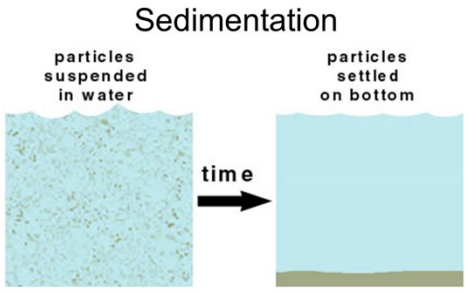
Pretreatment

The purpose of pretreatment is to reduce particulate and organic matter that can clog filters, interfere with UV disinfection or create potentially harmful byproducts if chlorine is used.

Pete's Lake water, as distributed currently, is not pretreated or disinfected before distribution. To comply with Drinking Water Regulations, the water must be disinfected before it is used for household purposes. This can be accomplished through centralized or decentralized treatments or possibly a combination of centralized pretreatment and decentralized disinfection.

Lake water contains fine suspended particles, organic solids, dissolved minerals and dissolved organic compounds that cause cloudiness, colour, odor/taste and visible bits and pieces. Both fine particles and larger pieces can carry bacteria and parasites, so removal is a good first step in making water safe to drink. Besides being unappealing, cloudiness and colour can interfere with the effectiveness of UV light treatment, protecting microorganisms from the light. Colour may indicate dissolved carbon compounds which can combine with chlorine to form "chlorinated hydrocarbons" or "trihalomethanes" which are suspected of causing cancers of the liver, kidney and intestinal system when present at elevated levels. It is therefore important to remove most of the organic matter from water before chlorination.

Sedimentation
Allow particles to settle out of water in a still tank. Sand particles can settle within a second, but smaller particles can take a very long time. To get them to settle faster, a coagulation/flocculation treatment may be applied.



Coagulation
Chemicals are added to the untreated water with rapid mixing to make the impurities stick together so that they can later be removed as a sludge. This treatment may also reduce colour from dissolved organics and minerals. Chemicals used at this stage are usually one or more of: iron or aluminum salts, organic polymers, activated silica, talcum, activated carbon, positively or negatively charged flocculants and acids or bases.

Flocculation
The coagulant-treated water is held in a flocculating tank with slow, gentle stirring. The very small particles bump into each other and stick together into larger particles, which can then be more effectively removed by sedimentation, floatation or filtration.

Prepared for Pete's Lake Water Users' Society
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Dissolved Air Flotation (DAF)

After flocculation, air is dissolved into the water under pressure. When the water is released into a tank, the air comes out of solution and creates tiny bubbles that attach to the "flocks" of impurities floating them up to the surface where they can be skimmed off, leaving clean water to flow out from lower in the tank. This technique is commonly used in wastewater treatment but can also be used for pretreatment of drinking water. The new water plant in Bamfield uses DAF.

Filtration

Filtration is generally required before treatment. If coagulation/flocculation/sedimentation is done before filtration, the filter system will require less frequent cleaning or replacement. There are many different approaches to filtration, from a simple string filter to ultrafiltration units, and from central processes to point of entry (POE) or point of use (POU) systems.

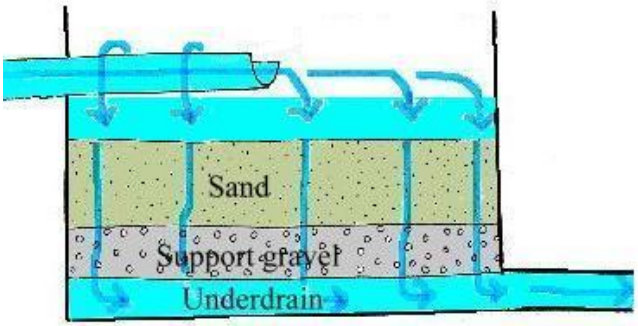
Disposable cartridge filters

Disposable cartridge filters are really only practical for POE/POU pretreatment. Commonly these are inline filters held within a housing canister. Generally, the water enters the canister on the outside of the filter and flows through to the center, leaving particulate matter on the outside of the filter. Over time, the finer particulates will move inward, filling up the filter pores, and flow may become restricted, so the filter will need to be cleaned and/or replaced. These filters may be made with pleated fabric, wound or spun string or various other materials.

