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Rural Water Supply in Developing Countries

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The Ndowa Pump

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Concurrent with the development of the Mark V pump, a hand pump suitable for use with heads of up to 10 m was being developed by the Christian Service Committee of the Churches of Malawi (CSC). It is called the "ndowa" pump, which means paid pump. The cost of materials for a 6 m long ndowa pump is approximately U.S.$60. This price is significantly lower than the least expensive imported pump, which costs U.S.$300 in Malawi. Overhead and labour costs for the ndowa pump are lower because production techniques do not require diverse or elaborate machinery. Furthermore, the pump has been designed so that the parts most susceptible to wear are inexpensive and easily replaced.

Pump Stand

The ndowa pump, like the Mark pump series, is based on a bicycle pump type action, which requires no lever. The pump stand is made of 2 in. (5.1 cm) galvanized pipe and fittings, and the pump pipe is a 50 mm class 10 PVC pipe. The plunger can be retracted through the standpipe after the reducing socket, which holds the bushing, is unscrewed. The outlet tee, which is situated just above the slab, is welded to a 2.5 in. (6.4 cm) pipe end. A 2.5 in. (6.4 cm) socket is cast into the slab and the pump stand is screwed into this socket. This system of anchoring the pump stand to the slab provides better protection against the entry of contaminated surface water into the well than the conventional system of using bolts and a flange. A long outlet pipe is usually screwed into the outlet tee and this pipe is supported at the end by a pillar, thereby keeping wastewater away from the well head and reducing the chances of contamination.

In-Well Mechanism

A 50 mm pump pipe is screwed into the galvanized tee of the pump stand by means of a reducing adaptor bushing. Because the plunger is retractable, the bushing, with male PVC thread, does not need to be unscrewed for maintenance inspection. The advantage of the 50 mm pump pipe, compared with a 36 mm pipe, is that the former is more flexible, facilitating installation and removal for maintenance in deeper wells. However, smaller plunger area allows water to be pumped from deeper wells without exceeding the maximum permissible force on the handle, which is approximately 15 kg.

Another feature of the ndowa pump is the large 32 mm pump rod with an internal air chamber. Water enters the pump rod through the plunger on the downstroke, compressing the air in the rod. During this stroke, part of the water is forced through the outlet due to the displacement of the air within the large rod. Expansion of the air in the pump rod takes place during the upstroke and forces additional water up into the pump pipe. These two phenomena create

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a steady outflow of water and, at the same time, reduce the required lifting force on the pump rod and, therefore, the effort required from the user.

In the ndowa pump, both the plunger and foot valve are of unusual design. The main plunger body has a polypropylene adaptor, which slides around the 32 mm pump rod. Its movement controls the opening of the holes in the pump rod. The stroke is limited to 6 mm by an end cap and a socket, which are solvent cemented onto the pump rod. The adaptor used is a standard adaptor filed down to fit inside the pump pipe.

In the foot valve, a 1 in. (2.5 cm) polypropylene adaptor is screwed into a 50 mm to 1 in. (2.5 cm) PVC reducing bushing and solvent cemented into the end of the pump pipe. The moving part of the foot valve consists of a short piece of 25 mm PVC pipe. The pipe has holes in it and a cap at each end. The end cap on the lower end is perforated with small holes. The valve stroke is about 6 mm.

Pump Design Recommendations

Hand pumps will always require maintenance, which can be expensive. The expense can be reduced, however, if pump design is based on the following criteria:

(1) Parts which wear out quickly should be inexpensive and replaceable by the village pump attendant. Worn-out parts should be easily detected and should only cause less satisfactory operation, not total pump breakdown. Replacement parts should be available from stores nearby.

(2) Field assistants should be familiar with simple methods of checking the condition of plungers and foot valves. If the state of operation of these parts is not up to a minimum standard, they should be replaced by the field assistant (preventive maintenance).

(3) Major pump problems should be reported to authorities through established channels. Where feasible, the faulty pump or part should be taken to the nearest workshop for repair.

(4) Field assistants should have easy access to replacement parts, a small workshop, and technical advice.

(5) Wells that cannot supply sufficient water at all times are hard on the pump. Because users are required to use greater force on the pump, the resulting wear is considerably increased. Attempts should be made to increase the yield of such wells or to decrease demand by providing more wells in the area.