Continuous chlorination of dug wells

Dug wells include open wells, dug wells fitted with a lid and bucket, and dug wells fitted with a handpump.

Groundwater is water which can be reached by using a well. It is generally of good microbiological quality. This is because the water has had to filter through surface layers of soil and most bacteria, viruses and parasites will have been removed.

Building a well increases the risk of contamination of groundwater because it provides a direct link between contamination on the surface and the water below. It is therefore important that the installations be given a proper sanitary finishing. Sanitary aspects of dug wells are covered in Fact Sheet 2.2.

As the risk of contamination of well water is high, it is important that sound sanitary precautions are in place and that the water is chlorinated. Chlorination will help to maintain the high quality of the water in the well and to minimize the effects of recontamination after collection, during transport and household storage.

Methods of chlorinating simple wells

There are two principal methods for dosing chlorine into simple wells : diffusion hypochlorinators ; and repeated (for example, daily) additions of hypochlorite solution. In both methods, it is preferable for a local person both to undertake routine monitoring and to be responsible for dosing.

Diffusion hypochlorinators

A number of simple devices have been devised, which are filled with calcium hypochlorite powder and lowered into wells. There, they slowly release the hypochlorite into the water and so disinfect it.

The effectiveness of these devices varies, depending partly on local conditions and practices. If continuous disinfection of wells with diffusion hypochlorinators is considered, then a preliminary evaluation is needed to select an appropriate technology.

One model, referred to as a double pot chlorinator, is illustrated in Figure 1.

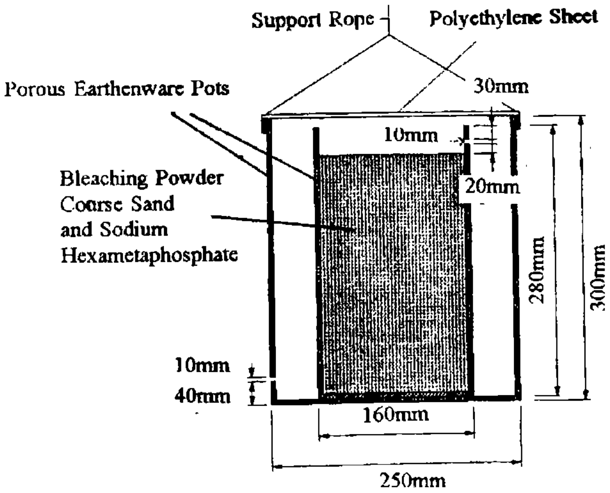

Figure 1. Double pot chlorinator

In the double pot chlorinator, each pot has one hole, that of the smaller pot near the top and that of the larger pot near the bottom. A moistened mixture of one kilogram of bleaching powder, two kilograms of coarse sand (two to three millimetres) and 75 grams of sodium hexametaphosphate is added to the inner pot to a level just below the hole. The smaller pot is placed in the centre of the larger pot with the two holes on opposite sides. The larger pot is then covered with a polythene sheet and the unit lowered carefully into the well.

A similar device, know as a porous pot chlorinator is illustrated in Figure 2.

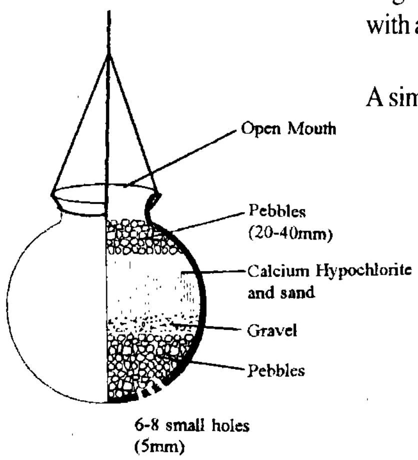

Figure 2. Porous pot chlorinator

Porous pot chlorinators can be made from plastic or ceramic material and typically have a capacity of seven to ten litres. Holes drilled into the base of the pot are required if the pot is not porous.

