

## Rope pump experience in Cambodia, Ideas at Work, V. Whitehead

### INTRODUCTION

The 'Rope Pump' is believed to have been initially made in China several centuries ago, but further development and improvements have been made more recently in Central America. Introduced in at least 28 countries<sup>1</sup> with at least 25,000 in Central America alone. The Rope pump has, and still is proving itself to be a reliable and appropriate pump for use in developing countries.

### 1. Ideas at Work

From previous experience of the rope pump in Cambodia 'Ideas-at-work' (IaW) had learned that that customers and implementing organizations found the pump to be reliable and simple to operate. This encouraged IaW to enter the 2006 World Bank's Development Marketplace competition. After successful winning funding IaW, in partnership with 'Resource Development International, Cambodia' (RDIC) have updated, tried and tested the Cambodian version of the rope pump the 'Rovai' (in the Khmer language 'Rovai' means to turn something by hand). The cost of a standard Rovai is currently \$89 at the factory.

A total of 750 pumps have been produced so far with a production rate of around 100/month being aimed at by the end of 2008. The Rovai pump and sales is being pursued as

a business opportunity for our Cambodian staff and for them to take over the production and sales in the near future.

So far all of the pumps have all been installed no deeper than 20m deep as Cambodia is fortunate in having high ground water table throughout many provinces.

Flow rates from the pumps, fitted with the 28mm diameter riser pipes, is typically around 40ltr/minute at around 5m deep.

### 2. THE 'ROVAI' WORKSHOP

IaW have set up a production workshop for the 'Rovai' hand pumps. Six full time staff are fully engaged in the production process and provide considerable contribution with the research and design stages. Raw materials are purchased and cut to size based on details within a full set of technical drawings. A wide range of standard tools and equipment have been built up to facilitate production. These mainly include



Figure 1 The 'Rovai' RP6 model



Figure 2 Example of a fixture used during welding the wheel spokes

<sup>1</sup> <http://www.ropepump.com/dvc/dvc.htm>, accessed Feb. 2008

hand tools (such as: angle grinders, electric drills, hacksaws, rivet guns, hammers, etc) as well as equipment such as arc welding sets, pipe benders, guillotine & a small pillar drill. Also Jigs and fixtures are used during the manufacturing process to provide a consistent quality product and to speed up the production process see Figure 2.

### 3. 'ROVAI' DESIGN FEATURES

**Basic framework:** the basic frame work of the 'Rovai' RP6 model is made from standard steel stock with the main parts being made from:

- 12mm & 10mm re-bar for the legs and spokes
- 20mm x 3mm steel strip for the wheel cover frame.
- 21mm GI pipe for the handle

The amount of materials used on our latest 'RP6' model has been reduced to keep the cost and the production time of the pump as low as possible. The overall height of the pump was reduced to 720mm to make it even more compact and easier to transport. This also makes it much easier for the elderly and very young to reach when positioned on existing wells.

#### Upper guide box and outlet fittings:

The PVC parts used for the outlet pipes and upper guide box are all made from standard PVC parts available from plumbing shops. These are modified by simply drilling, heating and flaring.

A standard 100mm PVC end cap is used to house the components for the upper guide box and outlet assembly. This design means that only a single hole is required in the well cover for the riser pipe and the returning rope (see figure 4). Only one design is needed for either a tube well or hand dug well.

