TREATMENT OF WATER

Introduction

Wherever possible, a water source that is chosen for development should be one which does not require treatment in order to give a satisfactory quality of water. A source which is relatively expensive to develop can often be more economical in the long-run than a source which is cheaper to develop but which requires daily maintenance - or even if it requires maintenance only weekly.

A community water supply scheme must be within the capacity, both financial and technical, of the benefiting community to operate and maintain it. It is more likely to be sustainable if the emphasis of the project is on the protection of the sources of water so as to maintain safe water quality rather than on the treatment of polluted water.

Sometimes it is necessary to develop a source for purposes other than drinking, such as bathing or clothes washing, where a reasonable supply quality is needed to combat “water washed” diseases.

Ground water from wells or springs is usually of an acceptable quality, due to natural filtration through the ground. However, water from surface sources such as streams, lakes and ponds will usually require some form of treatment. The quality of this water may vary greatly with the seasons of the year.

The treatment of surface water can be an expensive exercise and one which it is difficult for communities to sustain without long-term external support. Routine maintenance is essential and, in addition, an ability to vary the method of treatment so as to respond to changes in water quality is required. The ultimate water treatment, namely, using chemicals, is not considered viable in sustainable community development.

Three simple methods of treatment are considered viable: settlement, roughing filtration and slow sand filtration. Either of the first two will improve the appearance of the water but the third, particularly when used with one of the first two, should give a clear and bacteriologically pure water.

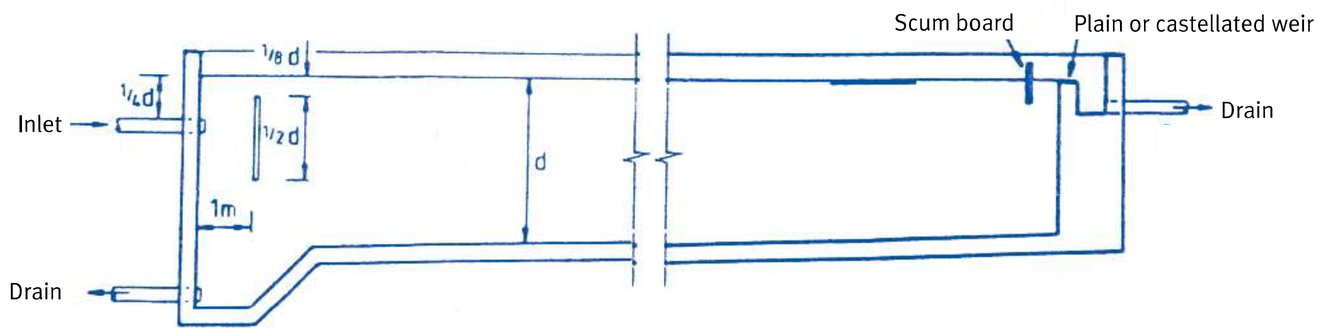
Settlement

The quality of water from streams etc can often be significantly improved by the removal of suspended matter by simple settlement.

Most suspended particles are heavier than water (although a few may float) and will settle in quiescent conditions; very fine clay particles may not settle out at all. Most structures that hold water will function as a settlement basin. Natural or manmade ponds or lakes will suffice, but purpose-made structures which incorporate efficient inlet and outlet arrangements and facilities for silt removal are generally more effective.

A layout of such a settlement tank is shown below. The length is usually about three times the width, and a practical depth is about 2 metres. A capacity of two to four hours retention at maximum flow should be sufficient to remove most sand and silt. On small installations it may be better to fill the basin with stone or gravel to prevent the incoming flow from disturbing the settled solids. The sediment can then be washed out with a hose pipe.

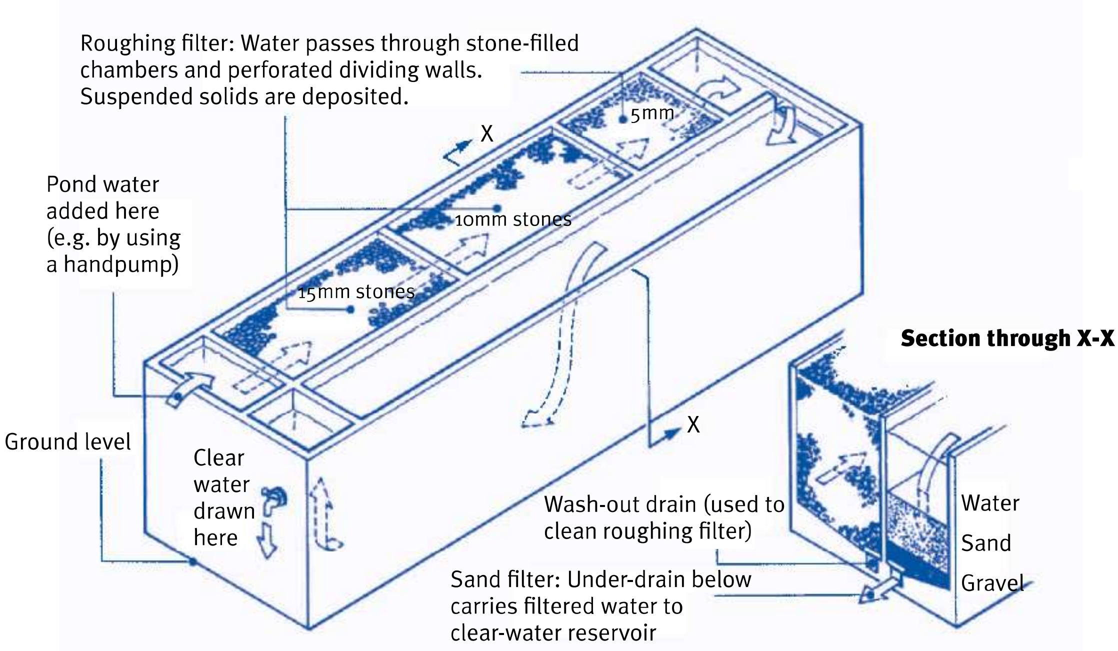
Typical section through a settlement tank



