**TECHNOLOGY OF TREADLE PUMP AND FABRICATION**

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 8th semester 8th semester 8th semester

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**ABSTRACT**

A Twin Treadle Diaphragm Pump was constructed for low lift irrigation. It is a modification of Treadle Pump that lifts water from ground. Initially it was found less workable due to huge frictional losses between the moving and the stationary parts. Several modifications were made to reduce these losses. For reducing the friction, the upward and downward movement of the diaphragm was made vertical and the length of the diaphragm piston rod was reduced. It was found to be more efficient than the previous attempt. At 71.10 cm suction head the average discharge was found to be 122.76liter/min. The pump is operated manually and a single man can operate this pump easily. It can be constructed at low cost with indigenous resources using local skills. The pump can be suitably used for small fragmented land holdings at lower suction head (<1.3 m) for irrigated vegetable and seedling cultivation.

**PAPER ON TECHNOLOGY OF TREADLE PUMP AND FABRICATION**

**INTRODUCTION :-**

The treadle pump is a human powered water pump that is used principally for irrigating smallholding of land. In all its forms water is pumped by two direct displacement pistons which are operated reciprocally by the walking/stepping motion of the user.

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 **Fig. Basic Components of Treadle Pump**

**Pump cylinders**

The use of two pump cylinders provides a nearly continuous flow of water. Although this is not so important for gravity irrigation, it can be an advantage for pressurized irrigation, where the buildup of pressure is important to create a spraying action. Cylinders are normally between 75 mm and 50 mm in diameter. A common diameter is 100 mm. Materials used include steel plate bent into a cylinder, PVC pipe, concrete and bamboo. The choice of material is strongly influenced by local availability and cost. Steel is a good choice if there are sufficient skills and machinery available to bend it into the right shape. Bamboo has been used where it is plentiful. It has the advantage that it can be maintained at farm level, but it does have a short working life. It is not suitable for pressure pumps.

**Pistons**

Pistons move up and down in the cylinders when the operator presses down on the treadles. Steel rods connect the pistons to the treadles. The pistons can be made of steel, wood or plastic, with leather or rubber cups or rings to form the seal with the cylinders. The seals must also stand up to the rigours of continually moving up and down against the cylinder wall

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**Pump manifold**

The manifold is a steel box in a pressure pump that connects the inlet and outlet pipes to the pump cylinders. It comprises two parts: the inlet side, which allows water into the cylinders, and the outlet side, which allows water to exit from the cylinders into a delivery pipe. The suction pump only has an inlet manifold, as water spills over the top of the cylinders via a spout and discharges into a channel.

**Non-return valves**

Non-return valves allow water to flow one way and stop it from flowing back to the source. Treadle pumps can have several non-return valves. One can be located at the entrance of the suction pipe to stop it from draining every time pumping stops. Interestingly, very few pumps use this valve, which means that the pump must be re-primed every time pumping begins. A second valve is located at the top of the suction pipe in the inlet manifold to stop reverse low during pumping. Pressure pumps have a third non-return valve in the outlet manifold, to stop reverse flow once the water has been pressurized.

**Treadles**

The operator stands on the treadles and pushes them up and down to work the pump. They can be about 1 metre long, hinged at one end and supported at the other by a rope or chain running over a pulley. They are connected to the piston rods so that the movement of the treadles is transferred to the pistons. Treadles can be made from steel, wood or bamboo. Treadles need to be strong enough to take the forces applied by the weight of the operator.

**Pulley wheel or rocking bar**

The pulley wheel and rope connect the two treadles and enable the operator to work the treadles up and down in a reciprocating movement. The pulley is usually made of wood soaked in oil to preserve it and to lubricate the movement. An alternative to the pulley is a rocking bar, which is pivoted in the middle.

**Frame**

The components of the treadle pump are mounted on a frame, which keeps all the parts together and provides support for the operator. Some pump frames are made from wood and are very portable. This can be important when security is a problem and pumps cannot be left in the field overnight. However, some designs use sturdy metal frames which can stand up to the rigours of continual use; one design is encased in concrete (see Swiss “concrete” pump) which makes it difficult to move and hence difficult to steal.