**Pistons:** The pistons are made from standard 21mm screwed PVC end caps available from plumbing supply shops throughout the country. These do require some modification (see Figure 5). For a small number of these this can be carried out with simple equipment such as an angle grinder and drill by a local workshop. This makes it easier for people to make their own spare pistons locally in the future. Because these end caps are already in markets the spares chain is already set up. This is a distinct advantage over



**Figure 3** The pump frame is made from widely available steel stock



**Figure 4** Standard PVC fitting are assembled in to one unit for the upper guide box and outlet

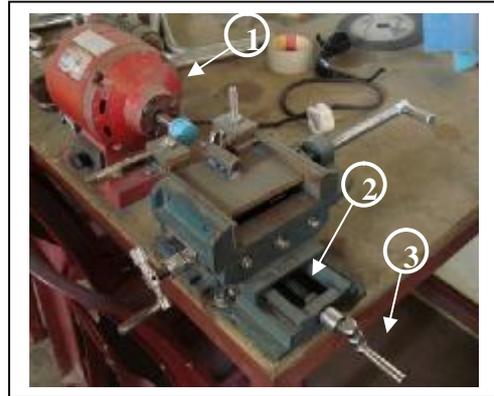


**Figure 5** Original 'end cap' on left and finished 'piston' on the right

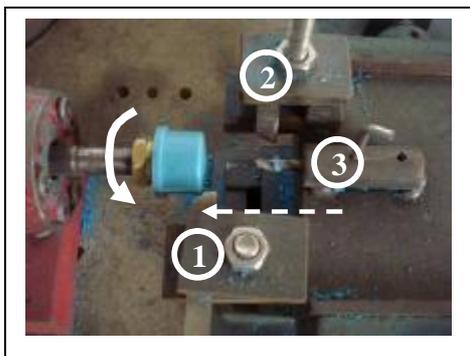
injection moulded pistons which are usually unique and only made by a limited number of workshops in limited location probably far away from where pumps are installed. This requires a spares network system to be set up which could be costly and time consuming.

For larger production quantities of pistons IaW developed a simple method of quickly modifying the ends caps into pistons (see Figure 6 & 7). The end caps are screwed on to the end of an ordinary bench grinder (with the grinding wheels removed). A sliding vice is fitted with 2 x cutting tools and a drill to cut the end cap. Figure 7 shows the basic set up of the equipment used:

- 1- A bench grinder
- 2- A vice with slides (X & Y directions)
- 3- The handle for moving the vice slide



**Figure 6 The equipment used to cut the PVC pistons**



**Figure 7 The three tools used to modify the end caps into pistons**

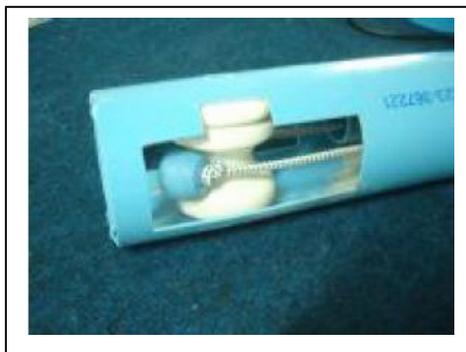
Figure 7 shows detail of the PVC end cap ready to be cut into a piston. The tools numbered 1-3 are used for:

- 1- Cutting the outside diameter
- 2- Cutting the cone end
- 3- Drilling the 5mm hole for the rope

Tools 1 and 2 can be adjusted to fit a wide range of piston sizes from around 42mm down to around 16mm.

As the handle of the slide is turned the tools travel from right to left (dotted arrow) until a stop is reached. this performs all three cutting operations in one go!

**Lower guide box:** The PVC guide box, which sits just above the bottom of the well, consists of a 90mm PVC pipe fitted with two short lengths of 34mm PVC inlet and outlet pipes (28mm inside diameter for the pistons). The inlet pipe is flared to guide the pistons in as they enter the guide box. A ceramic piece is fitted inside the main body and is used to guide the rope and pistons back up the riser pipe.



**Figure 8 PVC guide box – showing the ceramic guide with rope and pistons around**

Ideas at **the ceramic guide**

#### 4. KEEPING THE 'ROVAI' IN GOOD WORKING ORDER

Spares and tools kit: We now have a spare parts and tool kit to help ensure that the pump can be maintained on a regular basis. The kit is housed in a sturdy steel box and contains spare rope, pistons, small oil can, PVC connectors, 2 x adjustable spanners, glue and the operation and maintenance manual. The cost of the spares kit is currently \$10.

