29th WEDC International Conference Abuja, Nigeria, 2003

TOWARDS THE MILLENNIUM DEVELOPMENT GOALS

Low-cost tanks and filters in Sri Lanka

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DUE TO THE tremendous growth in population and financial constraints, providing a safe and adequate drinking water supply to all inhabitants is the major challenge for a country like Sri Lanka. Bearing this in mind an Asian Development Bank assisted water supply and sanitation sector project is being implemented in Sri Lanka with the adoption of appropriate low cost techniques to minimize the capital cost in rural water supply schemes. The idea of this is to use the available funds to continually increase the served population.

There are number of low cost components used in water supply schemes under this project such as ground tanks, elevated tanks, up flow roughing filters, slow sand filters using Ferrocement techniques and submerged, floating filters using prefabricated plastic containers. These techniques are not only suitable for rural water supply schemes, but also in town water supply schemes too.

This paper describes the low cost techniques used in number of pipe-borne water supply schemes under this project and it compares the cost with conventional methods.

Ferrocement Tanks

In the ferrocement tank only the base is constructed with concrete. Tank walls and domed roof are made out of 40 mm thick cement mortar reinforced with galvanised woven mesh. Where as in elevated tanks, the supporting tower is constructed from concrete and the tank from ferrocement. Small diameter mild steel wires and galvanised woven mesh (gauge 18) are being used as reinforcement. Cost comparison of some of these tanks related to conventional reinforced concrete tanks are tabulated in Table 1. It clearly shows that a remarkable percentage reduction in total cost.

Advantages of Ferrocement techniques

Costs are very low compared to concrete tanks, so the total cost of the water scheme could be reduced. This gives the opportunity to implement more water schemes with the available funds. Ferrocement technology is very simple, so that the skilled people from the rural community can be trained to use it for construction activities, so employment and training opportunity for rural populations to use this new technology is possible. Further improvements in this technique are possible.

Challenges of using Ferrocement techniques

Though this technique was introduced in Sri Lanka two decades ago by Danish assisted water supply project, a proper monitoring system had not yet been utilized to confirm the long-term durability. Nearly 4200 rainwater harvesting tanks (capacity 5 cum) and 180 storage tanks (ground and elevated tanks capacity ranging from 20 to 80 cum) were completed under this project. No any setbacks have been reported up to now. However we have already introduced a continuous monitoring system to confirm the long-term durability. If any setbacks are observed, remedial

Table 1. Ferro cement tanks

Description	Cost of Ferrocement tank US $	Cost of conventional Concrete tank US $	Percentage Cost Reduction
30 cum ground tank	1582	4000	60 %
50 cum ground tank	2208	5900	67 %
60 cum elevated tank 6.8m (height)	4874	8370	42 %
60 cum elevated tank 9 m (height)	9509	15410	38 %

action will be taken to rectify them whilst the project is under implementation.

Photographs of a ferrocement ground tank and elevated tank are shown below.

Figure 1. Ground tank

Figure 2. Elevated tank

Submerged filter

Submerged filters are used in this project in the treatment of water from irrigation tanks, as other methods were considered to be too expensive. This unit has been made out of prefabricated plastic cylinders. Filter media (stones and sand) are packed inside the cylinders above the lateral and manifold pipes. Whole system is submerged in the pond and the manifold collects the treated water. Please refer the drawing No 1 for the details of the filter units used in the field. In this unit both the manifold pipes are running separately to the bank and are connected with the intake well (treated water collecting well) in order to operate each filter unit individually. Water flows into the collecting well under the force of gravity because the inlet into the well is about 1.8m below the surface level of the pond. The filter is 20 to 25m from the bank. As the intake well is located at the bank, control valves could be used to operate the filter unit. Rubble packing was used to make the firm base for placement of filter units & to strengthen the filter walls.

This unit has been designed to filter the water at the rate of 5 m/hr for the removal of turbidity. Bacteriological quality has been addressed with disinfections using bleaching powder in the clear water storage tank. Prefabricated 1.3 m dia plastic cylinders (freely available in the market) have been used to fabricate the filter unit. This unit is being used in one of the Village water supply schemes in Monaragala District in Sri Lanka, where the daily demand is 130 m^3 / day. Two cylinders have been used for this purpose, so the area of the filter unit is 2.69 sqm. As the operation period of this scheme is designed to be 10 hours, this unit could be used to treat 5x2.69x10 = 134.5 m^3 / day.

