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# Utilizing Different Paddy Straw Feeding Material for Producing Biogas Using Semi – Automatic Bio Digested Slurry Lifting Machine

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**ABSTRACT**

*The paddy straw management is the biggest problem in Punjab. It is based on dry fermentation biogas plant, a batch system, which produces biogas continuously for a period of 3 to 4 months with initial filling of 16 quintal paddy straw husks and 4 quintal cow dung. After the duration of 3 to 4 months paddy straw husks get converted into bio-digested slurry due to fermentation that stop biogas production which ultimately give rise to a problem i.e. removal of bio-digested slurry. In this research work a semi-automatic machine is developed to overcome the major problem of removal of bio-digested slurry. Further different straw husks form like, round bales, square bales and well chopped material are used to find impact on the performance of machine.*

***Key word:*** *Semi- automatic bio-digested Slurry lifting machine, Paddy straw, Dry fermentation, Biogas plant, Square bales, Round bales.*

## INTRODUCTION

At present, Paddy straw management is the focus area of government. An open field burning becomes common practice in our country [1]. This produces harmful air pollution and problem for each age group and especially asthmatic patients. Recently, the effects of smoke were clearly observed in various regions of Punjab. Several accidents were reported at that time. So, it is vital requirement to develop some solutions to overcome these problems. The paddy straw based biogas plant is a big solution for paddy straw management. This is also an alternative of LPG cylinders and source of power generation[2].It has various properties in road constructions and other useful purposes[3]. It possesses various properties that make them suitable for bioethanol productio[4]. This paddy straw based biogas plant is a batch system, which produces biogas continuously up to 4 months. For the working of plant 16 quintals of paddy straw with 4 quintal cow is required to produce biogas at the rate of $4m^3$ to $6m^3$ daily. As per data it produces three LPG cylinders in one month. The composition of methane is similar to LPG. So the waste paddy straw can be used as a cooking gas instead of burning.

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Some farmers have problem to collect paddy straw from the field and they prepare bales i.e. square and round bales by using baler machine. These bales can also be used for feeding the plant. The feeding material that is round bales, square bales, well chopped after four months converted into bio-digested slurry. This is due to anaerobic decomposition in the absence of oxygen. Now the problem starts, it is difficult to remove the bio-digested slurry from the plant. It takes 3-4 days for removal of bio-digested slurry and 4 labor people were required. Working for four days was difficult for labor. At that time only chopped material could be used. So the semi-automatic machine was developed to lift the bio-digested slurry from the plant. After this development of machine, the options of using square and round bales become an option. So the farmer has become able to feed the plant as per availability of paddy straw in any forms. It takes 4 -5 hours for removal of bio-digested slurry and one person is required inside the plant.

Attempts have been made at school of renewable energy engineering, Punjab Agricultural University, and Ludhiana, Punjab. The machine was operated on various plants and for various forms of paddy straw materials.

**2. Purpose of Work**

At initial stage, the paddy straw based biogas plant is successful in producing biogas. The biogas production can be increased by increasing the size of plant. However, the plant has one drawback that is removal of bio-digested slurry from the plant. It was restricted to usage of chopped paddy straw as a feeding material, because bales are difficult to lift. The lifting of slurry was done by bucket and other person standing on top to lift it. This was very hard to do, because the slurry becomes heavy due to water consumed by straws during the fermentation. It takes many days to remove the slurry. This was the major problem of project, because this problem restricted farmers to adopt this technology. So, to overcome this problem and make plant flexible for various forms of paddy straw material, a semi-automatic bio-digested slurry removal machine was developed. The design of underground plant is shown in fig.1. This is masonry work, which is leakage proof. The paddy straw or any kind of biomass can be stored in it for biogas production. This plant is constructed under the ground

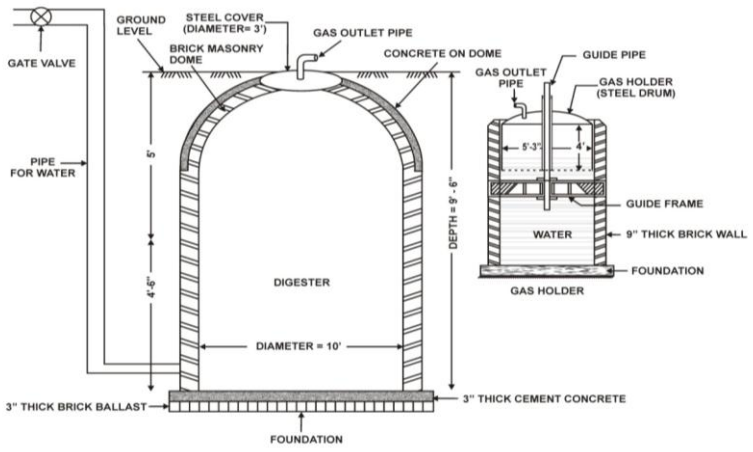


**Fig. 1: Dimensions of Dry Fermentation Biogas Plant**

## METHOD AND MATERIALS

The developed machine was operated on various paddy straw based biogas plants with three different materials, named as, round bales, square bales and well chopped material. These are used as a feeding material. In this research work 500 square bales and 600 round bales were used that was prepared after harvesting using Baler machine in research fields of Punjab Agricultural University, Ludhiana. The various feeding materials are shown in figures.

