

# Water treatment

Groundwater sources should be protected and sources of contamination eliminated (see Fact Sheets 2.2 to 2.4). Protected groundwater sources generally provide good quality water and may require only terminal disinfection prior to public supply.

Surface water sources, such as rivers, streams, ponds and lakes, are often contaminated and are always open to contamination. For this reason, surface water will require treatment before being used for drinking purposes.

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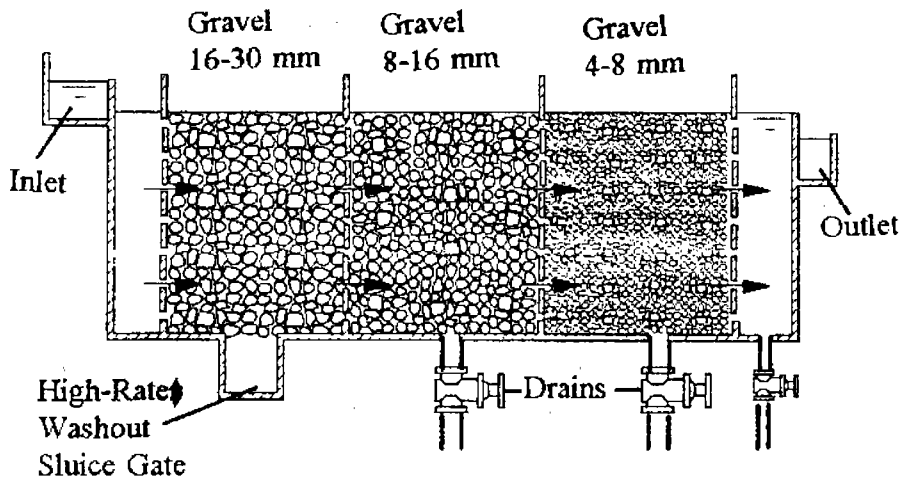
## *Water treatment processes*

The most commonly encountered water treatment processes are summarized below.

*Primary storage* is the storage of water after abstraction and before treatment. It helps to smooth variations in source water quality and quantity, and can provide a temporary reserve against short-term interruptions from the source. Primary storage should reduce turbidity considerably and assist in the reduction of pathogens (disease-causing microbes). In areas where schistosomiasis occurs, if water is in protected storage for a minimum of 48 hours then the risk of transmission is greatly reduced because the cercariae cannot find a host and will die. Although primary storage tanks should ideally be covered, this is not always practicable because of their large size. When they are uncovered, there will be evaporation losses and excess algal growth may occur. There is also the risk of introduction of pathogens by wild animals and birds. Primary storage tanks are easy to maintain but require large areas of land if they are to have a significant retention time.

*Pre-filtration* through coarse media such as gravel is used to remove suspended solids and to a lesser extent microorganisms from water. As pre-filtration reduces the turbidity of water it is especially useful as a pre-treatment prior to slow sand filtration. Operation and maintenance of pre-filters is generally straightforward. Much work has been done on pre-filtration in recent years and it now appears that upward flow of water through the filter medium is most efficient. Cleaning involves reversing the flow of water so that solids are removed through a drainage gate at the bottom of the filter bed. Most commonly three separate packs of gravel of decreasing size are used. A pre-filter is shown in Figure 1. Pre-filtration is described in more detail in Fact Sheet 2.11.

