

# DESIGN AND FABRICATION OF BUNDS PURGING MACHINE

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**Abstract** - In recent times purging of bunds in the agriculture field is done manually, but it takes more time and human effort. So, by using our bunds purging machine we can easily purge the bunds. Also, the time consumption and man power requirement is less. This machine does not require skilled person and can be easily handled by all farmers. Also the maintenance is also very less. Tillage is the most important unit and more energy consumption operation in agriculture. The most widely accepted method of tilling land is ploughing with plough and cultivators. The tractor mounted rotavator holds promise for overcoming these problems. Rotavator saves 30-35 % of time and 20-25 % in the cost of operation as compared to tillage by cultivator. It gave higher quality of work (25-30 %) than as cultivator. Rotavator under dynamic loading, blades are subjected to fatigue and abrasive wear. Abrasive wear has been emerged as a serious problem in rotavator blades. It increases the down time and maintenance cost. The objective of this study was to increase the wear resistance and reduce the down time by strengthening the rotavator blades by surface modification

with this growing demand within the past few years. As a result a sizable amount of rice is imported to the country, annually. To overcome this problem and to achieve sustainability in agriculture, development in the agricultural input was started to implement lately. Mechanization of agricultural activities play a main role which could eventually give a solution to growing labour shortage in agriculture. It also facilitates to increase the productivity of cultivation and create an efficient environment. Farm mechanization should be done in order to develop appropriate technologies to suit local conditions which are compatible with the socio-economic and field conditions available in Sri Lanka. Paddy cultivation is mostly performed by the rural population of Sri Lanka Around 879,000 farmer families are engaged in paddy cultivation each year and it represent 20% of country's population. They are less adaptive and live a life which is very simple. Therefore the main objective was to mechanize this bund making process, since it could be very usefull for farmers to save time, physical energy and make their work easy. The main purpose of bund forming is to reduce soil erosion and increase amount of water the soil can hold.

## 1. INTRODUCTION

Contour bunding is the construction of small bund across the slope of the land on a contour so that the long slope is cut into a series of small ones and each contour bund acts as a barrier to the flow of water, thus making the water to walk rather than run, at the same time impounding water against it for increasing soil moisture. Contour bunds divide the length of the slope, reduce the volume of runoff water, and thus preventing or minimizing the soil erosion.

Contour bunds are constructed in relatively low rainfall areas, having an annual rainfall or less than 600 mm, particularly in areas having light textured soils. For rolling and flater lands having slopes from 2 to 6% contour bunding is practiced, in red soils. Sri Lanka has been an agricultural based country for centuries. The country's agriculture mainly depends on rice production and it was responsible for 30.5% of employment in the country in 2005, down from 36.8% in 1995. At present the number has decreased much more as the younger generation refuses to perform hard work related to cultivation. As population in urban areas increases, the demand for food has been rapidly increased and the countries own food production has failed to cope

### 1.1 Features of Bund Purging Attachment

- ❖ Low cost.
- ❖ A very simple mechanism which any farmer could understand.
- ❖ Efficient than the manual bund preparation process.
- ❖ Easy to operate for the local farmers.
- ❖ Durable and which bear the rough conditions in the paddy field.
- ❖ Easily maintainable.
- ❖ Spare parts available

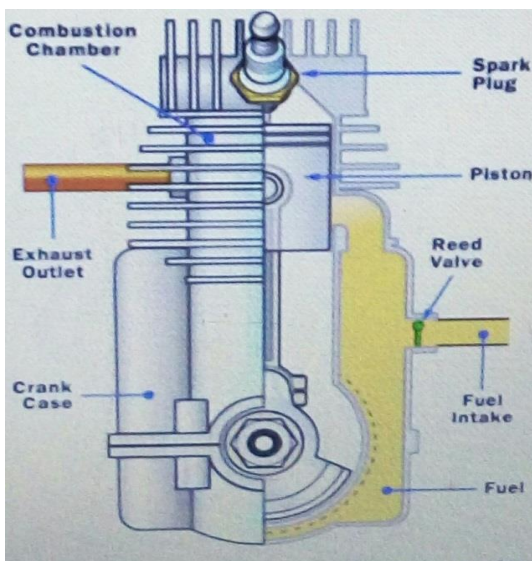
A new concept was tested for bund plastering, as a direct attachment to the tractor. A closed rectangular channel which has a curve along its length has been suggested to convey mud towards the bund. The flowing ability of mud was supposed to be utilized in this new concept. Mechanizing the mud plastering process would be an entirely a new innovative concept and lot of empirical investigations are needed during the testing of the attachments. The two attachments were fabricated with a minimum cost and field-testing was conducted to check the

