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DESIGN OF RAPID SAND FILTER

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ABSTRACT

Water is described as an universal solvent which is the most abundant and useful compound that nature has provided. Two main sources of water are: surface and underground water. Among the many essential elements for the existence of human beings, animal and plants, water is rated as one of the most important elements for human living. Man can survive for weeks without food but a few days without water. Sand has been used to purify water for over a thousand years; and it still remains the dependable methods of making water fit for drinking. The idea of water sand filtration can be seen when water taken from sandy river beds is generally pure, because it has percolated through the sand grains where harmful bacteria are removed

I. INTRODUCTION

The century ago filtration of river water was hardly necessary. The rivers where generally clean and unpolluted. Water was extracted from the river by hand or by simple pumps and was used by people without any form of purification. Due to the increasing population and industry the river water became more polluted and water purification became necessary. Originally slow sand filters were used. These filters consisted of large housings, containing sand, with a drainage pipe in the bottom. The enormous surface required by this slow sand filtration triggered a desire for a more efficient purification technique. This new technique was called rapid sand filtration, which required a lot less filter surface. Rapid sand filtration, however, demanded more management because cleaning the filters is done by backwashing which requires water and air pumps. In addition, the construction of the filter housing must be altered in order to allow the filter bed to be backwashed with water and air.This presentation focuses mainly on the construction of rapid sand filters.

A filter is mainly comprised of a filter housing containing filter sand. Depending on the available budget and the required lifespan the filter housing can either be made of concrete or steel.Even though the construction differs, the basic idea and functionality is identical.

II. MERITS

•Much high flow rate than a slow sand filter; about 150- 200 million gallons of water/acre/day
• Requires relatively a small land area
• Less sensitive to changes in raw water quality, e.g. turbidity
• Requires less quantity of sand

III. OBJECTIVES OF RAPID SAND FILTERS

1. To determine a feasibility of using "gravel bed flocculator as sedimentation media for treatment of surface waters, to produce water with turbidity less than 5 NTU.
2. To found out the contribution of gravel bed flocculator as pretreatment process for raw water. Through a removal efficiency of turbidity.
3. To determine the bacterial percentage removals for a gravel bed flocculator.

IV. METHODOLOGY

Adopted for filtration work

In this work, filters are designed to operate at much higher rate than slow sand filter. Another name of it is "mechanical filter", because the original units had mechanically operated rakes to assist in agitating the sand at the time of the washing process. Water flows through a sand by gravity. The various units of rapid sand filter are to be designed so as to be coordinated into whole plant in accordance with a basic plan. It is necessary for the character of the water, the proposed rate of filtration, the size of a plant and the anticipated reliability of the operators to be considered in relationship to one another. Specifications of the filter bed for rapid sand must be selected with care,

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with due regard to a anticipated effectiveness of pre-treatment, rate of filtration and the depth of sand. When a unit rate of filtration is 4.8m/h, the sand effective size is in a range of 0.40 - 0.50mm to secure reliable filtration. For high rate of filtration, the size should be between 0.50mm to 0.7mm. A factor of safety is provided by the sand depth of 0.75-0.90m. The minimum depth must not be less than 0.6m (Rox, 1960).

Filter bottom

In the conventional filtration water is distributed on top of the filter. Gravity causes water to seep through the filter bed. On or underneath the bottom the drainage system is constructed, which allows water to exit a filter, and keeps the sand in the place. The Rapid filtration requires the filter to be periodically backwashed. In many situations ,backwashing procedure is done with the combination of water and air. The filter bottom therefore has different many functions.

Functions of filter bottom

- Draining away filtered water
- Preventing the filter material from draining away
- Allowing distribution of backwash water (not relevant for slow sand filtration)

The first slow sand filters were equipped with a drainage pipe on the bottom of the filter housing. This design was also used for the first rapid sand filters, and uses drainage pipes with small holes in the bottom. These drainage pipes are covered with support layers which should prevent small sand particles from being drained away. These support layers should also cause an even distribution of the backwash water. For the distribution of backwash air a separate pipe system must be placed on the bottom.

Characteristics of a filter bottom with perforated pipes:

- The Ancient principle, seldom used
- Separate backwash air system is necessary
- For a even distribution of backwash water the diameter of the holes in the pipes must be carefully calculated
- A support layer underneath the filter bed is essential

Backwash nozzles

The filter with modern backwash bottom. This double bottom is equipped with synthetic backwash nozzles. These nozzles keep the filter bed in the place and allow water to drain away. Backwashing the filter can be easily be achieved. By using nozzles with perforated pipes the filter can be backwashed using water and air simultaneously

Characteristics of a filter bottom with backwash nozzles

- Double bottom construction
- Lower compartment often accessible to check for leakage of filter material (broken nozzle)
- Backwash water and air can be distributed through the filter bottom simultaneously
- The amount of nozzles varies from 50 to 90 per m2 and depends on the desired maximum backwash velocity

Filter material

A filter is designed for a specific filter capacity. The following table shows the starting points when designing and installing both slow and rapid sand filters. A very significant aspect is the use of proper filter material .The Sand is most commonly used, and a sieving procedure is therefore very important. This procedure will be elaborated in a different tutorial.

	Slow sand filtration	**Rapid sand filtration**
Grain	0,1-0,3 mm	0,5-3 mm
Filtration velocity	0,03-0,3 mm/s	1-5 mm/s
Duration	Months	Days
Cleaning	Skimming	Backwashing

Fig 1 .Grain Sizes For Both Filters

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V. CONCLUSION

The following conclusions can be made from this research. A Rapid sand filtration method is the most suitable among several treatment processes, locally available materials are used in the construction ,the depth and capacity of filter bed were increased which makes it to be more efficient to a appreciable degree. In conclusion, despites the fact that water taken from the tap has undergone some of treatment process, it still need to be filtered for it to be safe for drinking and using. A efficient and capable filter tank having more capacity using rapid sand filtration method with inclusion of activated charcoal and a filter bed length increased have been produced.

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