**WEEK 4**

**PURIFICATION OF WATER**

Various methods of water purification been have developed which depend on the amount and character or water, that is whether the water is for a single household or a town or city. Water is purified to make it satisfactory in appearance, taste, and odour as well as safe by removing harmful organisms. Disinfection is the only treatment required for water from properly constructed wells. Municipal water supplies, however, require a number of treatments. Three principal methods for the purification of water are sedimentation, filtration and disinfection.

**Sedimentation**

Water usually undergoes some degree of purification during storage in ponds of reservoirs. Suspended particles settle and carry down most of the microorganisms. The rate of purification by sedimentation depends upon the kind and amount of suspended matter as the well as physical, chemical and biological conditions of the stored water. The rate of sedimentation is enhanced by adding alum, iron salts, colloidal silicate etc., which produce flocculent precipitates. Microorganisms and suspended particles are entrapped and settle rapidly. Sometimes activated carbon is also added. This adsorbs the compounds responsible for objectionable colour and taste of water. Microorganisms remain viable for a considerable time, even though visible evidence of pollution bas disappeared Sedimentation, therefor, reduces the microbial population but does not sterilize polluted water. To produce portable water further treatment is necessary. Thus sedimentation is often used as a first stage in purification.

**Filtration**

Filtration is an effective means of removing microorganisms and other suspended matter from water. Many waters require some type of filtration, because of turbidity and color, presence of a large amount of organic matter, or sewage pollution. Two types of sand Filters are used to purify the clarified water after sedimentation.

Slow sand filter. Slow sand filtration plants requite considerable area because the rate of filtration is slow. A concrete floor with drainage tiles to collect the filtered water is constructed. The file is covered with coarse gravel, fine gravel, coarse sand and finally 2 to 1 feet of sand at the top. Water seeps through the filter slowly, is collected by tile drain pipes at the bottom, and is pumped into a reservoir. At best five million gallons of water per acre, per day can be filtered. Slow sand filters are clogged by turbid water. Water to be filtered is, therefore, clarified by sedimentation with or without coagulation.

The purification of water is accomplished not by the serening action of the sand, for the spaces are much to large, but by a difierent principle. A colloidal, flocculent material composed of bacteria, algae, and Protozoa accumulates in the surface layers of fine sand. This slimy, gelatinous film closes up the pores between the sand grains and makes the filter bed more and more effective. Since bacteria have a negative electrical charge and colloidal material on the sand grains has a positive charge, bacteria are thus adsorbed on the particles. Bacteria are also ingested by Protozoa that inhabit the upper layer of the film.

Metabolic activity of microorganisms also greatly reduces the chemical content of the water. When the gelatinous film finally become too thick, the efficiency of the filter gradually decreases. The filter is taken out of service and the surface layer is cleaned,

Rapid sand filter. Rapid sand filters are constructed in a manner similar to that of slow sand filters. They also consist of layers of sand, gravel, and rock. Water is pre-treated before filtration by a coagulant such as alum or ferrous sulphate. The water passes through a settling tank in which most of the precipitate settles out, and the remainder is pumped on to the filter. Rapid sand filters soon become clogged and are cleaned by forcing cleaned water backward (back washed) through the bed of gravel and sand, and bubbling air through them. The back water rises through the filter and carries the accumulated material to the sewer. The wash water is thus wasted. Care is taken in this backwashing procedure to see that the fine sand on the surface is not lost.

Rapid sand filters are usually operated in batteries, so that some may be in operation while others are being cleaned. They are nearly as cifective as slow sand filters but operate 50 times faster than slow sand filters. Rapid sand filers are capable of delivering 150 to 200 milion gallons of water per acre, per day. They require a much smaller area of land for more water filteration and cost much less to install and maintain.

Many other filtration devices such as pressure filters, diatomite filters, membrane filter, reverse osmosis ete., are employed to remove various impurities in water. Recovery of potable water from the sea and from domestic and industrial sewage is also undertaken by the use of filtration techniques.

**Disinfection**

Water purified by sedimentation or filtration cannot be considered safe for human consumption. Disinfection of public water supply is a final step in water purification before it reaches the consumer.

A number of chemicals have been recommended for the disinfection of water supplies. Solutions of calcium or sodium hypochlorite are satisfactory for treating water in small towns. In recent years chlorination of the public water supply is widely practised. Chlorine released as gas readily mixes with water. The amount of chlorine required depends on the organic matter. present, more chlorine being required.if there are more bacteria, more organic matter, and a shorter time to act. The amount of chlorine taken up is termed chlorine demand. The point at which the available chlorine becomes proportional to the added chlorine is called the break point. Water is usually' treated to contain 0.1 to 0.2 parts per million of residual chlorine. Residual chlorine is the available chlorine remaining 20 minutes after its addition to the water. An over dose of chlorine gives peculiar odours and tastes, because of its action upon various compounds present in water. Frequently it is due to the formation of chlorophenols. At times chlorine action may be prolonged, particularly in waters containing considerable organic matter, by the simultaneous addition of liquid ammonia, with the formation of chloramines.

Chlorine reacts with water to produce hypochlorous acid, which in turn quickly decomposes and releases oxygen. This nascent oxygen oxidizes cellular components and the organic matter. Another gas, ozone behaves in a similar manner, as it also releases oxygen. Chlorine kills most of the microorganisms but does not kill spores. Chlorinated water is, therefore, not always sterile, but is usually safe for human consumption.

In small communities, where cost is not an important factor, chlorine is replaced by other purification agents. Germicidal ultraviolet rays are used to disinfect water supplies. Objectionable taste and odor which accompany chlorination are, therefore, avoided by this process. But the simplest and the best method to make water safe for human consumption is to boil it for 10 minutes. This practice is often recommended for household use during floods or other disasters that disrupt the normal Water purification system.