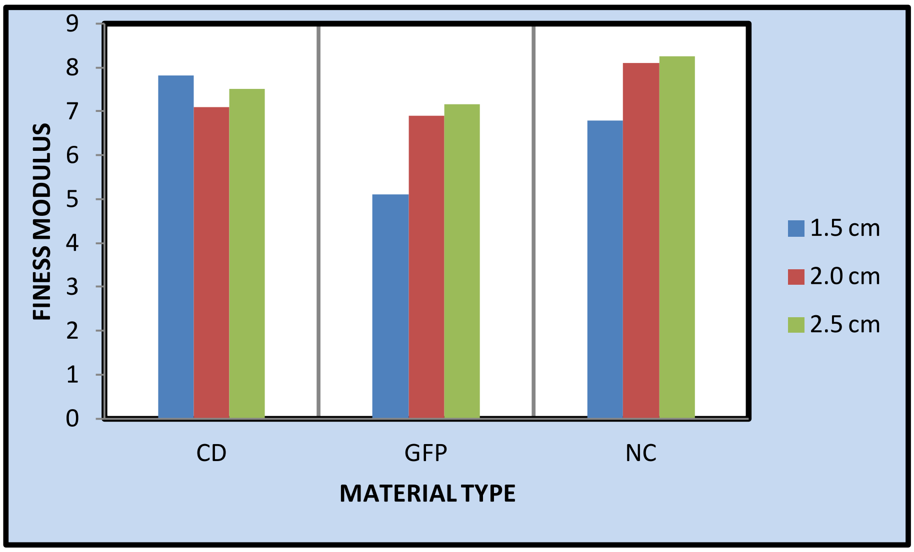


Fig 4.11 Variation of finess modulus with clearance at 10 mm sieve

The effect of sieve size and clearance between sieve and pulverizing blade on pulverizing dried manures at different moisture content was statistically analysed by analysis of variance (ANOVA) is presented in Appendix III. The treatments with 14.20 per cent moisture of neem cake at 5mm sieve size and 1.5 mm clearance on pulverizing dried neem cake are significantly superior.

The treatments with 20.93 per cent moisture of cow dung at 5mm sieve size and 1.5 mm clearance on pulverizing dried cow dung are significantly superior.

The treatments with 16.70 per cent moisture of goat faecal pellets at 5mm sieve size and 1.5 mm clearance on pulverizing dried goat faecal pellets are significantly superior in pulverizing efficiency and time of operation, and recorded as group 'a'.The treatments with 10.82 per cent moisture of goat faecal pellets at 5mm sieve size and 1.5 mm clearance on pulverizing dried goat faecal pellets are significantly superior in particle size.

4.5 Cost analysis

The capacity of the KAU Manure pulverizer is 499.44 kg h^{-1}. The unit uses a 1.5 hp 1440 rpm prime mover with a maximum power consumption of 0.5 kW h^{-1}. Cost required for the working of KAU Manure pulverizer is Rs 269.82 per hour. From this the cost required to pulverize dried manure for 1kg is Rs. 1only. The detail of the cost analysis is given in Appendix IV.

SUMMARY AND CONCLUSION

CHAPTER V

SUMMARY AND CONCLUSIONS

Agriculture has changed dramatically during the recent past, especially since the advent of green revolution. Several movements have emerged during the past four decades to question the role of the agriculture establishment in promoting practices which in the long run, will affect the sustainability of the farming system. To enhance the productivity of the soil we use different chemical fertilizers and organic manures. However with the increased use of chemical fertilizers, land is rapidly become infertile. Organic manures are good fertilizer to increase soil properties without causing any damage to plant and other related things. For the sake of protection of public health Government introduced many programs to enhance jaiva krishi with the use of organic manures.

Water content is a major reason for nutrient content variation in manures. Fresh manures generally contain 70 to 80% of water. When manure dried and ground into a fine soil like texture, nutrients are more concentrated and the soluble salt level is probably higher in dehydrated manure than in locally available farm manure. Compared to fresh manure, it is easier to handle and transport because of decreased volume and weight. Additionally dehydrated manure has a consistent texture and is easier to apply to gardens and has a lower pathogen and weed seed content than fresh manure.