**WORKING :-**

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 **Fig.Treadle pump operating principles**

A treadle pump comprises a cylinder fitted with a piston and some means of pushing the piston up and down. A pipe connects the pump to the water source and at the end of this pipe is a nonreturn valve that allows water to enter the pipe and stops it from flowing back into the source. The piston and the cylinder must have a very close fit, so that when the piston is raised, it creates a vacuum in the cylinder and water is sucked into the pump. When the piston is pushed down, the water is pushed through a small valve in the piston to fill up the space above it. When the piston is raised again, it lifts this water until it pours out over the rim of the cylinder and into an irrigation channel or tank. At the same time, more water is drawn into the space below the piston. The downward stroke of the piston once again pushes water through the small valve into the space above the piston and the process is repeated.

**Manufacturing of Treadle Pump :-**

**Materials and tools**

Pump manufacture is essentially a metal fabrication process involving the cutting and welding of metal sheets and pipes. All the trained manufacturers are producing similar pumps using similar materials and designs specified by IDE. The pumps are not difficult to manufacture once the workshops are set up and staff have been trained properly. It is manufacturing precision that ensures pumps are durable and perform reliably and well in the field. For this reason, quality control has become one of the most important activities in the manufacturing process.

***Tools needed***

Basic tools and equipment required to make the pumps include:

• welding equipment

• manual or hydraulic cutting machines and/or guillotine

• angle cutter

• lathe (optional)

• rolling machine

• junction block mould

• drilling machine

• dies

• mandrel

• grinding machine

In addition to the above equipment, the following tools are required:

• hacksaw frame and blades

• rubber perforators

• big and small files

• welding electrodes

• pliers

• scissors

• large and small hammers

• steel measuring tape

• square

• metal scribers

***Materials***

The twin cylinders are manufactured from sheet steel rolled into cylinders with a manual roller. They are spot welded and smoothed with a mandrel to avoid damage to the rubber cups caused by the welded spots. It is usually necessary to file out such spots. The suction pumps use rubber cups on the pistons and plastic non-return valves in the base of the cylinders. These are specialist items made by injection moulding. At present, they are imported from IDE Bangladesh and made available to retail outlets. The pressure pumps use leather seals for the pistons and rubber seals cut from old tyres for the non-return valves. These can be obtained locally.Treadles are made from mukwa wood, which makes them stronger than those made from pine.

**Problem Faced :-**

1. The national economy of the country is solely dependent upon the development of agriculture but the income sources for agriculture are less.

1. Income source can be increased by producing food all year round by utilizing the available water resources.
2. The technologies which are used for utilizing water are more expensive so it is need a simple and inexpensive device with which farmer can produce crops in dry season also and also he can produce varieties of crops.
3. The size of pump and its installation is also a task for the farmer.

**How Treadle Pump Solves It :-**

Households with relatively low labour availability have a higher probability of adopting the treadle pump. These households benefit most from increased labour productivity.

The treadle pump increases income, as farmers can produce more and higher value crops under irrigation. Income is an important, but in no sense complete, measure of welfare.

**Conclusion :-**

The treadle pump is a low cost, simple in construction, easy to operate and is expected to be attractive pumping device for rural poor people having small fragmented land holdings. It may be suitable for rural women to participate in different pumping operations especially to cultivate irrigated vegetables and seedlings. Local people with less technical skill can made this pump using various resources. As this is a foot operated pump, body weight of an operator enables to operate the pump with less effort for a long time.

 Our basic conclusion is that low-cost water management technologies such as treadle pumps and drip irrigation kits can be very important tools for households to improve their food security and incomes, and escape poverty. However, they are generally not appropriate as disaster assistance investments because of the short-term nature of the support. The exception is when they add value to on-going longer term development programs that already include provision of such technologies. We recommend that before disaster relief programs are launched, they be preceded by careful locally-based needs assessments as a basis for identifying the most appropriate interventions. Further, we recommend much greater attention to targeting those who are most in need, especially women; not only women-headed households, but women who are members of male headed households having significant responsibility for food production. This will require assisting implementing agents to acquire new skills and capacities but we believe it will enhance the effectiveness and efficiency of disaster relief programs.