When starting disinfection of a well for the first time with a diffusion hypochlorinator, it should be remembered that the water may have a chlorine demand and this may at first use up the dissolving hypochlorite. It is preferable to add hypochlorite solution (usually 5 per cent) until residual free chlorine can be detected, before *positioning the hypochlorinator for the first time.*

It is important that regular and frequent monitoring of chlorine concentrations is undertaken after dosing. A record of chlorine used, results of monitoring, and adjustments made should be kept. Similarly, a record of adjustments and repairs to equipment should be maintained.

The sodium hexametaphosphate added to the mixture reduces caking and helps prevent calcium hypochlorite reacting with hardness salts in the water to form calcium carbonate. When this occurs, the chlorine outlet openings tend to block with precipitate. If sodium hexametaphosphate is not added to the mixture then the hypochlorinator will be less efficient and special care should be taken with cleaning when re-filling.

The rope or cable used to suspend the chlorinator in the well should be checked each time it is removed and replaced whenever necessary.

Repeated addition of chlorine

It is often possible to maintain an acceptable chlorine residual in wells by daily or twice-daily additions of hypochlorite solution.

The objective should be to ensure that the free chlorine residual is always within an acceptable range - for instance 0.2-1.0 mg/l. A level of 0.2 mg/l may generally be taken as a minimum, whilst concentrations above about 1 mg/l (depending on temperature) may make consumers reject the water because of the taste of chlorine.

The most straightforward procedure is to measure the volume of the water in the well (see Box 1) and then calculate the amount of chlorine solution needed to dose 1 mg/l to the water (see Box 2).

- Add the solution and wait for the chlorine to react (about 20 minutes), then measure the free chlorine residual.
- If there is no residual, add a further similar dose, leave it to react and then measure the free residual.
- Repeat this as many times as necessary.
- Once a free chlorine residual is detected, calculate and then add the dose of chlorine needed to raise the free residual concentration to the top of the chosen range (say, 1 mg/l).
- Thereafter, make daily or twice-daily measurements.
- Each time, calculate the amount of chlorine solution needed to raise the free residual concentration to the top of the chosen range (say, 1 mg/l) and add this amount (see Box 3).

Experience has shown that the measurement and addition of hypochlorite may often be successfully undertaken by members of the local community, if they are provided with initial training and occasional but regular supervision.Box 1. Estimating the volume of water in a well

Box 1. Estimating the volume of water in a well

Measure the diameter of the well in metres = D ;
Measure the depth of water in the well in metres = W ;

Calculate the area of the well, $A = \frac{D^2 x 3.14}{4}$ (in square metres)

Volume of the water = AxW cubic metres

Example : A well 1.2 metres diameter with 3 metres depth of water.

$Area = \frac{1.2^2 x 3.14}{4} = 1.13 m^2$

$Volume = 1.13 x 3 = 3.39 m^3$

Box 2. Calculating the amount of chlorine needed to add 1 mg/l of chlorine to the well

$\text{Volume of stock solution (litres to be added)} = \frac{\text{volume of water in well } (m^3)}{\text{\% Cl in stock solution} x 10}$

Example : A well containing $9.5 m^3$ water stock solution of 1% chlorine.

$\text{Volume to be added (litres)} = \frac{9.5}{1.0 x 10} = 0.95 l$

Box 3. Calculating the amount of chlorine needed to raise the concentration of chlorine

Volume of stock chlorine to be added (litres) =

$\frac{\text{increase needed (mg/l)} ' \text{volume of water}}{\text{\% Cl in stock solution} x 10}$

The increase needed is the difference between the free chlorine residual concentration and the concentration required. For example, if the free chlorine residual is 0.3 mg/l and the target is 1.0 mg/l, then the increase needed is 0.7 mg/l.

Example : A well with $9.5 m^3$ of water has 0.3 mg/l chlorine residual and 1.0 mg/l residual is required. The stock solution is 1% chlorine.

Increase needed = 1.0 - 0.3 = 0.7 mg/l

$\text{Volume to be added} = \frac{0.7 x 9.5}{1.0 ' 10} = 0.665 \text{ litres} = 665 \text{ ml}$