Roughing filters

A settlement tank for small flows, as described above, is, in fact, a roughing filter. However roughing filters are usually vertical flow filters where the sediment is deposited on the filter media as the water flows down through it. This filter media can vary in size but 4mm to 20mm is the range to be considered, depending on the sediment to be removed. The filter media can be cleaned by washing it down, or by backwashing under pressure, with a supply of clean water.

The ultimate roughing filter is a rapid gravity filter with sand 1mm to 4mm as the filtering media. Such a filter needs careful design and must have the facility for backwashing under pressure with water at a high rate of flow. The filter rate for this type of filter is usually about 5 metres per hour, but this can safely be exceeded in many situations.



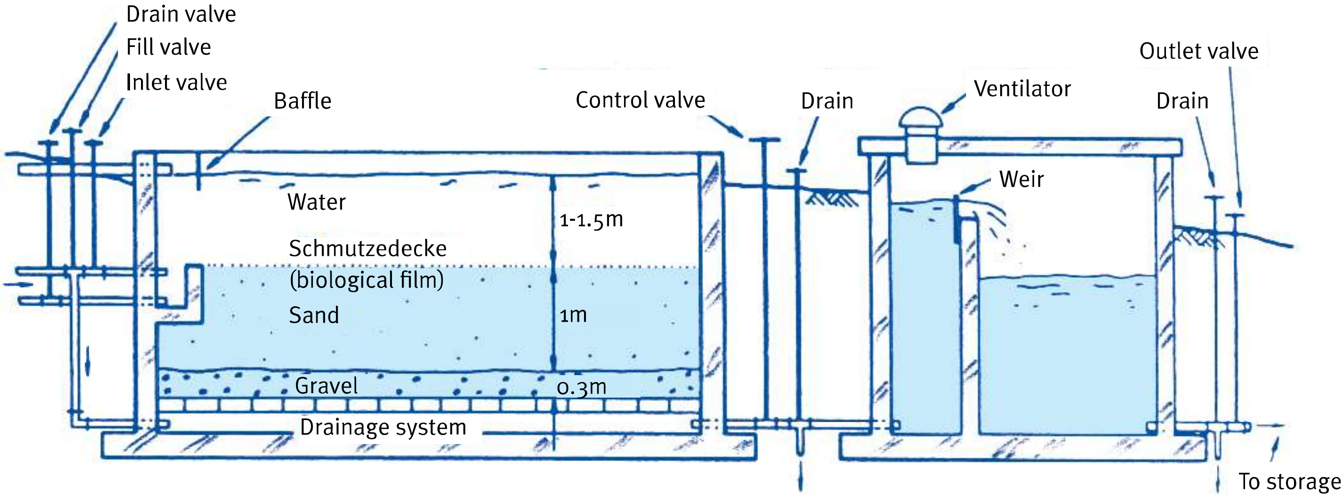
Slow sand filters

Slow sand filters function by forming a film of bacteria and algae on the surface of the sand as the water passes through it. The rate of flow must be controlled to 2.5 cubic metres per square metre per day, or a vertical flow rate of 0.1 metres per hour, and the filter must be cleaned periodically as the flow rate drops, by removing a skim of sand (20mm). The incoming water must be of a reasonable quality, or must receive pre-treatment, to prevent the slow sand filter from blocking too quickly. It is usually necessary to have two units in parallel, so that some supply can be maintained when one unit is out of commission for cleaning.

A typical layout is shown in the diagram below but the following factors should be borne in mind:

- The open tank should be about three metres deep.
- The filter media is one metre deep with clean sand of one size, between 0.15mm and 0.35mm.
- The filter media is supported on gravel, varying between 2mm and 10mm.
- An underfloor drainage system is required, which is constructed of bricks, blocks or pre-cast slabs.
- The baffled inlet should be about one metre above the sand.
- The outlet flow needs to be controlled by a weir and outlet valve.

Section through filter



Treatment of water on a household basis

Sometimes it is necessary to remove suspended matter, either occurring naturally within the water or precipitated by aeration or chemical action, in a small domestic treatment system. A basic slow sand filter can be set up in a 200 litre drum with a flow velocity of 0.1 to 0.2 m/hr downwards or, similarly, an upward flow filter can be set up to handle a flow of about 1m/hr. The former can be used to remove silt, algae or particulate matter and the latter to remove iron or manganese precipitated by aeration, or fluorides or arsenic precipitated by chemicals.

Note

The treatment of polluted water is a major undertaking and these notes give only an indication of what may be involved. The reference books listed below will give more details of the design and operation of a treatment plant. Without proper maintenance a treatment plant is worse than useless.

REFERENCES:

1 **Edited by Pickford J** (1998) *The Worth of water,* Intermediate Technology

2 **Edited by IRC Wiley J** (1983) *Small community water supplies*

3 **Morgan P** (1990) *Rural water supplies and sanitation,* Macmillan

4 **R Shaw** (1999) *Flowing water,* IT Publications