IaW have also developed a training program and manuals to help ensure that the pump is well understood by users. Quality training is essential for NGO's and contractors involved with the introduction of the 'Rovai' pumps to new villages. Training includes making the cement covers, installing the pumps and carrying out operation & maintenance instructions to the water user groups. Training can be carried out at either our workshop or on location in the field. A set of manuals have been produced in both Khmer and English.

Because of the high humidity and the fact that rope pumps inherently splash water off the wheel they can have a tendency to corrode. This not only looks unsightly but it can reduce the life of the pump and prevent it working correctly. From our early we found that it is essential for the pump frame to be rigorously cleaned and painted within a few hours. Our new paint system provides better protection against the aggressive environment than before. After grinding and cleaning the frame is coated with three different paints on the steel work: a) an etching primer, b) an undercoat and c) a top coat.

#### 5. INSTALLATION

The installation of the 'Rovai' on a standard well is relatively simple, though training is recommended. The installation generally takes around 1.5hrs. A cement cover is required in advance so that pump can be mounted. Once this is made and fitted it is a matter of:

- Measuring the depth of the well and cutting pipes and ropes to length.
- Installing the guide box and riser pipe (see Figure 11).
- Fitting the 'Rovai' head frame on the cover, and



Figure 9 Spares kit and tool box



Figure 10 Training session carried out with NGO German Agro Action (GAA)



Figure 11 Installing the guide box and riser pipe

- Fitting the rope and pistons around the wheel.

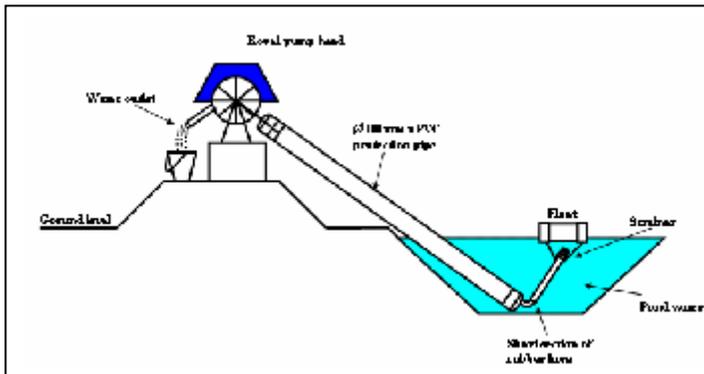
The installation manual provides a step by step guide on installation with simple descriptions and drawings showing each step. The manual also lists the tools and equipment needed to ensure that all of the tools and materials are prepared before hand.

## 6 RECENT DEVELOPMENTS

**Pond pumps:** The latest addition to the 'Rovai' range is the 'Pond pump' (See Figure 12). This is intended to pump water from sources such as a ponds, lakes or slow moving rivers. The Pond pump is similar to our standard pump but differs in that the riser pipe and guide box are housed in a 100mm diameter protective outer pipe. This is clamped to the main pump frame with an adjustable arm attachment. This allows the riser pipe, to be angled between 30 and 60 degrees. Also a floating intake is used so that only water from the top of the pond is used (the least turbid). A flexible rubber pipe allows float and intake pipe to rise and fall as the water level changes over the seasons.



**Figure 12 The 'Pond Rovai' pump fitted at an orphanage in Kompong Thom**



**Figure 13 Diagram of the pond pump**

The cost of the Pond Rovai is currently \$165 from the factory.

Installation time for the pond pump is around 3-4hours Compared with 1.5 hours for the standard Rovai fitted to a ring well.

