



## Rejuvenation of SSF using HRF technique

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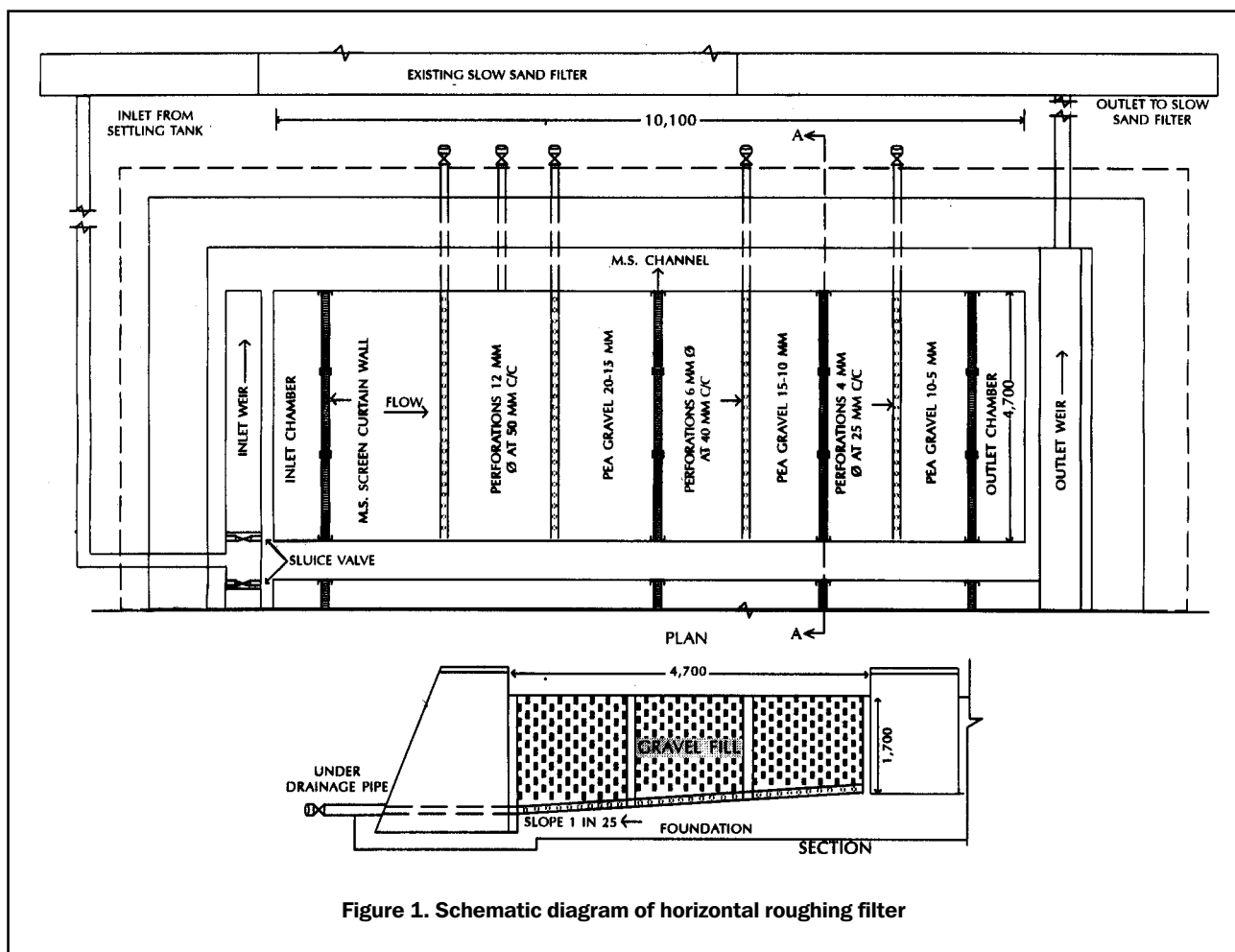
SLOW SAND FILTERS (SSF) find global application specifically in small community water supply schemes in developing countries, due to its added advantages of most qualitatively, cost effective, simplest and reliable technology, which require limited professional skill and easy maintenance. SSF require few technical component and usually no chemicals. The performance of SSF is not controlled by mechanical system but by ecosystem of living organism.

However their narrow and stringent requirements for low turbidity limits which is major draw back (10 to 20 NTU) for the influent water make it immediately susceptible to heavy, recurrent silting and choking especially in rainy season due to solid matter load which has resulted mostly in mal/non functioning of such SSF. The practical experience with SSF in Madhya Pradesh - India reveals that most of the installation (in hundreds) are facing opera-

tional problems or are even out of the operation due to this draw back i.e. high turbidity due to major changes in the surface water quality in recent past. Hence an appropriate pretreatment technology for SSF is not only essential today but vital necessity.

### Technology background

Horizontal Roughing Filter (HRF) is a pretreatment technology. HRF copies natural purification process. In HRF water runs in horizontal direction. This usually consists of differently sized relatively coarse filter material (ranging from 20 to 4mm) which successively decrease in size to treat highly turbid (300-400 NTU or even 1000 NTU for shorter duration) surface water over prolonged period. Sedimentation is the main solid separation process. It mainly reduces the fine solids efficiently and partly sus-



pended solid impurities from raw water. Bacteriological water quality improvement is also observed to a great extent. The resulting water quality from HRF found suitable for charging SSF. This also improves the performance of SSF which also helps in increasing the rate of filtration without affecting the water quality, ultimately resulting in economy.

