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the S W S unit for water supply in developing countries

A LOW-MAINTENANCE IN SITU FILTER

The SWS Unit is the outcome of nearly ten years work on the sub-sand abstraction of seawater for use in Aquaria and Marine Biology Laboratories, where this method was found to have three massive benefits - freedom from silt, absence of blocking of open intake by wrack and, most important, complete exclusion of the zoo-plankton which cause pipe fouling. Monitoring has shown that there is also almost complete removal of bacteria and that the water is of a quality that allows breeding of species of fish previously found impossible.

For most of this time our system required sand of considerable depth; the SWS Unit was devised early in 1975 to allow sub-sand abstraction from beds not more than 1 m deep and under water. It was quickly seen to have potential in fresh water also and this was confirmed by trials in Nigeria and Ghana, as well as by numerous experiments in Britain.

As far as we can see, nothing closely comparable has been suggested previously; it has similarities to both jet wells and infiltration methods, but its large cross-section and capacity for 'development' give great advantages over each. The unit is best described not as a filter but a device for making the bed of the sea or river serve as a slow sand filter. We frankly admit that to a large degree practice preceeded theory and we are only now understanding what it does - also realising that it does more than we expected and has applications far beyond those for which it was designed.

Although standard works still argue about certain details there is general agreement that in a slow sand filter with flow rates of up to 10 l/m^2 (0.2 gal/ft^2) per minute, the water is processed in two different zones:

i) The physical filtration is done by the Schmutzdecke, a mat of up to 20 mm that forms on the surface; the sand is the framework for a felt of assorted debris that removes particles to 1 micron or less. It also retains clusters of bacteria and those attached to larger particles, as well as multi-cellular disease organisms.

ii) Below this a biological filter layer forms, up to 150 mm deep, which removes bacteria, oxidises ammonia, biodegrades phenols etc.

The efficiency of the first is consistently confirmed by the unit's performance in both sea and river. There is good evidence that the second is true in the sea; we expect it to be broadly true in fresh water, because of the close analogy with slow sand filters, but await results of detailed monitoring now being done.

The unit is a strongly made fibreglass box with false ceiling of compression moulded slotted plates. This must be both strong and precise, with slots tapered away from the direction of flow to prevent clogging. It has a 50 mm (2") take-off and is buried with the open end down in sand which should be not less than 1 m deep. The process of development, described below, is such that provided that the sand has a wide range of particle sizes the precise grading is not very important. (It is interesting that recent findings of the Thames Water Authority show that the narrow sand specification formerly demanded is not really necessary.) If possible the unit should have at least 150 mm water over it when developed, but this is as much to give stability and freedom from scour as for technical reasons.

Development is absolutely basic to success, and it needs a pump that can be controlled over a wide range of volumes. This is comparable to the treatment of tube wells and is, in essence, the hydraulic classification of the bed. It is done by a series of stops and starts as the flow slowly increases. Each stop ends the partial vacuum and allows the sand to rearrange itself, so that when the pump starts again more dirt and fine particles can be evacuated, leaving the unit filled and surrounded by coarser particles. When the pump is first started the output may be almost black and it is allowed to run until almost clear; after restarting it becomes dirty again but clears more quickly. This continues progressively until stopping and restarting have no visible effect, showing that the perimeter of its source has been pushed out and is developed to the limit of the pump. This usually takes up to two hours but may take up to one day. The process has two separate functions:

i) It clears and cleans the sub-stratum for a radius of some 5 m at 25 000 l/h, allowing water to flow freely to the unit after it has come down through the filter zone.

ii) The whole bed becomes aerobic by the continuous passage of oxygenated water from the surface and thus allows the biological filter zone to form. In addition, buried vegetable matter quickly breaks down and is evacuated with no further formation of H_2S and CH_3.

Measurements on several sites show that at about 25 000 l/h the flow rate through the bottom surface is around 10 l/m^2 per minute i.e. within the slow sand filter range.

The unit is ideally used in moving water, which keeps the surface clean, aided by small fish, invertebrates etc. Our experience in still water so far is limited but for the average village supply, where pumping is for only a few hours a day, we calculate that any blocking effect will be very small.

The deposit depends on various factors - nature and amount of suspended solids, wind action etc. If any reduction of volume occurs this is quickly dealt with by several simple procedures - surface raking, blowing back, moving to adjacent site etc. followed by redevelopment, taking a total of two or three hours.

The system can be used effectively in areas where there is little or no sand but where a hole can be made and sand brought in. If the native sand is too fine or too coarse this can be corrected by adding some of one or other, but it has no application to deep soft mud sites or steep rocky ravines.

It is hard to speak of precise costs, for in at least some countries there will be manufacture under licence, but the cost on site of a Village Unit capable of 25 000 l/h and 30 m armoured hose would perhaps be £300: both items have a long life. A Patay hand pump would add about £30 and a petrol-driven pump about £200. Only the pumps would need any maintenance. Storage probably would cost more than all the other items combined. A trained team of three, including one skilled man, should install an average of one unit a day. We believe the training of such teams to be basic to success, but once the system is installed it is very simply run.

This is intermediate - or appropriate - technology. We do not claim that the water is equal to top quality piped supply but it is physically clean, free from all multicellular parasites such as guinea-worm and bilharzia and, we think, with a much reduced load of bacteria, so it is infinitely better than the raw water. Further, it separates the women from the water, thus cutting the two-way chain of infection.

We see village water supplies as the biggest single outlet but it is now obvious that there are many other applications. In the sea for fish farming, marine laboratories, electrolytic chlorine, desalination intake, cooling water, swimming pools etc. In fresh water for fine-spray and trickle irrigation, recycling washing water in farms and industry, fish farms etc. An increasing interest is being taken by water authorities in several countries for use as pre-filtering intakes of water with much suspended matter.