

Household Water Treatment for Fluoride Removal Factsheet: Contact Precipitation

Potential Treatment Capacity

Very Effective For:	Somewhat Effective For:	Not Effective For:
<ul style="list-style-type: none"> • Fluoride • Taste, odour, colour 	<ul style="list-style-type: none"> • Other chemicals • Turbidity 	<ul style="list-style-type: none"> • Bacteria • Viruses • Protozoa • Helminths • Hardness

What Is Contact Precipitation?

Contact precipitation is a technique in which fluoride is removed from water through the addition of calcium and phosphate compounds, which leads to precipitation of fluoride. The water is then filtered through bone char that has been pre-saturated with fluoride.

The process uses buckets, column filters or a combination. Different kinds of contact precipitation filters exist.

How Does It Remove Contamination?

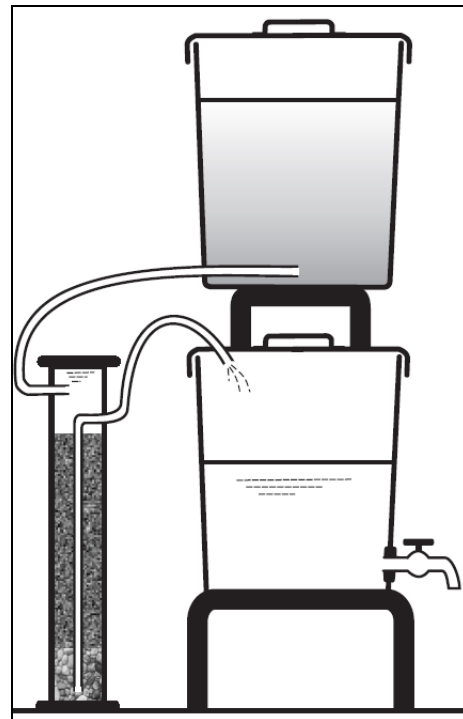
The precipitation of fluoride from water containing calcium and phosphate is theoretically possible, but in reality it is not feasible because the reactions are so slow. The addition of a compound like bone char is necessary to allow the precipitation of fluoride within a reasonable time. The saturated bone char helps with the removal of fluoride, and filters out the precipitate. The contact time of the water in the filter with the compounds needs to be long enough to allow sufficient fluoride removal; however, if the contact time is too long, calcium ions may precipitate in the filter and fluoride removal efficiency will decrease. A 20 to 30 minute contact time is recommended.

Operation

Water is first treated with calcium and phosphate compounds. Any calcium and phosphate compounds can be used, but it is important to dissolve the chemicals prior to mixing them with the water. The chemicals are preferably prepared as two separate stock solutions and can be prepared once every month, but should not be mixed together

before treatment to avoid the precipitation of calcium phosphate. It is advisable to check the bulk density as it may vary for different brands.

The most common calcium compounds used to react with the fluoride are either lime or calcium chloride (CC). This reacts with fluoride to form a precipitate (solid form) of calcium fluoride. A common phosphate compound used is sodium dihydrogenphosphate, also called monosodium phosphate or MSP.



Contact Precipitation Filter for Household Use
(Credit: WHO, 2006)

Long term operation of the contact precipitation technique in Tanzania has shown that the process functions effectively when the

Household Water Treatment and Safe Storage Factsheet: Contact Precipitation

dosage ratios are 30 and 15 for CC and MSP respectively, with a raw water fluoride concentration of about 10 mg/L. This dosage ensures at least 65% precipitation of fluorapatite (fluoride compound) and a surplus of calcium for precipitation of the residual fluoride as calcium fluoride (WHO 2006).

Water is then passed through a column filter filled with gravel or coarse grained bone char. It is important to take into account that the use of bone char may not be culturally acceptable. The steps for preparing bone char include: charring, crushing, sieving and washing/drying.

The colour of the charred bone char is a simple way to determine its quality (Jacobsen and Dahi, 1997):

- Grey-brownish: highest fluoride removal
- Black: still contains organic impurities causing odour and colour
- White: reduced fluoride removal capacity

Bone char from any animal needs to be carbonized (burnt) at a temperature of 400 to 500°C with a controlled air supply. Then the charred bones can be crushed manually or by machine. Particles between 0.5 mm and 4 mm can be used as media.

The bone char used in contact precipitation needs to be pre-saturated with fluoride through contact with water containing a high concentration of fluoride (up to 100 mg/L).

Household Water Treatment and Safe Storage Fact Sheet: Contact Precipitation Key Data

Inlet Water Criteria

- No specific limits

Treatment Efficiency

	Bacteria	Viruses	Protozoa	Helminths	Turbidity	Fluoride
Laboratory	Not available	Not available	Not available	Not available	Not available	>90% ¹
Field	Not available	Not available	Not available	Not available	Not available	>95 % ²

¹ Depending on dose (Albertus et al., 2000)

² WHO, 2006

- High fluoride removal efficiency, even the fluoride concentration in inlet water is high

Operating Criteria

Flow Rate	Batch Volume	Daily Water Supply
Not available	20 litres (typical)	Not available

- The flow rate, batch volume and daily water supply depend on the kind of filter used

Robustness

- Taps can be broken and may need replacement
- Difficult to optimize without training and equipment
- Requires supply chain, market availability and regular purchase of chemical compounds

Estimated Lifespan

- Chemical solutions must be prepared every month

Manufacturing Requirements

Worldwide Producers:

- Bone char is still produced in several countries as it is used in food industries such as sugar production
- Calcium and phosphate compounds: many producers around the world

Local Production:

- The chemical products involved are difficult and complex to manufacture and local production is not always feasible
- Bone char can be produced locally in any country

Materials:

- For saturated bone char: bones from animals, furnace or kiln, sieves, crushing machine (facultative), fluoride solution for saturation

Fabrication Facilities:

- For bone char: Storage place with roof to keep bones dry

Household Water Treatment and Safe Storage Fact Sheet: Contact Precipitation

Key Data

Labour:

- Anyone can be trained to produce bone char

Hazards:

- Safety precautions are needed when charring the bones

Maintenance

- Daily operation is easy; experience from Tanzania has shown that a young student can easily operate the system
- No health risk in the case of misuse or over-dosage of chemicals
- The two stock solutions can be prepared once every month
- Clean filter on a regular basis

Direct Cost

Capital Cost	Operating Cost	Replacement Cost
Not available	Not available	Not available

Note: Program, transportation and education costs are not included. Costs will vary depending on location.

References

Albertus, J. (2000). Bone char quality and defluoridation capacity in contact precipitation. 3rd International Workshop on Fluorosis Prevention and Defluoridation of Water Session 1 Epidemiology: 57.

Cavill, S. (2007). Appropriate treatment options for high levels of fluoride in groundwater, Naivasha, Kenya. Dew Point.

Fawell, J. Kirtley, K. Bailey, and World Health Organization (2006). Fluoride in drinking-water: Chapter 5, Removal of excessive fluoride. World Health Organization.

Lyengar L. (2002). Technologies for fluoride removal. Small Community Water Supplies: Technology, people and partnership, TP 40, Chapter 22.

CAWST (Centre for Affordable Water and Sanitation Technology)
Calgary, Alberta, Canada
Website: www.cawst.org, Email: cawst@cawst.org
Last Update: June 2011