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SUSTAINABLE DEVELOPMENT OF WATER RESOURCES, WATER SUPPLY AND
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Sustainability of Roughing Filters in Sri Lanka

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Roughing filters of various types and shapes, such as Up flow, Down flow and Horizontal flow are operated in Sri lanka. Performance of some the filters was evaluated to assess the sustainability of filters and find out what improvements are needed for efficient operation of the filters in future. The recent observations show that rectangular type Up flow & Down flow filters have been sustainably managed for several years of operation where a proper maintenance schedule is used with a trained care taker. The circular filters of large diameter have some operational problems due to short-circuiting and inefficient hydraulic cleaning. The major problems affecting the sustainability are due to the design problems associated with filtration velocity, scouring velocity, uniform distribution of inflows and some operational problems such as operation manuals, training and operator's commitments. Even though roughing filtration is a simple technology which can be simply managed, it needs constant care and monitoring for efficient operation and sustainability.

Introduction

Roughing filters as pretreatment were introduced to Sri Lanka in early 1980's by constructing two horizontal flow filters (HRF) in Udatenna & Wellawaya Water Supply Schemes. The filters did not function properly after a few years of operation, due to filter clogging problems.

With the help of research and development work of National Water Supply and Drainage Board, Sri Lanka and the new design guidelines developed under Water and Sanitation Centre (SANDEC) at Swiss Federal Institute for Environmental Science and Technology (EWAG), Improved Versions of HRF, Up flow (URF) and down flow (DRF) roughing filters were constructed in several places of the country with different shapes of structures. Some of the installations are in operation for more than 10 years. Hence it was decided to check and review the performance of different types of filters in operation to find out the sustainability of these systems and propose further improvements for effective use of roughing filters in future. Filters constructed at Udatanne, Aranayaka, Gampola, Pussellawa, Keppitipola, Medawela and Kegalle were inspected to collect performance information and observe the operations. This survey covered two HRFs, two DRFs and six URFs, of rectangular & circular shapes. Sources of all schemes except filter at Bisowela in Kegalla are mountainous streams with low turbidity having short peaks during rainy seasons. Bisowela filter is being used for removal of Iron in borehole water.

Observations

All filters except Bisowela URF in Kegalla are being used for turbidity and suspended matter removal in gravity water supply schemes with low turbidity raw water. Bissowela filter is being used for removal of Iron in borehole water.

Some of the URFs are directly connected to gravity water mains with high pressure. Therefore there is a possibility of overloading the system by operators and clogging the pipes with silt during rainy weather.

The gravity head available at the site could have been used for hydraulic cleaning in the filters at Gampola and pusellawa. Gampola filters are malfunctioning due to insufficient hydraulic cleaning. The performance of Pusellawa filter also could have been enhanced if the available head is utilized. This situation could have been corrected at the commissioning stage.

Photograph 1. Short circuiting of DRFs at the inlet

Discussion

Out of the nine filters inspected, 5 filters are performing well while two large diameter filters at Gampola and one rectangular filter at Medawela are malfunctioning. The performance of the rectangular URF at Pusellawa may be called moderate.
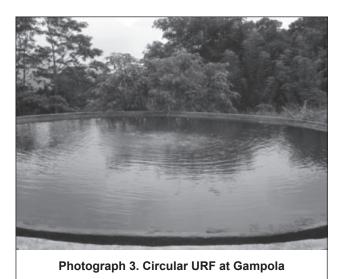
Table 1. Summary of observations

