

Filter Bed



This activity center is part of the **Water Technology** theme.

What's the purpose of this activity?

A working filter bed is demonstrated by PUSI Water Treatment Plant Operators. The students will watch as water is passed through a filter and see how contaminants are removed.

Filtration is one step in the water treatment process which helps to make the water safe for people to drink. Because it is a good solvent, water picks up all sorts of natural pollutants. In nature, water is not always clean enough for people to drink.

Ensure students understand the key terms **highlighted** in this activity by using them in several different contexts throughout the presentation.

Materials

Permanent:

- Filter Bed column equipment
- Hose hook-up to water supply

Supplies:

- 'Water Treatment Plant Process Schematic' mounted poster.

What will I be doing?

There are 11 filter beds in the Peterborough Water Treatment Plant. This treatment plant is considered to be a conventional filtration process, where some of the **impurities** are settled out before reaching the filter beds. These impurities consist of suspended particles, like silt and clay, bacteria, plankton and floc.

Water is run through the water treatment process, which includes the obtaining the raw water from the Otonabee River. Alum is added in the coagulation and floc is formed in the flocculation process. The floc is settled out in the sedimentation basins and the clarified water is sent onto the filter beds.

A popular misconception is that the filtration process is mainly through straining. Straining is a term used to describe the removal of particles from a liquid by passing the liquid through a filter with pores.

Filters have three component materials, which all assist in the filtering process; Anthracite (coal), sand and gravel.

This material traps any remaining impurities and particulates not settled out in the sedimentation step.

A very important process in filtration is that of adsorption. Most particles removed are considerably smaller than the pore spaces in the media. This is particularly true at the beginning of the filtration cycle when the pore spaces are clean (not clogged by particulate removed during filtration).

The water comes onto the top of the filter bed and by gravity works its way through the filter bed. The water level above the filter media forces the water through the filter. The rate water passes through the filter is known as the filter rate and ranges from 2 to 5 litres per second per square metres.

The water coming from the filter beds is monitored for **turbidity**, which is a measure of how "cloudy" the water appears. The lower the turbidity the better and clearer the water.

Eventually the filter clogs with the particulate that it is removing. The filter is turned off and taken out of service to be cleaned. **Backwashing** is the process of reversing the flow through the filter media to remove the entrapped solids. In order to release the trapped solids, the filter media must be expanded or fluidized, by reversing the flow. Pumps are used to push water back through the filter media.

To assist in cleaning the filters, air scouring is also used to fluidize the filter media so that the impurities can be more easily washed off.

On three of the 11 filters an activated carbon layer is placed on the top of the filter bed to assist in the removal of taste and odour problems. The taste and odour causing compounds are removed through the adsorption process, where microscopic compounds are attracted to the carbon and then are flushed away during backwashing.

The backwash water is flushed over a trough and disposed of in the process waste treatment building. This backwash water is then treated and sent back to the Otonabee River.

Background Information:

Knowing the steps in the process is only the beginning. Treatment must be adjusted for changing conditions, like changing flow rates, temperature, or seasonal changes in raw-water quality. When engineers design a water treatment process, they look at the characteristics of the raw water and choose steps to solve the problems.

Not all water systems work the same way... some are simple; some much more complex. It all depends on the quality of water with which you start.

Many consumers believe that the water supplier's job is to restore water to its "naturally pure" state. But water in nature is far from pure. Bacteria from feces and rotting vegetation have always polluted water. In addition, all water naturally contains dissolved minerals or other substances. Some substances, like arsenic, can cause health problems.

Man and nature have always contributed to source water contamination. Nature supplies coliforms, Giardia, radioactivity, and all manner of elements. Man's most notable contributions include fertilizers, pesticides, and microbial contaminants, as well as synthetic organic and industrial-waste compounds.

Naturally occurring chemical contamination in water includes inorganic substances, such as lead or arsenic, and organic substances, such as feces and leaves. In addition to these natural contaminants are manmade organic substances and toxic chemicals.

Toxic chemicals that have been discharged into the environment over the years are now being found in water. More than 60,000 toxic chemicals are used by industry and agriculture, not to mention those used in private homes. Pesticides, fertilizers, and even furniture polish contain chemicals that eventually make their way into drinking water. Because these chemicals are believed to pose health threats, new drinking water regulations establish standards and require water systems to monitor and remove many of these chemicals.

Both surface water and groundwater can become contaminated surface water picks up contaminants more easily than groundwater because it is open and exposed. However, because running streams are constantly flowing, they restore themselves more quickly than groundwater (if the contamination is temporary, as in a spill). Groundwater moves so slowly that restoration and replenishment may take

Biological contaminants include disease-causing organisms, such as bacteria, viruses, and parasites. Various types of bacteria cause salmonellosis (better known as a form of food poisoning), typhoid fever, and cholera. Viruses cause polio and infectious hepatitis. A widespread parasite, Giardia lamblia, causes severe diarrhea and nausea.

Other biological contaminants include iron bacteria, slime growths, insects, and snails. While these contaminants do not themselves cause disease, they may harbor bacteria, viruses, or parasites. They also cause taste and odor problems and clog equipment.

Water's physical qualities, including taste and odor, temperature, color, and turbidity, are not contaminants, but they may signal a form of contamination. For example, turbidity interferes with disinfection by shielding bacteria. Since most customers judge water on its physical qualities, appealing water not only indicates safety but practically ensures consumer acceptance.

Protecting the water supply helps protect consumers by eliminating contaminants before they enter the system. A clean supply can mean savings: the cleaner the source water the less treatment it needs.

You can call the Peterborough Utilities Services and arrange for a field trip to the Peterborough Water Treatment Plant or request that a utility representative come to your school and explain the treatment process.

Clean Up Procedures:

Shut off the source water supply and drain the filter column. Place the poster inside the tent.