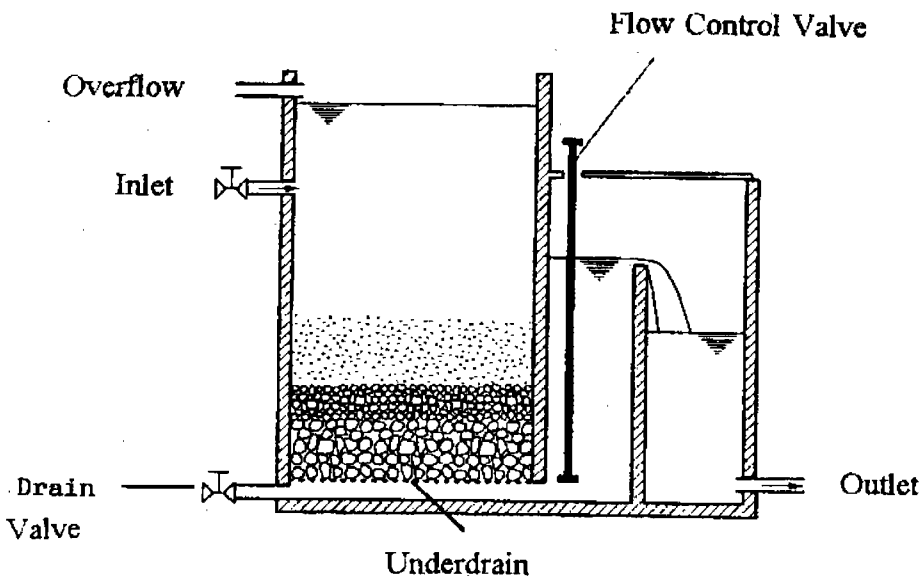
**Fact Sheet 2.8**



Section

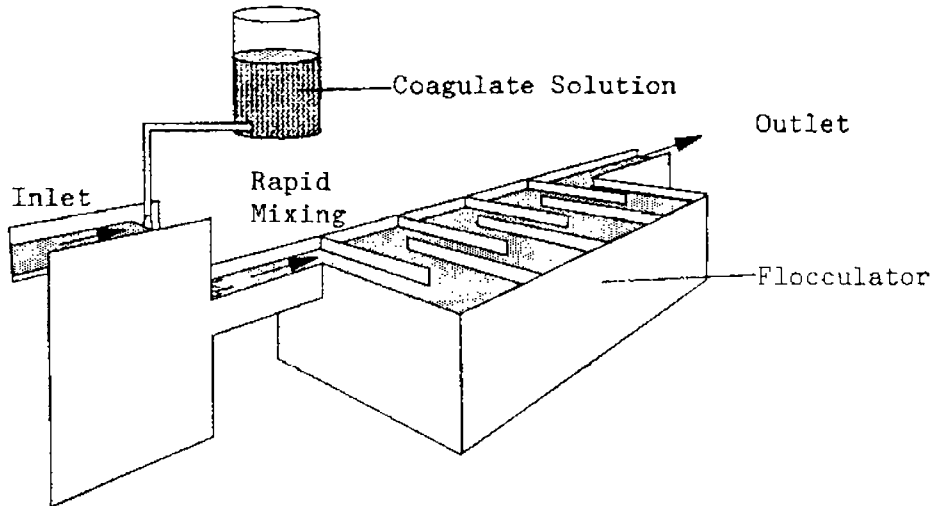
**Figure 1. A horizontal gravel pre-filter**

*Slow sand filters* use a form of biological treatment which is very efficient in the removal of pathogens from water. The filters use fine to medium sand through which water filters slowly. They require large areas of land and this makes them unsuitable for larger towns and cities. Slow sand filters are easy to operate and maintain but must be protected against turbidity in the source water, for instance by using pre-filtration. A simple slow sand filter is shown in Figure 2 and slow sand filters are described in more detail in Fact Sheet 2.12.



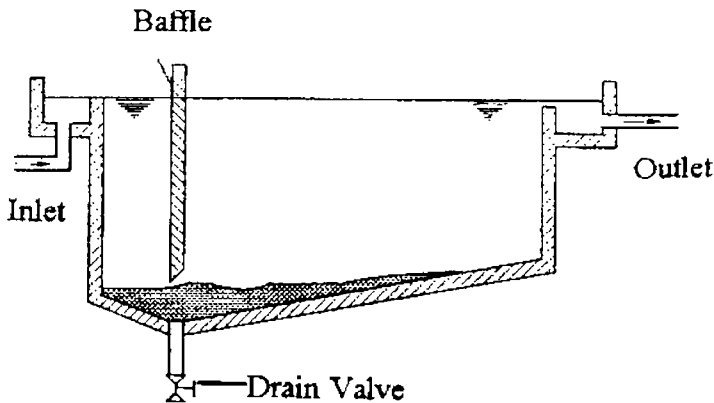
**Figure 2. A simple slow sand filter**

*Coagulation and flocculation* involve the addition of chemicals to water in order to improve the removal of suspended solids. The solids join together as “flocs” and are removed by sedimentation in a settling tank, or clarification. Careful process control is necessary and skilled operation and maintenance are essential for efficient coagulation and flocculation. Coagulation and flocculation are normally restricted to larger water treatment plants serving large towns and cities. A simple flocculator is shown in Figure 3. Coagulation, flocculation and clarification are described in more detail in Fact Sheet 2.13.