By knowing the importance of Jaiva krishi and the need for powdering the dried manures KAU has developed a machine KAU Manure Pulverizer to pulverize dried organic manures such as cow dung, neem cake, biogas slurry, and goat and rabbit faecal pellets etc.

Thus the objectives are, to study the different machine and material parameters, to evaluate the performance of KAU manure pulverizer, to optimize the machine parameters and cost economics.

Test has been conducted with three different dried manures like cow dung, goat faecal pellet and neem cake at different moisture content. During the testing it was observed that moisture content of manures influences the powdering operations. In order to minimize the problem we optimize the moisture content of each manure which is best suited for the operation of machine. As the moisture content increases from optimum value pulverization become difficult due to the adhering nature of manure. And if it is dried to very less moisture content efficiency of operation decreases due to the material loss as dust. From the analysis the efficient moisture contents for cow dung, goat faecal pellet and neem cake are 20.93%, 16.70% and 14.20% respectively.

Time of operation depends upon moisture content, sieve size and clearance between the blade and sieve. Time of operation increases with the increase in moisture content and sieve size except in the case of cow dung. As it dries, it forms large clumps and become harder, it takes less time to get pulverize at larger clearance and larger sieve size.

Efficiency of operation was found out by comparing the amount of powdered manure with the input feed. Efficiency was influenced by machine parameters such as sieve size and clearance between sieve and blade. From the analysis maximum efficiency of 98.5% was obtained for the goat faecal pellets at 1.5 clearances and at 5 mm sieve size. With 10 mm sieve size maximum efficiency of 99% was obtained for goat faecal pellets. Least efficiency was observed for both cow dung and neem cake.

Performance of pulverizer was also analysed by finding finess of the powder. Finess of the powder was found out by sieve analysis. It was observed that at 5 mm sieve size, the size of the particle of each manure increases with increase in clearance between the sieve and blade. Most fine powder obtained was goat faecal pellet powder with finess modulus of 4.80.

The whole testing and analysis indicated that, KAU manure pulverizer with 5 mm sieve and 1.5 cm clearance is perform efficiently for all kind of manures. But it is most suited to pulverize goat faecal pellets than other manures. The average capacity of the pulverizer was found to be 500.00 Kg hr^{-1}

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CHAPTER VI

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APPENDICES

Appendix I

Efficiency Moisture relationship of dried manures

Sieve size (mm)							
		5			10		
Material	**Clearance (cm)**	**Time (sec)**	**Efficiency (%)**	**Finess modulus**	**Time (sec)**	**Efficiency (%)**	**Finess modulus**
Cow dung	1.5	67.60	98.10	5.40	100.0	94.9	7.81
	2.0	46.00	93.00	6.14	70.0	96.0	7.10
	2.5	44.00	94.00	6.50	85.0	84.7	7.52
Goat faecal pellet	1.5	71.00	98.50	4.80	41.6	99.0	5.11
	2.0	75.00	92.00	6.23	63.3	97.1	6.90
	2.5	78.00	93.00	7.11	76.6	94.0	7.17
Neem cake	1.5	61.31	98.50	5.20	90.0	94.4	6.79
	2.0	65.00	96.00	6.90	95.0	95.8	8.10
	2.5	69.00	94.00	7.36	100.0	97.8	8.25

Appendix II

Determination of fineness modulus of dried manures

Particle size of Cow dung at 5mm sieve size with 1.5 mm clearance between sieve and blade

	IS sieve (Col.2)	Particle size (mm) (Col.3)	Mass retained (Col.4)	Cumulative mass retained (Col.5)	(Col.5/2)
1	2 mm	2.000	34.03	34.03	17.02
2	1 mm	1.000	50.11	84.40	42.07
3	600 micron	0.600	39.67	123.80	61.90
4	425 micron	0.425	15.69	139.50	69.75
5	300 micron	0.300	15.89	155.39	77.69
6	212 micron	0.212	20.84	176.23	88.10
7	150 micron	0.150	4.48	180.70	90.35
8	75 micron	0.075	8.26	188.90	94.45