Location/Type	Shape	Age (Yrs)	Perform-ance	Cleaning method	Operator's skill	Comments
Udatenna DRF & HRF	Rectangular	10	Good	Regular, once a week and when necessary	Good	Same operators at the site from the beginning.
Aranayake URF	Rectangular	8	Good	Regular, once in three days and when neces-sary	Good	Same operator at the site from the beginning. Granite filter media.
Gampola - Datry URF	Circular	5	Poor	No regular cleaning, Clean only after filter is blocked	Poor – contracted labour	Short circuited at the middle of filter. Operator has no idea about filter operation.
Gampola - Gampolawatta URF	Circular	4	Poor	No regular cleaning, Operator decides on cleaning	Moderate – contracted labour	Short circuited at the middle of filter.
Pusellawa URF	Rectangular	5	Moderate	No regular cleaning, Once a month in dry period and once a week in rainy season.	Poor	Algae have formed on top and commissioning has not being done properly. Operator has no idea about filter operation
Keppitipola DRF	Rectangular	3	Good	Regular, once in three days	Good	Same operators at the site from the beginning. Granite filter media.
Medawela URF	Rectangular	3	Poor	No regular cleaning, only when filter is blocked	Poor	Operator's commitment is very poor. Operator has no idea about filter operation
Aranayake - Rahala URF	Circular	0.5	Good	Once a week, or when necessary.	Good	Granite filter media. Maintained by Community based organization.
Bissowela URF	Circular	0.5	Good	Only when the water quality is bad	Moderate	Used for Iron removal. Granite Filter media Maintained by Community based organization.

Large (7m) diameter circular filters at Gampola, have an average filter area of 35 m² per drain outlet and the rectangular filter has an average area of 8 – 10 m² per drain outlet. Circular filters constructed recently at Rahala & Bissowela in Kegalla have 10 – 12 m² per drain outlet. The recommended minimum drainage velocity is 30 m/h and 50 – 90 m/h is required for efficient cleaning (Wegelin, 1996). Therefore, 35 m² filters need at least 1050 m³/hr discharge while a 10m² filter needs only 300 m³/hr and size of scour pipes needed are at least 400mm and 250mm respectively.

Major problem affecting the sustainability of the large circular filter observed is inadequate hydraulic cleaning, which leads to filter short circuiting and solidifying sludge within filter media. Lack of regular cleaning arrangement has also contributed to filter clogging. Success of rectangular filter operation is mainly due to low filter area per drain pipe and the operator's knowledge and regular cleaning of filters before the blockage of filters. Poor performance of Medawela rectangular URF is mainly due to lack of operator's commitment.

Photograph 2. Rectangular URF at Aranayake

Photograph 3. Circular URF at Gampola

According to the observation and information gathered from the operators and officers in charge of water schemes, the following important factors seem to contribute to the sustainability of Roughing Filters in Sri Lanka.

- Use of correct design guidelines at the design stage and correction of minor errors at the commissioning stage. (Hydraulic cleaning system)
- Operator's skill, knowledge and commitment on filter operation and use of maintenance schedule.
- Monitoring of filter operation and maintenance for at least one year period by an experienced engineer and preparation of maintenance guidelines according to the site situation.

Filters installed 8 -10 years ago are still in operation efficiently as they are maintained well under a trained care-taker. Therefore, roughing filters for mountainous streams or sources with low turbidity with occasional peaks are a suitable sustainable pretreatment system in Sri Lanka.

Granite was introduced as filter media in 1994 (Jayalath et. al., 1994) and several filters are operating sustainably with granite media for several years. There is no significant difference in performance of filters with granite and river pebbles. Therefore, granite is a cheap alternative for river pebbles as filter media.

Conclusion and recommendation

Sustainability of filters is dependent on proper design suitable for site condition, sound construction, operation & maintenance. It is recommended that the design engineer answers the following key questions during the design process.

- Is filtration velocity according to the guideline (prefer-ably <1 m/s for URF, DRF)
- What is the scouring velocity in the filter, what is the filter area per outlet and size of drain pipe?
- Has the advantage of gravity head available at site been utilized for hydraulic cleaning?

- Will there be a problem of algae formation in URF.
- Will the filter be over loaded accidentally or purposely by operators?
- Is inflow evenly distributed throughout the filter bed?

Following operational aspects are recommended for sustainability of a filter.

- Proper commissioning of the filter and site specific operation and maintenance manual to be prepared after monitoring the system for at least one year.

Even though roughing filtration is a simple technology which can be simply managed, it needs constant care and monitoring for efficient operation and sustainability.

References

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