**Tube wells:** IaW are also experimenting with fitting the 'Rovai' on to tube wells. Cambodia is fortunate that in many areas the ground water table is often less than 10m deep. This is why around 95% of our standard pumps (with 28mm pistons) are fitted on to hand dug wells. However there are some areas where aquifers are much deeper and drilled wells have been provided to access these sources. It is common for the Afridev to be fitted to tube wells beyond 15m in Cambodia. Afridevs are one of the standard pumps recommended by the Ministry of Rural Development. These pumps are imported and the costs of these are currently around \$500. Obtaining spares for these still remains a problem especially in the provinces. Many hardware shops are reluctant to stock spares Afridev spares as they are often not fast selling items.

This all helped to identify that the 'Rovai' pump appears to have some distinct advantages over the Afridev:

- It can reach a similar depths to the Afridev at around 25% of the cost,

- Spare rope and pistons are already available in many markets,
- The skills required for repair on the Rovai are much less and
- People quickly understand how the 'Rovai' pump works and they are more likely to repair the pump as and when it breaks down - improving its comparative breakdown and sustainability.

However we have found a limitation in how small the guide boxes can be made. Currently we have produced a 75mm diameter guide box pipe which is designed to fit the next standard pipe size up which is a 90mm tube well pipe. This is a common size however many tube well pipes are smaller than this.

Several contractors and NGO's have expressed increasing interest in fitting 'Rovai' pumps on new and existing tube wells during 2008.

**Higher volume pumps:** A 42mm diameter riser pipe is currently being fitted to a Rovai pump for a higher volume pump at the 1-5m range. This is expected to be around 70ltr/minute. This may be advantageous where larger quantities are required - in small scale irrigation for example. Also a pedal version of the rope pump is being tested at the moment which will probably be used with the 42mm pistons. We are also considering adding the option of using a small petrol engine to operate a 'Rovai' pump for larger quantities of water. The handle will be replaced by a pulley wheel and belt arrangement to connect it to the engine.

#### **8. Financing options for the 'Rovai' pumps**

Our partners in this project 'Resource Development International Cambodia' (RDIC) have offered their own interest free credit terms to allow the pump to be purchased by poorer families. During the collection of payments none of the families purchasing the pumps have defaulted on payments. IaW are also currently implementing a pilot distribution channel in conjunction with 'Prasac' a micro finance institution (MFI) in Cambodia. Both of these methods are intended make the 'Rovai' an affordable option to families who don't have the capacity to pay cash.

#### **9. User satisfaction and technical survey brief**

A survey was recently carried in our pilot project area for user satisfaction and technical issues. This involved surveying 40 users with Rovai pumps that were installed over a period of over 1 year. A selection was chosen based on various installation periods and different locations. The survey showed that 100% of the pumps were functioning and being used on a daily basis. The vast majority were generally satisfied with the design, reliability and flow rate of the pump. It should be noted that all of the pumps surveyed were those that had been purchased by the users. Wear on the rope and pistons were found to be very limited and showed that no replacement of either is needed certainly within the first year. Users are informed about applying oil to the bearings as part of the operation and maintenance. However there were only 16 out of 40 pumps with evidence of oil recently applied during the survey. Around 90% of the pumps were installed with a lift height of 5m or less. A separate longer term water quality check is being carried out and data on this has yet to be analyzed.

**More information:** Our 'Cement cover manual', 'Installation manual' and 'Operation and maintenance manual' as well as a Rovai order form, in English and/or Khmer, can be downloaded from the bottom of our web page. Home page: <http://www.ideas-at-work.org/IdeasRopePump.html>

A set of technical drawings plus other documents for the Rovai pump will be available shortly as soon as the manufacturing manual is complete - this will be available on CD or downloaded from our website.

For further details please email us at [info@ideas-at-work.org](mailto:info@ideas-at-work.org)

IaW would like to express our thanks to:

- The World bank's Development Marketplace
- Mickey Sampson at Resource Development International Cambodia' RDIC for their support, encouragement and input during the introduction of the Rovai pump in Cambodia
- Henk Alberts in Nicaragua

Website for Resource Development International Cambodia (RDIC)  
<http://www.rdic.org/home.htm>