Fineness modulus = 540/100

= 5.4

Particle size of goat faecal pellets at 5mm sieve size with 1.5 mm clearance between sieve and blade

Sl.no (Col.1)	IS sieve (Col.2)	Particle size (mm) (Col.3)	Mass retained (Col.4)	Cumulative mass retained (Col.5)	(Col.5/2)
1	2 mm	2.000	38.0	38.0	19.0
2	1 mm	1.000	41.0	79.0	39.5
3	600 micron	0.600	42.0	121.0	60.5
4	425 micron	0.425	14.0	135.0	67.5
5	300 micron	0.300	16.0	151.0	75.5
6	212 micron	0.212	19.0	170.0	85.0
7	150 micron	0.150	2.50	172.0	86.2
8	75 micron	0.075	5.50	178.0	89.0

Fineness modulus = 520/100

= 5.2

Particle size of goat faecal pellets at 5mm sieve size with 1.5 mm clearance between sieve and blade

Sl.no (Col.1)	IS sieve (Col.2)	Particle size (mm) (Col.3)	Mass retained (Col.4)	Cumulative mass retained (Col.5)	(Col.5/2)
1	2 mm	2.000	10.5	10.5	5.250
2	1 mm	1.000	45.5	56.0	28.00
3	600 micron	0.600	45.5	101.5	50.75
4	425 micron	0.425	19.5	121.0	60.50
5	300 micron	0.300	20.0	141.0	70.50
6	212 micron	0.212	27.0	168.0	84.00
7	150 micron	0.150	7.00	175.0	87.50
8	75 micron	0.075	13.5	188.5	94.25

Fineness modulus = 480/100

=4.8

Particle size of cow gung at 5mm sieve size with 2.0 mm clearance between sieve and blade

Sl.no (Col.1)	IS sieve (Col.2)	Particle size (mm) (Col.3)	Mass retained (Col.4)	Cumulative mass retained (Col.5)	(Col.5/2)
1	2 mm	2.000	34.5	34.50	17.25
2	1 mm	1.000	35.5	70.00	35
3	600 micron	0.600	37.0	107.0	53.50
4	425 micron	0.425	19.0	126.0	63.00
5	300 micron	0.300	19.5	145.5	72.50
6	212 micron	0.212	29.5	175.0	87.50
7	150 micron	0.150	6.0	181.0	90.50
8	75 micron	0.075	11.0	192.0	96.00

Fineness modulus = 614/100

= 6.1

Particle size of goat faecal pellets at 5mm sieve size with 2.0 mm clearance between sieve and blade

Sl.no (Col.1)	IS sieve (Col.2)	Particle size (mm) (Col.3)	Mass retained (Col.4)	Cumulative mass retained (Col.5)	(Col.5/2)
1	2 mm	2.000	31.00	31	15.50
2	1 mm	1.000	44.00	75	37.50
3	600 micron	0.600	36.50	111.5	55.75
4	425 micron	0.425	18.50	130	65.00
5	300 micron	0.300	18.50	148.5	74.25
6	212 micron	0.212	26.50	175.0	87.50
7	150 micron	0.150	6.00	181.0	90.50
8	75 micron	0.075	12.50	193.5	96.75

Fineness modulus = 623/100

= 6.23

Particle size of Neem cake at 5mm sieve size with 2.0 mm clearance between sieve and blade

Sl.no (Col.1)	IS sieve (Col.2)	Particle size (mm) (Col.3)	Mass retained (Col.4)	Cumulative mass retained (Col.5)	(Col.5/2)
1	2 mm	2.000	88.5	88.5	44.25
2	1 mm	1.000	59.0	147.5	73.75
3	600 micron	0.600	32.0	179.5	89.75
4	425 micron	0.425	7.50	187.0	93.50
5	300 micron	0.300	5.50	192.5	96.25
6	212 micron	0.212	4.50	197.0	98.50
7	150 micron	0.150	0.50	197.5	98.75
8	75 micron	0.075	1.50	199.0	99.50