proper functionality of the two attachments. The bund clearing attachment worked successfully though several modifications were to be made. The mud plastering concept failed during testing. Approximately about 30-fold productivity gain in terms of time consumption is expected with the introduction of this mechanization compared to the conventional methods currently used by the farmers.

## 2. Theoretical Analysis

### 2.1 Two Stroke Engine

The two-cycle carburettor type engine makes use of an airtight crankcase for partially compressing the air-fuel mixture. As the piston travels down, the mixture previously drawn into the crankcase is partially compressed. As the piston nears the bottom of the stroke, it uncovers the exhaust and intake ports. The exhaust flows out, reducing the pressure in the cylinder. When the pressure in the combustion chamber is lower than the pressure in the crankcase through the port openings to the combustion chamber, the incoming mixture is deflected upward by a baffle on the piston. The, two-stroke cycle engine can be easily identified by the air-fuel mixture valve attached to the crankcase and the exhaust Port located at the bottom of the cylinder. When the cycle is completed in one revolution of the crankshaft, it is called two stroke cycle engine. In two stroke cycle engines, the whole sequence of events i.e., suction, compression, power and exhaust are completed in two strokes of the piston i.e. one revolution of the crankshaft. There is no valve in this type of engine. Gas movement takes place through holes called ports in the cylinder. The crankcase of the engine is air tight in which the crankshaft rotates



**Fig -1** Two Stroke Engine

### 2.2 TYPES OF STROKES IN A TWO STROKE ENGINE:

1. Upward stroke of the piston (Suction + Compression)

2. Downward stroke (Power + Exhaust)

#### 2.2.1 UPWARD STROKE OF THE PISTON (SUCTION + COMPRESSION)

When the piston moves upward it covers two of the ports, the exhaust port and transfer port, which are normally almost opposite to each other. This traps the charge of air-fuel mixture drawn already in to the cylinder. Further upward movement of the piston compresses the charge and also uncovers the suction port. Now fresh mixture is drawn through this port into the crankcase. Just before the end of this stroke, the mixture in the cylinder is ignited by a spark plug. Thus, during this stroke both suction and compression events are completed.

#### 2.2.2 DOWNWARD STROKE (POWER + EXHAUST)

Burning of the fuel rises the temperature and pressure of the gases which forces the piston to move down the cylinder. When the piston moves down, it closes the suction port, trapping the fresh charge drawn into the crankcase during the previous upward stroke. Further downward movement of the piston uncovers first the exhaust port and then the transfer port. Now fresh charge in the crankcase moves in to the cylinder through the transfer port driving out the burnt gases through the exhaust port. Special shaped piston crown deflect the incoming mixture up around the cylinder so that it can help in driving out the exhaust gases. During the downward stroke of the piston power and exhaust events are completed.

### 3.1 FABRICATION MATERIALS USED

#### 3.1.1 PARTS USED

1. Engine 2. Frame 3. Rotavator Blade 4. Wheel 5. Bearing  
6. Shaft 7. Petrol tank

#### 3.1.2 MATERIALS USED FOR ENGINE PARTS

- Cylinder head Cast iron, Cast Aluminium.
- Cylinder liner Cast steel, Cast iron.
- Engine block Cast iron, Cast aluminum, Welded steel.
- Piston Cast iron, Aluminium alloy.
- Piston pin Forged steel, Casehardened steel.
- Connecting rod Forged steel. Aluminium alloy.
- Piston rings Cast iron, Pressed steel alloy.
- Connecting rod bearings Bronze, White metal.
- Main bearings White metal, Steel backed Babbitt base.
- Crankshaft Forged steel, Cast steel.
- Camshaft Forged steel, Cast iron, cast steel.
- Timing gears Cast iron, Fiber, Steel forging.
- Push rods Forged steel.
- Engine valves Forged steel, Steel, alloy.

