Ministry of Higher Education and Scientific Research Al-Mustaqbal University College

Department of Chemical Engineering and petroleum Industrials

Pollution

2nd Stage

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Tertiary Treatment

Tertiary treatment process includes sand filtration, membrane filtration , and chemical oxidation. It is applicable for removal of total suspended solids, dissolved and suspended matter, COD, and trace organics. After secondary treatment process, effluent contains suspended solids depending on operating conditions in the clarifier. Metals and fine solids, which could not be settled down in sedimentation process, can be removed by sand filtration.

This process involves passing the wastewater through a filter bed comprised of a filter media. Generally, chemical oxidation is used for reduction of residual COD, trace organic compounds, and non-biodegradable compounds. This method uses different types of oxidation reagents like **hydrogen peroxide, ozone, and chlorine dioxide.**

Sand Filtration

-Types of Filters

Several types of filters are used for water treatment. The earliest ones developed were the slow sand

filters. This type of filter requires large filter areas. The top several inches of the sand has to be removed regularly-- usually by hand--due to the mass of growing material that collects in the filter. The sand removed is usually washed and returned to the filter. These filters are still in use in some small plants, especially in the western United States as well as in many developing countries. They may also be used as a final step in wastewater treatment. Most filters are classified by filtration rate, type of filter media, or type of operation.

A. Gravity Filters 1. Rapid Sand Filters 2. High Rate Filters -Dual media -Multi-media

B. Pressure Filters -Sand or Multi-media

Rapid Sand Filters

Filter Sand

The filter sand used in rapid sand filters is manufactured specifically for the purpose of water filtration. Most rapid sand filters contain 24-30 inches of sand, but some newer filters are deeper. The sand used is generally 0.4 to

0.6 mm in diameter. This is **larger than the sand used in slow rate filtration. The coarser sand in the rapid filters has larger voids that do not fill as easily.**

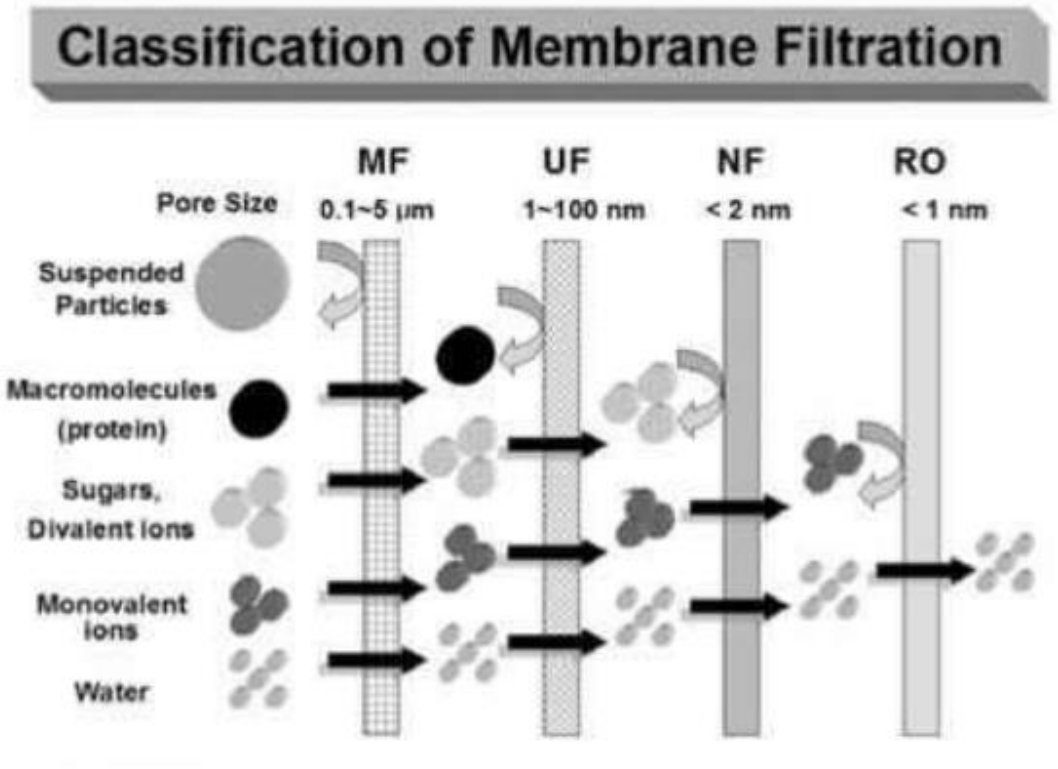
Graded Gravel

The gravel installed under the sand layer(s) in the filter prevents the filter sand from being lost during the operation. The under-gravel also distributes the backwash water evenly across the total filter.

This under-gravel supports the filter sand and is usually graded in three to five layers, each generally 6-18 inches in thickness, depending on the type of under drain used.

Membrane separation

Depending upon the **pore size** of utilized membrane process is categorized as a (a) microfiltration (MF), (b) nanofiltration (NF), (c) ultrafiltration (UF), and (d) reverse osmosis (RO), which are mostly applied to treat oily wastewater.



This separation method play role in physical removal of way of the trapped particle size of contaminants. According to membrane pore size, ultrafiltration membranes are more effective than microfiltration membranes. Nanofiltration and reverse osmosis can be also used for separating oil from water especially for high-salinity.

Chemical oxidation

The principal health risk from drinking water in most locations is waterborne diseases from microbial

contamination. According to the World Health Organization (WHO), an estimated 1.7 million deaths a year can be attributed to unsafe water supplies. The concept of waterborne disease was first realized in the 1850s during a cholera in London. But it wasn't until almost 20 years later that Louis Pasteur and Robert Koch developed the germ theory of disease, and it was another 30 years before the regular use of disinfectants to kill the germs. Continuous chlorination was used for the first time in Lincoln, England, in 1905 to arrest a typhoid outbreak. The first use of ozone for disinfection was at Nice, France, in 1910. Since that time, disinfection has become an accepted water supply practice throughout the world. Chlorination has been the dominant method employed, but ozonation has been widely used also. There has also been increasing use of chlorine dioxide as a disinfectant in the United States and Europe.

Oxidants (chlorine, ozone O_3, chlorine dioxide ClO_2, and permanganate,are used in water treatment to accomplish a wide variety of treatment objectives Oxidants are used in water treatment to accomplish a wide variety of treatment objectives besides disinfection, including

mitigation of objectionable tastes and odors, removal of color, removal of iron and manganese, and oxidation of organic chemicals.

In Situ Chemical Oxidation