Fineness modulus = 690/100

= 6.90

Particle size of Cow dung at 5mm sieve size with 2.5 mm clearance between sieve and blade

Sl.no (Col.1)	IS sieve (Col.2)	Particle size (mm) (Col.3)	Mass retained (Col.4)	Cumulative mass retained (Col.5)	(Col.5/2)
1	2 mm	2.000	37.0	37.0	18.5
2	1 mm	1.000	47.0	84.0	42.0
3	600 micron	0.600	40.5	124.5	62.25
4	425 micron	0.425	17.5	142.0	71.0
5	300 micron	0.300	16.0	158.0	79.0
6	212 micron	0.212	23.0	181.0	90.5
7	150 micron	0.150	5.0	186.0	93.0
8	75 micron	0.075	6.5	192.5	96.25

Fineness modulus = 650/100

= 6.50

Particle size of Goat faecal pellets at 5mm sieve size with 2.5 mm clearance between sieve and blade

Sl.no (Col.1)	IS sieve (Col.2)	Particle size (mm) (Col.3)	Mass retained (Col.4)	Cumulative mass retained (Col.5)	(Col.5/2)
1	2 mm	2.000	58.0	58.0	29.00
2	1 mm	1.000	43.0	101.0	50.50
3	600 micron	0.600	32.0	133.0	66.50
4	425 micron	0.425	24.5	157.5	78.75
5	300 micron	0.300	16.5	174.0	87.00
6	212 micron	0.212	19.0	193.0	96.50
7	150 micron	0.150	3.5	196.5	98.25
8	75 micron	0.075	6.0	202.5	101.25

Fineness modulus = 711/100

= 7.11

Particle size of Neem cake at 5mm sieve size with 2.5 mm clearance between sieve and blade

Sl.no (Col.1)	IS sieve (Col.2)	Particle size (mm) (Col.3)	Mass retained (Col.4)	Cumulative mass retained (Col.5)	(Col.5/2)
1	2 mm	2.000	54.5	54.5	27.25
2	1 mm	1.000	57.5	112.0	56.00
3	600 micron	0.600	40.5	152.5	76.25
4	425 micron	0.425	16.5	169.0	84.50
5	300 micron	0.300	14.0	183.0	91.50
6	212 micron	0.212	14.0	197.0	98.50
7	150 micron	0.150	3.0	200.0	100.0
8	75 micron	0.075	2.5	202.5	101.25

Fineness modulus = 736/100

= 7.36

Appendix III

Effect of moisture content for dried manure powder

Effect of moisture content for Neem cake powder

Variables	Sieve size (mm)					
	5			10		
Moisture content (%)						
	14.20	20.70	26.90	14.20	20.70	26.90
Efficiency (%)	**98.50**[a]	96.10[b]	97.80[a]	94.4[c]	**83.3**[e]	91.90[d]
Finess modulus	**5.20**[a]	6.10[b]	6.70[b]	6.79[b]	**7.92**[c]	7.29[c]
Time (sec)	**61.31**[a]	84.32[b]	120.8[d]	90.0[c]	**130.**[d]	98.00[c]

Effect of moisture content for Goat faecal pellet powder

variables	Sieve size (mm)					
	5			10		
Moisture content (%)						
	10.82	**16.70**	**24.48**	**10.82**	**16.70**	**24.48**
Efficiency (%)	**93.30**[d]	**99.00**[a]	95.00[c]	96.5[c]	98.5[b]	97.50[b]
Finess modulus	**4.01**[a]	4.80[a]	4.80[a]	5.16[b]	5.11[b]	**5.41**[c]
Time (sec)	48.33[a]	**41.60**[a]	50.00[b]	56.3[b]	71.0[c]	**84.33**[d]