**Fig. 2: Round bales**

**Fig. 3: Square bales**

**Table 1: Description of Round & Square Bale**

| | **Round Bales** | **Square Bales** |
|---|---|---|
| **Dimension** | 3 feet diameter x 3 feet | 2 feet x 3 feet |
| **Average Weight** | 18 kg | 12 kg |

Chopped material was prepared by toka machine. In this research work it was observed that the feeding capacity vary from according to different material used. It took 70 to 80 round bales to fill plant, whereas 110 to120 square bales were used to fill the same plant. On another hand 16 quintal well chopped material was used to feed the same plant. After the duration of three months the feeded material got converted into bio-digested slurries. Earlier well chopped material was feeded which later on gave rise to problem of slurry removal. To overcome this problem a semi-automatic machine was developed, which is remote controlled operated by a person standing on the top. The person inside the plant fills material in clamps and the slurry is lifted by a person on the top. The weight up to 500 kg can be easily be lifted by machine. The semi-automatic machine so developed was operated on every material in different time intervals on different plants. Fig 3 shows the machine with removed bio-digested slurry. With the development of this machine it becomes easy to lift any kind of material and fig 4. Shows the bale lifted by machine.

**Fig. 4: Semi-automatic solid bio-digested slurry removal machine with lifted bio-digested slurry**

**Fig. 5: Bales lifted by Semi-automatic solid bio-digested slurry lifting machine**

**Bio-digested slurry lifting machine Specifications**:

1) Electric Hoist : a) capacity of lifting 500kg per lift.
   b) 1 H.P Single phase motor.
   c) 10 meter long cable with hook./jaws

2) Mild steel pipe : a) three pipes (3inch dia x 10 feet long).

3) Clamping jaws : 5 feet long with jaws.

## RESULTS

The Bio-Digested Slurry lifting Machine was under testing from past 1 year. The machine was tested 16 times on various plants and for various forms of paddy straw material, having capacity of 16 quintal paddy straw with 4 quintal cow dung, located in Punjab Agricultural University and various other locations (fields).There are eight paddy straw based biogas plants. The machine was tested twice on each plant. The Results and impact of square bales, round bales and chopped materials so obtained for bio-digested slurry lifting machine is as follows:

**Table 2:**

| | **Well chopped paddy straw** | **Round bales** | **Square bales** |
|---|---|---|---|
| **Time Taken** | 5 hours 30 min | 4 hours 40 minutes | 5 hours 10min |
| | 5hours 30 min | 4 hour 50 min | 5 hours 10 min |
| **No. of lifts** | 138 | 110 | 125 |
| | 135 | 115 | 130 |
| **Gas Production** | 4-5 $m^3$ per day | 4-5 $m^3$ per day | 4-5 $m^3$ per day |

Table.2 shows the results observed during the working of machine. In this the impact of square bales, round bales and well chopped material are also evaluated. In this the number of lifts taken for each material and daily gas production is shown. Also the total time taken by a semi-automatic slurry lifting machine is shown. The data of two plants is shown for each material.

## RESULTS FOR WELL CHOPPED MATERIAL

After 3-4 months the bio-digested slurry is well meshed and the clamp with jaw is attached with machine. The total lifts taken to remove the bio-digested slurry is 135 to 138.The time required for filling the plant is more as compare to bales. During testing of machine it was observed that maximum of 20 kg material is lifted by machine. The time taken for lifting the slurry from the plant is more as compare to other form of paddy straw material. However the manure obtained was very good. The gas obtained is 4-5 $m^3$ per day

### Results for Round bales

After fermentation of 3-4 months, the round bales were compressed. All bales were found lying over other bales very tightly. Bales become tight due to binding with ropes and ropes were as it is. So in this case the hook of cable is used for lifting the bio-digested slurry of round bales. Sometime the rope of bale breaks during lifting, but the part of rope was used to clamp. The weight of each lift was more than 20 kg, because the bales contain water contents in it. The weight of each lift was more than well chopped material and the time taken was less. The lifts required to empty the plant is 115 maximum. The gas obtained is 4-5 $m^3$ per day

### Results for Square bales

The condition of square bales was same after 4 months. It was converted to bio-digested slurry. These were also lying on other bales and tightly compressed each other. The bales were easily lifted by semi-automatic bio-digested slurry removal machine. The maximum bales required to fill the plant are 110-120. The lifts required to remove the bio-digested slurry was more as compare to round bales and least if compares to well chopped paddy straw material. The time taken was more than lifting the slurry of round bales and least time if it is compared to well chopped material. The gas obtained is 4-5 $m^3$ per day. In this research work results of three different types of material were observed. The developed machine has made it possible to use all three different ways to feeding material, which may vary according to availability with farmer, as it has overcome the major problem of removal of bio digested slurry.

## CONCLUSIONS

1. Semi-automatic bio-digested slurry removal is cheaper and successful as compare to hydraulics and conveyers machine.
2. The machine supports the three forms of paddy straw material and their bio-digested slurry machine was easily lifted by this machine.
3. Square bales, Round bale and well chopped paddy straw materials did not affect the production of biogas. They biogas produce is same in all cases.
4. The vibrations and accident chances were not observed during the working of machine. This is very safe and easy to operate.
5. All forms of paddy straw material can be used for manure.

6. Remove labor cost, physical load as well as work load.
7. The machine can be installed within 10 minutes and the lifting capacity is up to 500 kg.

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