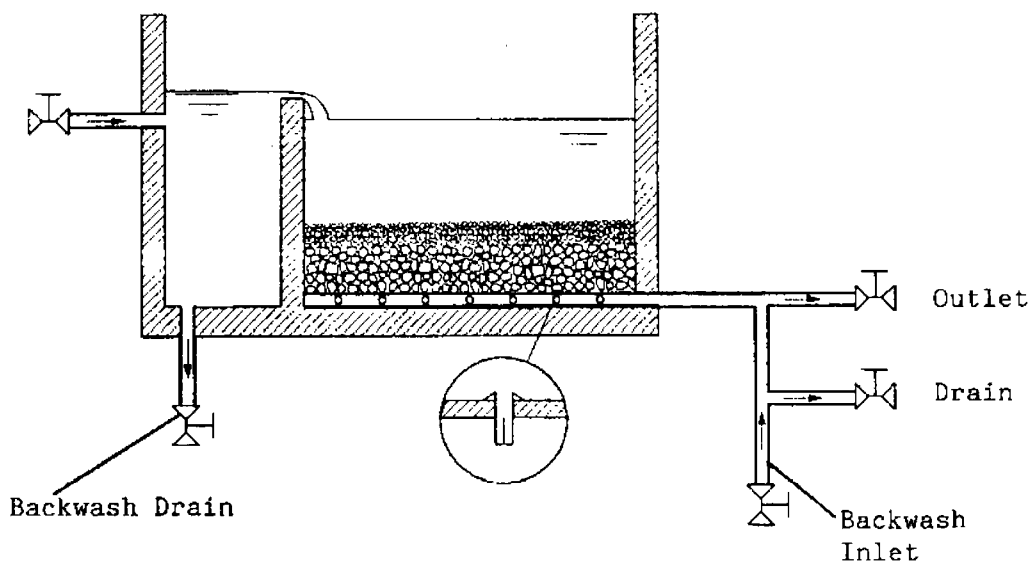
**Figure 3. A flocculator**

*Simple sedimentation* occurs in large settling tanks where water is stationary or flows slowly so that particles are able to sink to the bottom and settle. Settling tanks are often combined with slow sand filters and this combination of treatment technologies can be effective where source waters are not very turbid and turbidity is not due to small particles (clay and fine silt). Settling tanks are mainly used after coagulation and flocculation where the designs are often more complex. A typical simple sedimentor is shown in Figure 4, and is described in more detail in Fact Sheet 2.10.



**Figure 4. A simple sedimentor**

*Rapid sand filters* are tanks in which water passes under pressure through a filter medium, usually coarse sand. The tanks may be open, in which case the head of water above the sand provides the pressure to drive the filtration, or they may be closed metal tanks into which water is fed under pressure. These filters are cleaned regularly by back-flushing the sand bed with water. Rapid filters remove solids effectively. Because the flow rate is high, they do not occupy large areas of land ; but they are expensive to construct and require skilled operation and maintenance. For this reason, they are usually used to treat water in larger water treatment plants serving towns and cities. A gravity rapid sand filter is shown in Figure 5 and rapid filters are described in more detail in Fact Sheet 2.14.



**Figure 5. A gravity rapid sand filter**

*Disinfection* is needed for all water after treatment and should always be used where there is an increased threat from water-borne disease. Under most circumstances, chlorine is the disinfectant of choice for community water supplies. Disinfection is described in detail in Fact Sheets 2.16 to 2.28.

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### *Siting abstraction and treatment*

Prior to treatment, it is important to select the most appropriate water source and its site of abstraction. This selection procedure should take into account water quality along with other factors such as cost. In particular, it is often possible to achieve a significant improvement in water quality by siting intakes above human settlements.

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### *Monitoring of treatment*

It is essential that water treatment processes be monitored regularly in order to ensure their adequate functioning. Monitoring should involve :

- Verifying water quality during various stages of treatment and where it leaves the treatment plant. As a minimum, testing should be for thermotolerant (faecal) coliforms, turbidity/suspended solids and chlorine residual. Where coagulation and flocculation are practised, “jar” testing (for the optimum dose of chemical required) and pH testing should also be undertaken.
- Verifying that planned operation and maintenance is being undertaken and adequate records kept.
- Confirming that all processes are operating within design limits; for example, that filters and settling tanks are not over-loaded.