Effect of moisture content for Cow dung powder

variables	**Sieve size (mm)**					
	5			10		
Moisture content (%)						
	16.36	**20.93**	**28.00**	**16.36**	**20.93**	**28.00**
Efficiency (%)	97.10[b]	**98.10**[a]	96.70[b]	91.5[c]	94.9[c]	**88.70**[d]
Finess modulus	4.38[b]	**3.40**[a]	5.40[c]	7.24[d]	**7.81**[d]	7.30[d]
Time (sec)	78.80[b]	**67.60**[a]	86.30[c]	96.0[d]	100.[e]	**106.00**[e]

Appendix IV

Cost analysis of the KAU Manure pulverizer

A) Basic information

i) Cost of the unit (Rs) :31,500

ii) Useful life in years : 10

iii) Rate of interest (%) : 10

iv) Hours of use per year : 100

v) Salvage value

(10 % of investment cost) : 3150

vi) Capacity of machine (kg h^{-1}) : 500

vii) Electricity required (kW h^{-1}) : 0.5

B) Various cost

I. Fixed cost

i) Depreciation cost per year (Rs) : $\frac{\text{Initial cost} - \text{Salvage value}}{\text{Useful life}}$

: $\frac{31500 - 3150}{10}$

= 2835

ii) Interest on investment per year (Rs) :

$$\left(\frac{\text{Cost of unit} + \text{salvage value}}{2}\right) \times \text{Interest rate}$$

: $\left(\frac{31500+3150}{2}\right) \times 0.10$

= 1732.5

iii) Taxes, insurance and shelter per year (Rs) : cost of unit × 0.02

: 31500×0.02

$= 630$

iv) Total fixed cost per year (Rs) : $2835 + 1732.5 + 630$

$= 5197.5$

v) Total fixed cost per hr (Rs) : $\frac{\text{Total fixed cost per year}}{\text{Hours of use per year}}$

: $\frac{5197.5}{100}$

$= 51.97$

II .Variable cost

i) Repair and maintenance per hour (Rs) : $\frac{\text{Cost of unit} \times 0.5}{1000}$

: $\frac{31500 \times 0.5}{1000}$

$=15.75$

ii) Cost of unit electricity : Rs 4.2 per kW h

Power consumption of the machine : 0.5 kW h

Total cost of electricity (Rs) : $4.2 \times 0.5 = 2.1$

Labour cost per hour, Rs : 200

iii) Total variable cost (Rs) : $15.75 + 2.1 + 200 = 217.85$

Total cost per hour (Rs) : fixed cost + variable cost

: $51.97 + 217.85$

$=269.82$

PERFORMANCE EVALUATION OF KAU MANURE PULVERIZER

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ABSTRACT OF THE REPORT

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in

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Faculty of Agricultural Engineering and Technology

Kerala Agricultural University

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ABSTRACT

Performance Evaluation of KAU Manure Pulverizer

Organic manures are good fertilizer to increase soil properties without causing any damage to plant and other related things. By knowing the importance of Jaiva krishi and the need for powdering the dried manures ,Dept. of FPME,KCAET-KAU has developed a 'KAU Manure Pulverizer' to pulverize dried organic manures such as cow dung, neem cake, biogas slurry and goat and rabbit faecal pellets, etc . It is now tested to determine its performance and to optimize the machine parameters and material parameters. The capacity of the pulverizer is 500.00 Kg hr^{-1}. Dried manures were fed into the pulverizing drum from hopper through feed chute and it get pulverized due to the rotation of pulverizing blade. Performance of the pulverizer was evaluated for different dried manures at different moisture contents. Efficient moisture contents obtained for cow dung, goat faecal pellet and neem cake are respectively as 20.93%, 16.70% and 14.20% . Time of operation increases with the increase in moisture content and sieve size except in the case of cow dung. The analysis indicated that maximum efficiency of 98.5% was obtained for the goat faecal pellets at 1.5 clearance and at 5 mm sieve size. With 10 mm sieve size maximum efficiency of 99% was obtained for goat faecal pellets. The least efficiency was observed for both cow dung and neem cake. The complete testing and analysis indicated that KAU manure pulverizer with 5 mm sieve with 15 mm clearance was performed efficiently for all types of dried manures.