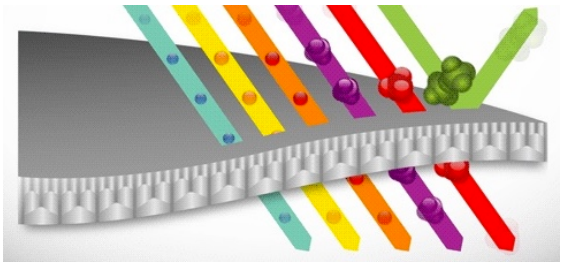
Clean and clogged prefilters

Rapid sand filter

Rapid sand filtration can be used for either central pretreatment or POE/POU pretreatment and can be gravity fed (common for central treatment) or pressurized (common for POE/POU and for some central treatment systems). In simplest terms, the filter provides a column or bed of sand that is about a meter thick through which the water passes. The sand used is generally 0.5 to 2.5 mm particle size, sometimes mixed, sometimes layered, on a bed of gravel. Some filters replace all or part of the sand with crushed coal or activated carbon which have the advantage of lighter weight and less pressure requirement when cleaning the filter and also a greater ability to remove colour, off-tastes and minerals. Small particles get caught between the grains of sand and very fine material will also coat the surface of the grains of sand. After operating for a period of time, the filter becomes partially clogged and needs to be back-washed to regenerate it. Some systems require manual intervention for this maintenance, and some are fully automated.

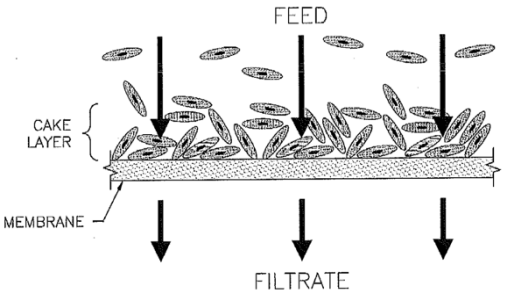


Membrane filters



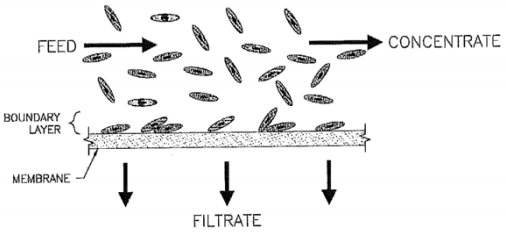
Membrane filtration is similar to cartridge filtration except on a much larger scale. Water is passed through or along the surface of the membrane – a physical barrier of known pore size. The membranes for water filtration are usually made from various sorts of synthetic polymers.

Dead-end filtration



Passing the water through the membrane barrier leaving behind only the too-large particulates is called "dead-end" or "deposition-mode" filtration. (A sand filter as described above is also a deposition-mode filter.) Over time, a layer of particles too large to pass through the filter builds up on the membrane surface, eventually reducing the flow rate of the filtered water. Dead-end filters are either run until fouling reduces flow to an unacceptable level and then replaced, or else they are back-washed with clean water to remove built up particles. If they are backwashed, they may lose about 5-10% of overall feed water volume, depending on backwashing efficiency. This backwash water then must be disposed of appropriately.

Cross-flow filtration



Some microfilters and ultrafilters are dead-end filters, but often they are set up as "cross-flow" or "suspension-mode" filters. For cross-flow filtration, the water is run along the surface of the filter, allowing some of the water to flow through, with the rejected particles concentrated in the water that continues along the surface of the filter. Cross-flow systems have the advantage of less downtime for maintenance and more consistent flow rates but may lose about 15% of the inflow water to the waste stream.

The water is now pretreated:

- particulates removed
- solid organic matter removed
- dissolved minerals reduced
- dissolved organics reduced
- micro-organisms somewhat reduced

It looks much better, and it smells much better, but it isn't yet ready to drink!!

Next up:
Disinfection