Calcium hypochlorite

Different forms of calcium hypochlorite

Calcium hypochlorite $Ca(OCl)_2$ for drinking water disinfection is most commonly encountered as : chlorinated lime or bleaching powder ; high test hypochlorite (HTH) ; or calcium hypochlorite in tablet form.

Chlorinated lime or bleaching powder is a white powder which is a mixture of calcium hydroxide, calcium chloride and calcium hypochlorite. It is variable in quality, that is, in the amount of chlorine which it contains. It typically contains 20 to 35 per cent available chlorine.

High test hypochlorite (HTH) is also a white powder and contains a greater concentration of chlorine than ordinary bleaching powder - typically 65 to 70 per cent. It is also more stable. HTH is sold under a number of proprietary names.

Tablets are made of calcium hypochlorite with added materials to prevent powdering, to stop moisture being absorbed too readily and in some cases to assist dissolving. Tablets are available in various sizes. Small tablets are intended for individual use and contain measured amounts (for instance milligrams) of chlorine suitable for disinfecting, for example, one litre of water. Larger tablets are designed for use in dosing equipment and dissolve at a predictable rate, enabling addition of a measured dose to a water supply. They may also be added to tanks for batch disinfection of large volumes, especially in emergency situations.

The mixture of chlorinated lime and quicklime is known as tropical bleach and is said to be more stable than other forms. It contains 25-30 per cent available chlorine.

All forms of calcium hypochlorite contain a proportion of inert material. This varies from 30-35 per cent in the case of HTH, to 65-80 per cent in the case of bleaching powder.

Where transport or storage costs are high, such costs may represent a significant proportion of total costs.

Calcium hypochlorite is generally unstable and all forms lose potency with time. Chlorine loss may be rapid and is accelerated by light, warmth, humidity and ventilation. HTH is more stable than bleaching powder, although all forms must be properly stored.

Uses of calcium hypochlorite

Calcium hypochlorite may be dosed as a solution into a flow of water at a constant rate (see Fact Sheet 2.22). It can be used for disinfecting installations (see Fact Sheets 2.25 to 2.28). It is also used for disinfection of water in batches, typically in disaster situations and for disinfection of water in the home (see Fact Sheet 2.34).

Storage and handling

Chemicals should be stored in accordance with manufacturers' instructions and local safety regulations. This is to ensure both the safety of the operator and that the chemical does not deteriorate.

Bleaching powder and HTH are both commonly supplied in sealed plastic bags or in drums or sometimes jars. Individually sealed plastic bags containing a suitable volume for immediate use (for example 1, 2 or 5 kg) are preferable. Calcium hypochlorite will, however, deteriorate even in such bags, and should be stored properly.

All forms of calcium hypochlorite should be stored in a cool, dark, dry place in closed, corrosion-resistant containers (for instance wood, plastic, ceramic, dark glass or cement). In hot climates, containers may burst if not stored correctly.

When stored in a container opened daily for 10 minutes, calcium hypochlorite loses about 5 per cent of its initial available chlorine in 40 days. If left open for 40 days, about 18 per cent loss is suffered.

As with other disinfecting chemicals, stocks should be dated and controlled, and used in rotation to minimize the effects of deterioration.

Calcium hypochlorite which has been stored badly or which may have deteriorated with time may be tested to determine its available chlorine content as described below.

Making chlorine solutions

For many disinfection purposes it is necessary to dissolve calcium hypochlorite in water, and the clear chlorine solution produced is used as the disinfectant.

All forms of calcium hypochlorite contain some inert material which is insoluble. This must be separated otherwise it may cause clogging and blockages. In general, therefore, the powder is mixed with water in one tank, left to settle and the clear supernatant decanted off into a storage tank. The preparation of calcium hypochlorite solution is shown in Figure 1.