- Valve springs Carbon spring steel.
- Manifolds Cast iron, Cast aluminum.
- Crankcase Cast iron, Welded steel.
- Flywheel Cast iron.
- Studs and bolts Carbon steel.
- Gaskets Cork, Copper, Asbestos.

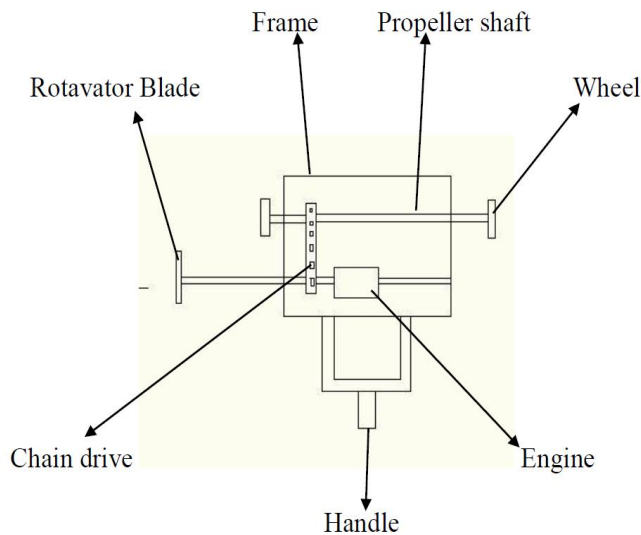


Fig -2 Design Purging Machine

#### 4.1 THEORY AND CALCULATION

Maximum torque required for cutting action. The following parameters were assumed for the worst possible case,

No of blades in the Cutter (n) = 4

Blade span (s) = 22.5 cm

Maximum blade thickness (t max) = 6 mm

Shear stress of the soil ( $\tau$ ) = 24 kPa

Cutter maximum operating speed (Nmax) was considered as the tiller shaft speed at high rotary gear position and 1st main gear position.

Nmax = 257 rev/min

At any given moment, the cutter will only use half of the no of blades for bund clearing. To calculate the torque generated due to cutting action, the blade profile was assumed to be on the periphery of a semicircle with a radii of half of the blade span (s). Fig 17 shows the approximate blade profile when viewed from the front.

Total shear area (A) =  $2 \pi R t$

Resultant shear force (F) =  $\tau A$

F = 101.78 N

It was assumed that the resultant shear force acts along the centre point of the blade span. Then maximum torque required for cutting action would be,

Maximum torque (T max) = F \* R

= 17.05 Nm

Maximum power required for cutting action. Since the maximum rotational speed of the cutter is 27 rad/s (257 rev/min), the maximum power required for cutting action would be,

P max = T max \*  $\omega$  max

= 17.05 Nm \* 27rad/s

= 0.46 kW (0.61 hp)

The rated maximum power of the two wheel tractor is 12 hp. If a maximum of 20% transmission losses are taken, the minimum power supplied by the tractor transmission system would be ~ 9.6 hp. This would be more than enough for the cutting operation. In addition a static FEM stress analysis was performed using Solid work Simulation for the cutter blades to ensure safe operation without failure.

#### 5. ADVANTAGES

- Easy to operate by all farmers.
- It does not require any skilled labour.
- Man power effort for making bunds are very less.
- Maintenance cost also very low.
- Time consumption for making bunds are also reduced.

#### 6. RESULTS

During testing, both attachments operated safely without any major component failure. The bund clearing cutter cleared the bund successfully and the height adjusting mechanism suit for the harsh conditions in the paddy field. But the inclination of the cutter blade was not sufficient to get a significant slanted cut in the bund. A mismatch in the cutter feed and speed was also observed which resulted in an improper cut along the bund, as expected. The mud conveying channel concept failed during testing as the mud got stuck at the inlet of the channel.

#### 7. CONCLUSION

The mechanization of the bund making process is one of the important tasks to be done to achieve sustainability in paddy cultivation. As no similar method is developed to fulfill this task, a new conceptual design development and trial and error testings are required for improvement. The suggested design above is one such innovative concept and lot of further study is required to improve it. The successful mechanization of bund making process can provide an

approximately about 30-fold productivity gain in terms of time consumption compared to the conventional methods currently used by the farmers.

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