An actual filtration rate of 6 to 7 m/hr is observed at the beginning and this declines with time. However the filtration rate of 5 m/hr is maintained at the beginning by controlling the valves. Turbidity of the pond water is around 16 to 20 FTU and nearly 60 % of the turbidity removal is recorded. An end suction centrifugal pump is being used to pump the treated water around the area of the pump house closed to the intake well at the bank. Back washing system is also incorporated through same collector pipe. The pump used for pumping the filtered water to the storage reservoir could also be used for back washing with appropriate valve arrangements. Back wash rate of 200 to 250 L/min per sqm shall be adopted for this filter unit. As the irrigation tank water is low turbid, this back wash rate is fairly enough.

Cost of this filter unit is only US $ 800, however the cost of the pumping system is around US $ 5000 with all accessories including standby pump. Running cost of the pumping system for future demand is estimated as US $ 80 per month. As the present demand is low the actual running cost of the pump is around US $ 50 per month. Similar filter units are in operation in two village schemes and both the schemes are functioning well. This filter unit can be adapted to any of the irrigation tank water treatment. However number of plastic cylinders is decided according to the daily demand.

Advantages of submerged filter

Cost of the filter is very low compared to any other type. As the pre fabricated units are being used, it can be constructed within a short period of time. Skilled personnel shall be trained in similar filter construction works due to its simplicity. Filter unit shall be used for long life span, as there won't be any danger in clogging possibilities due to the introduction of proper back washing system.

Challenges & setbacks in submerged filter

As the technology is new, it is difficult to convince the community to accept this technique. Preparing the firm rubble base in the surface water source and constructing the surrounding walls are not easy. However this could be achieved with the help of a diver. A floating platform is unavoidable while constructing the unit inside the tank.

During backwashing, there is a possibility of settling the disturbed solids back quickly onto the filter bed itself. This has been observed during backwashing operations. To capture and remove the newly suspended particles a nylon

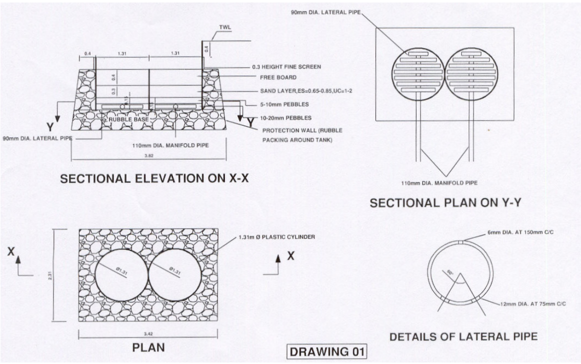

Figure 3. Submerge filter

Figure 4. Floater and construction works

Figure 5. Floater used in construction works

bag, open at one end, and fixed to a steel ring on the end of a role is used. It operates rather like a tea strainer. The aperture size of the mesh is from 0.6 to 0.8mm. The collection of suspended materials is done quickly just after the backwashing.

Floating filter

As a pilot project, a floating filter unit is being tested. This has been done as an experimental basis with the help of University of Peradeniya. In this filter polystyrene (rigifoam) particles of 1 to 3 mm in size have been used as filter media. The media is packed into the prefabricated plastic cylinders. Six cylinders (each having volume of 1 cum) have been placed up side down (as shown in the drawing No 2) to work as filter units. The two cylinders placed in the centre in an upright position act as the filtered water-collecting sump. Since polystyrene is having very low specific gravity, the buoyancy of the filter media will keep the whole intake afloat.

Suitable counterbalancing weights will be provided to keep minimum water level at filter to ensure filter operation, though the water level of the tank fluctuates. Lateral & collector pipes were fixed inside the tank & these pipes are being used for back washing purpose. (See Figure 3).

This unit has been designed with a filtration rate of 5 m/hr. The whole unit consists of floating filter, filtered water sump, alum feeder and backwash arrangements. The turbidity & color of the irrigation tank water are around 16 FTU & 60 Ptco. Nearly 60 to 65 % of the turbidity & color removal is observed in the field.