In HRF, the filtration rate ranges between 0.3 to 1.5 m/hr. Length of filter is dependent on raw water turbidity. Filter cleaning is also carried out with hydraulic filter flush which helps in periodical removal of accumulated solids from filter media. Hydraulic filter cleaning plays key role in long term and efficient roughing filter operation. Turbidity reduction can be achieved to the extent of 70-90 per cent and even in some cases up to 98 per cent, depending upon raw water characteristics.

HRF is simple in construction, using locally available material and skills for operation. Neither mechanical parts nor chemicals are necessary for HRF.

### A pilot study

The case study pertains to a village Kurawar of District Rajgarh of the State of Madhya Pradesh in India. Water supply was commissioned in 1981. The raw water source is regional major river Parvati (7<sup>th</sup> order, catchment area 2500 Sq km approx.). SSF was non functional since 1991 due to frequent clogging on account of high turbidity and unfiltered water was being supplied to community. Deforestation, soil cover degradation etc. in catchment area of source for last 12-15 years had resulted in increase in turbidity. Maximum turbidity was observed in the range of 1400 to 1500 NTU in the rainy season of 1995.

The existing sedimentation tank and SSF alone could no longer cope up with increased raw water turbidity. To counter the said problems, HRF was considered to be most appropriate pretreatment technology to boost the performance of SSF which was other wise lying unused or under used.

While proposing separate HRF unit due consideration was also given for following options:

- Converting sedimentation tank into HRF.
- Converting one SSF unit in HRF.

Due to high turbidity in rainy season and due to increasing water demand both options were not considered feasible.

### Methodology

The experimental HRF 2 units have been constructed parallel to existing SSF units. Existing sedimentation tank and SSF (without changing the dimensions) are being used with higher surface loading rate as well as filtration rate respectively. Schematic diagram of Horizontal Roughing Filter showing various details is shown in Figure 1.

The details of rehabilitation of treatment plant are shown below in Table 1.

**Table 1. Details of existing and rehabilitated of treatment plant are shown below**

◆	<b>Capacity</b>	=	<b>350.00 m<sup>3</sup>/d</b>
	350 : 24	=	14.58 m <sup>3</sup> /h
◆	<b>Existing sedimentation tank :</b>		
	length	=	6.00 m
	width	=	3.50 m
	depth	=	3.25 m
	tank volume	=	68.25 m <sup>3</sup>
	number of units	=	1
	surface load	=	16.61 m/d
	retention time	=	3.75 hour
◆	<b>Existing slow sand filter :</b>		
	filter length	=	10.20 m
	filter width	=	6.00 m
	filter area	=	122.40 sq m
	no. of units	=	2
	filtration rate	=	0.119 m/h
	<b>Rehabilitation of the treatment plant :</b>		
◆	<b>Capacity</b>	=	<b>540.00 m<sup>3</sup>/d</b>
	540 : 24	=	22.50 m <sup>3</sup> /h
◆	<b>Sedimentation tank :</b>		
	length	=	6.00 m
	width	=	3.50 m
	depth	=	3.25 m
	tank volume	=	68.25 m <sup>3</sup>
	no. of units	=	1
	surface load	=	25.78 m/d
	retention time	=	2.40 hours
◆	<b>Horizontal roughing filter :</b>		
	filter length	=	10.10 m
	filter width	=	4.70 m
	filter depth	=	1.60 m
	sectional area	=	7.52 sq m
	no of units	=	2.00
	filtration rate	=	1.50 m/h
	<b>Layout of filter bed:</b>		
	1st gravel fraction Ø 15-20mm		4.3 m
	2st gravel fraction Ø 10-15mm		2.3 m
	3st gravel fraction Ø 05-10mm		2.0 m
	Inlet/Outlet		0.75 m
◆	<b>Augmented slow sand filter :</b>		
	filter length	=	10.20 m
	filter width	=	6.00 m
	filter area	=	122.40 sq m
	no of units	=	2
	filtration rate	=	0.184 m/h

**Table 2. Percentage reduction in turbidity, suspended solids and colour**

Turbidity	64-91
SS	46-80
Color	15-37
Coliform	58-90

### Performance study

The results obtained since its commissioning have proved the efficacy of the process. The influent and effluent water of HRF was tested for turbidity, suspended solids, colour and coliform.

Excellent performance of HRF under study has been observed for removal of settleable solids i.e. to the extent of 90 per cent, specially in rainy season. Since commissioning of HRF, the SSF is working quite satisfactorily at higher filtration rate.

### Conclusion

- HRF improved the water quality, meeting the requirement of SSF.

- SSF capacity augmented/enhanced by more than 50 per cent due to improved water quality.
- Cost effective in comparison to rapid gravity filters.

Thus HRF technique is not only an appropriate and economical option for rejuvenation/augmentation of existing SSF where high turbidity is problem but is also most suitable for new systems in rural and semi urban areas with similar problems.

### References

- WEGELIN, MARTIN, 1992, Surface water treatment by Roughing Filters with special emphasis on HRF - IRCWD report no. 10/92.
- WEGELIN, MARTIN, 1996, Surface water treatment by Roughing Filters - SANDEC report no. 02/96.

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