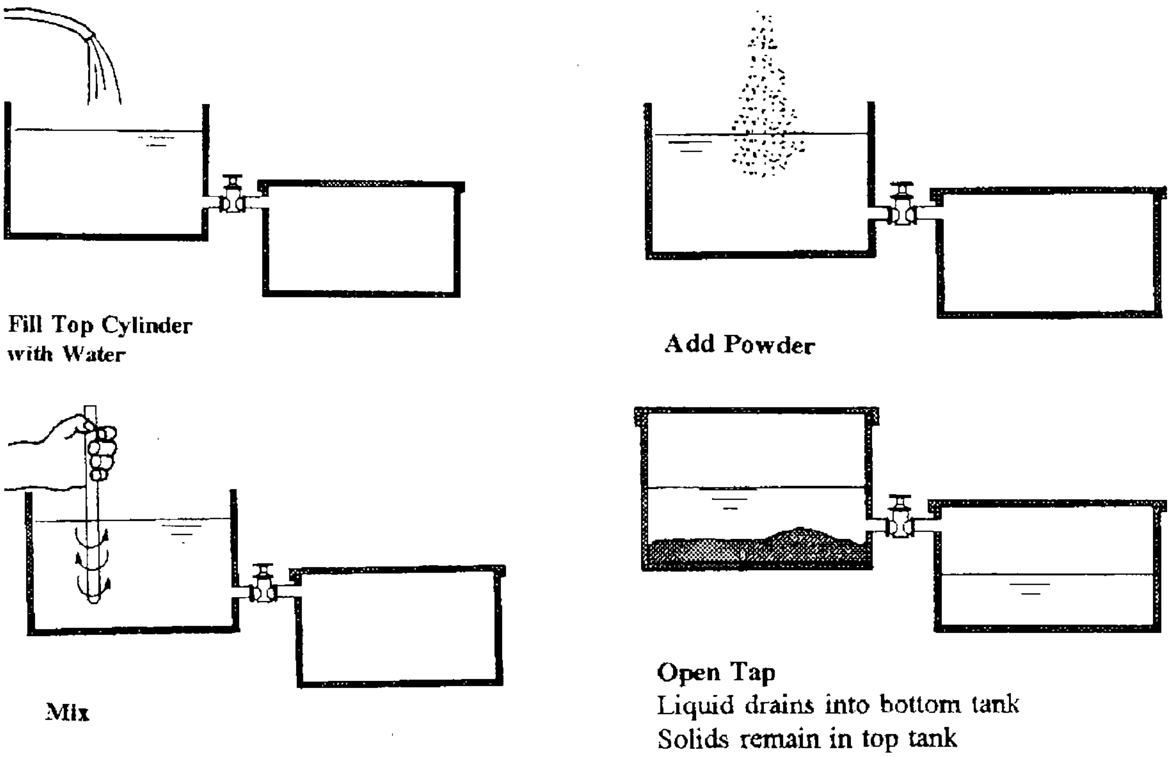

Figure 1. Preparing calcium hypochlorite solution

The concentration of chlorine in solutions, once they are prepared, should not exceed 5 per cent. If it does, then considerable chlorine may be lost in the sediment. The weight of powder to be added to a tank to prepare a chlorine solution of a given strength can be easily calculated, as shown in Box 1.

Box 1. Calculation of powder weight needed to make up a chlorine solution in a tank

Weight of powder required, $W = \frac{1000 \times V \times C}{S}$ (in grams)

where: V = volume of tank in litres;
C = concentration of solution required in per cent (percentage by weight available chlorine);
S = strength of powder in per cent weight chlorine.

Example: A solution of concentration 0.5% (5 grams available chlorine per 1 litre water) is to be prepared, using a tank of 80 litres volume and a powder with a strength of 20% weight chlorine.

Weight of powder required, $W = \frac{1000 \times 80 \times 0.5}{20}$; therefore, W = 2000 grams.

* * *

A volume, v, of this solution of concentration 0.5 % (500 mg/l) can be diluted into a new volume of water V_1 to give new solution of concentration C_1: $C_1 = \frac{v \times C}{V_1}$

Example: 2 ml of the 0.5% solution is added to 1 litre of water. The concentration of the newsolution will be:

$$C_1 = \frac{2\ ml \times 0.5}{1000\ ml} = 0.001\% = 10\ mg/l$$

Chlorine solutions are less stable than calcium hypochlorite in powder form. They can be stored for several weeks but may deteriorate rapidly. The same general precautions used for storing powders should be applied. It is especially important that the solution is protected from light in a closed container.

Preparing a chlorine solution from powder for disinfection of water in the home is described in Fact Sheet 2.34.

Safety

Chlorine is a hazardous substance. In solution it is highly corrosive and splashes can cause burns and damage the eyes.

When handling concentrated chlorine solutions, appropriate precautions should be taken. Ideally, gloves and protective eye glasses should be worn. In the event of splashes and especially splashes to the eyes, it is important immediately to rinse thoroughly with water.

When a disinfecting agent has to be transported under difficult conditions (for instance on foot), then solid forms (rather than hypochlorite solutions or pure chlorine in cylinders) are advantageous because they are less hazardous to handle. Although solid forms are generally less hazardous to handle, it is good practice to wash hands after handling.

All containers in which chlorine is stored should be labelled, identifying the contents, and with a hazard warning in a form which is readily understood locally.

Storage sites for chlorine in any form should be secure against unauthorized access and especially against children.

Available chlorine

The potency of the various forms of presentation of calcium hypochlorite is expressed as available chlorine. Available chlorine is expressed as a percentage. For instance, a bleaching powder may have 25 per cent available chlorine, that is, 25 parts by weight of chlorine per 100 parts by weight of bleaching powder.

It is important to be able to assess the potency of calcium hypochlorite powders. This is especially useful for comparing potential sources of supply, and in assessing the deterioration of powders in storage. Available chlorine can be estimated simply if basic laboratory equipment is available (see Box 2).

Box 2. Assessing calcium hypochlorite solutions

A representative sample of the powder is taken (or several samples), mixed thoroughly and a small amount (say 1 gram) is accurately weighed. This is dissolved in distilled water to produce a solution of less than 5 per cent available chlorine (for example 1 gram of bleaching powder of about 25 per cent available chlorine dissolved in 1 litre of water, will give a solution of about 0.25 per cent chlorine). This is then diluted in distilled water to within the range of chlorine measurement (depending on the equipment and method used) and the concentration of chlorine accurately determined. The percentage of available chlorine in the original powder may then be calculated.