The treatment process of contact flocculation and filtration with an upward direction of flow is up flow, and the alum is introduced just as the water enters the filter media. Flocculation occurs in the filter bed itself, which 600 mm thick, through the alum feeder pipeline. The alum dose is manually mixed and filled into the containers. 20 mm alum feeder pipe with the perforations have been fixed below the media and this pipe is connected to alum Tank (please refer Drawing No 2 for details). Valve arrangement is used to control the alum dose depending on the requirement. The alum dose is prepared according to the requirement fed in during pumping (i.e. during the operation of filter). The alum is supply is stopped when the pump shut down.

Cost of this unit is around US $ 1520, where as the cost of the pumping unit with accessories including stand by pump is around US $ 6500. A submersible de–watering type pumping set has been used for this purpose and the running cost of the pump is estimated around US $90. As the present demand is low, the actual running cost is around US $ 55; this will increase slowly with the demand.

The pump used for pumping filtered water to the storage tank is being used for backwashing with valve arrangements as shown in Drawing No 2. As the filter media is suspended, a little flow will be sufficient to expand the bed downward and backwash it, the gravity will assist in backwashing, which is a useful feature of this filter.

Some of the field photographs of the filter unit are given below.

Advantages of Floating filter

The cost is very low compared to any other type of filter. Whole units can be fabricated outside & placed into the irrigation tank. Coffer dam or any other arrangements are not necessary for construction. As the backwashing take place in a downward position, the backwash solids can simply settle at the bottom of the tank due to its gravity.

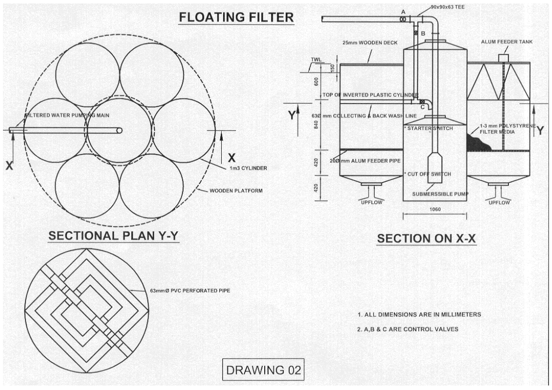

Figure 6. Floating filter

Figure 7. Assembled filter unit

Figure 8. Filter placed on pond

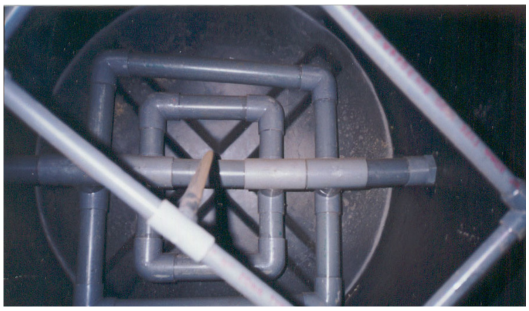

Figure 9. Pipe arrangements

Challenges & setbacks in Floating filter

It is a difficult task to convince the community to accept the technique, as it is strange one. Special training is important for the operator in alum feeding and backwashing. It has been observed that there was a possibility of media loss through the inlet opening at bottom while backwashing. In order to prevent this, nylon mesh has been fixed at the inlet opening. This nylon mesh will be removed at a later stage, once the exact backwash rate is finalised. As this is the new technique, further operational problems and durability of the filter unit to be studied to ensure the long-term usage.

Conclusion

From the above it is obvious that these techniques are very economical, technically acceptable and functionally viable. In Ferrocement tanks, past records shows better performance. There have been no major setbacks observed till now. So the technology shall be used wherever applicable.

In case of submerged filters and floating filters; field operation commenced about 6 months ago. So long term operational suitability to be studied, as this is a new concept. However monitoring system have been utilized to record the operational problems etc. A reasonable time duration is needed to ensure the long-term durability of these filter units. Simplicity in construction is a useful feature in these filters. Pre arrangements such as coffer dam, dewatering equipments and skilled personnel are not involved. And costs of submerged and floating filters is very low compared to any other type. Therefore this technique shall be introduced to any of the schemes, where irrigation tank water treatment is involved.

References

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