

Chapter 19

Water Purification Using Different Chemical Treatment

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ABSTRACT

Water from surface sources is often contaminated by microbes, whereas groundwater is normally safer, but even groundwater can be contaminated by harmful chemicals from human activities or from the natural environment. The purification process of water may reduce the concentration of particulate matter including suspended particles, parasites, bacteria, algae, viruses, fungi, and a range of dissolved and particulate material derived from the surfaces. Water purification is the process of removing undesirable chemicals, materials, and biological contaminants from contaminated water. Most water is purified for human consumption (drinking water), but water purification may also be designed for a variety of other purposes, such as medical, pharmacology, chemical, and industrial applications. In general, the methods used include physical processes such as filtration and sedimentation, biological processes such as slow sand filters or activated sludge, chemical processes such as flocculation and chlorination, and the use of electromagnetic radiation such as ultraviolet light.

INTRODUCTION

Even though over 70% of the Earth is covered with water, only 3% is fit for human consumption, of which two thirds is comprised of frozen and largely uninhabited ice caps and glaciers, leaving 1% available for consumption. Remaining 97% is saltwater, which cannot be used for agriculture or drinking. Unique qualities and properties of water makes it so important and basic need of life. The cells in our bodies are full of water. The excellent ability of water is to dissolve so many substances allows our cells to use valuable nutrients, minerals, and chemicals in biological processes. Water's "stickiness" (from surface tension) plays a part in the body's ability to transport these materials throughout our bodies. Carbohydrates and proteins are used as food which are metabolized and transported by water in the bloodstream. No less important is the ability of water to transport waste material out of our bodies.

Water facts:

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- Water is also used to fight forest fires; yet, we spray water on coal in a furnace to make it burn better.
- Chemically, water is basically hydrogen oxide.
- At a temperature of 2900°C, substances that contain water cannot be forced to part with it; because others that do not contain water will liberate it when even slightly heated.
- Water is virtually incompressible; as it freezes, it expands by an 11th of its volume.

Treatment of water requires chemical, physical, and sometimes biological processes to remove contaminants. The more common processes used in portable water treatment are the chemical and physical processes. Biological processes for treatment of water. However, the slow sand filtration process is a biological process that has been historically used to remove pathogens from potable water. The biological activated carbon (BAC) process is also a biological process that is used to remove organic contaminants from potable water.

The chemical processes involved in potable water treatment include oxidation, coagulation and disinfection. The physical processes include flocculation, sedimentation, filtration, adsorption, and disinfection using ultraviolet light. The types of processes that are required and the order in which they are used depend on the types and concentrations of contaminants that can be removed. Examples of this include oxidation followed by filtration or sedimentation, followed by filtration. One of the example, is the oxidation process causes the dissolved contaminants to form a precipitate, which can be removed by filtration. Other example is, sedimentation that removes most of the solids by gravity and reduces the solids loading on the down stream filtration process.

The following section describe a brief introduction to each of these basic water treatment processes. Each process will be presented in the order that they are normally used in a treatment train.

OXIDATION

Chemical oxidation is used in water treatment to aid in the removal of inorganic contaminants such as iron (Fe^{2+}), manganese (Mn^{2+}), and arsenic (As^{3+}) to improve removal of particles by coagulation or to destroy taste and odour causing compounds. Oxidation can also be used prior to coagulation, filtration, adsorption, or sedimentation to improve the removal of inorganic, particulates, taste, or odour.

Oxidants

Most commonly used oxidants in small systems include chlorine (Cl_2) and potassium permanganate (KMnO_4). To a lesser extent, ozone and chlorine dioxide are also used for this purpose. Chlorine can combine in gas, solid, and liquid forms; and potassium permanganate is usually supplied as a fine granular solid material that is dissolved in water. Ozone is generated onsite using pure oxygen or air. Most desirable oxidants are dependent upon a number of factors, including process requirements, operational cost, chemical safety, and operational complexity.

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