

Introduction:

We will start with an overview of treatment processes

1) *Why do we treat water and wastewater?*

The main objectives of the conventional wastewater treatment processes are the reduction in biochemical oxygen demand, suspended solids and pathogenic organisms.

It also may be necessary to remove nutrients such as N and P, toxic components, non-biologically degradable compounds and dissolved solids.

Removal of these materials are necessary for the simple reason that discharge to the environment will result in “damage” of some sort.

Of course the damage is a function of the type of pollutant discharged -- heavy metals = toxicity, organic matter = oxygen depletion, N or P-eutrophication, etc. In the case of water treatment the objective is to remove contaminants from the water which can result in health or aesthetic problems.

2) *What are the materials in water and wastewater that we must remove?*

There are a wide range of these pollutants (contaminants) ranging from municipal sewage to highly specific industrial wastes. The usual approach in discussing treatment schemes is to categorize pollutants into general classes so that a general class of treatment methods can be applied.

Note that many pollutants fall into several categories. For example, some biodegradable organic matter (one category) is in the form of suspended solids (another category), so removal of SS sometimes results in the removal of organic matter. As an example consider the **content** of typical municipal wastewater as represented by its solids content.

Total Solids (400 –1200 mg/L)

Inorganic (ash)
50%

Organic (volatile)
50%

Dissolved inorg.
35%

Suspended ($>1\ \mu$) 45%
(15% inorg) (30% inorg)

Dissol.
organic
20%

Non-settleable
Inorganic
40%

Settleable ($>10\mu$)
25%(10% inorg)
(15% organic)

Non-setteable
Organic
35%

Each solids “type” may require a different type of treatment process. We generally try to remove large very settleable or screenable particles first and then proceed to the smallest and finally to the soluble species.

3) *To what level do we need to remove contaminants?*

The degree to which drinking water must be treated depends on the raw water quality and the desired quality of the finished water. Similarly the degree of treatment of a wastewater depends on the quality of the raw waste and the required effluent quality.

For example *wastewater treatment* may require
"secondary treatment" as shown here:

- $\text{BOD}_5 = 30 \text{ mg/L}$ monthly average
- Suspended Solids = 30 mg/L monthly average
- pH (if there is industrial input) = 6 – 9 continuous

Note that "secondary" standards are just the “basic” requirements. More stringent standards are placed on effluents which are discharged to potentially eutrophic lakes, etc. or whenever there is a known toxic contaminant in the wastewater (e.g. industrial discharges).

For drinking water treatment the requirements are, of course, much more stringent with many more categories and lower contaminant limits. Some examples are:

Turbidity (a measure of suspended solids): less than 0.5 NTU in at least 95% of samples taken each month.

Lead: 0.005 mg/L

Copper: 1.3 mg/L

Total Coliform: no coliform detection in more than 5% of samples collected each month.

4) How are these contaminants removed from water and wastewater?

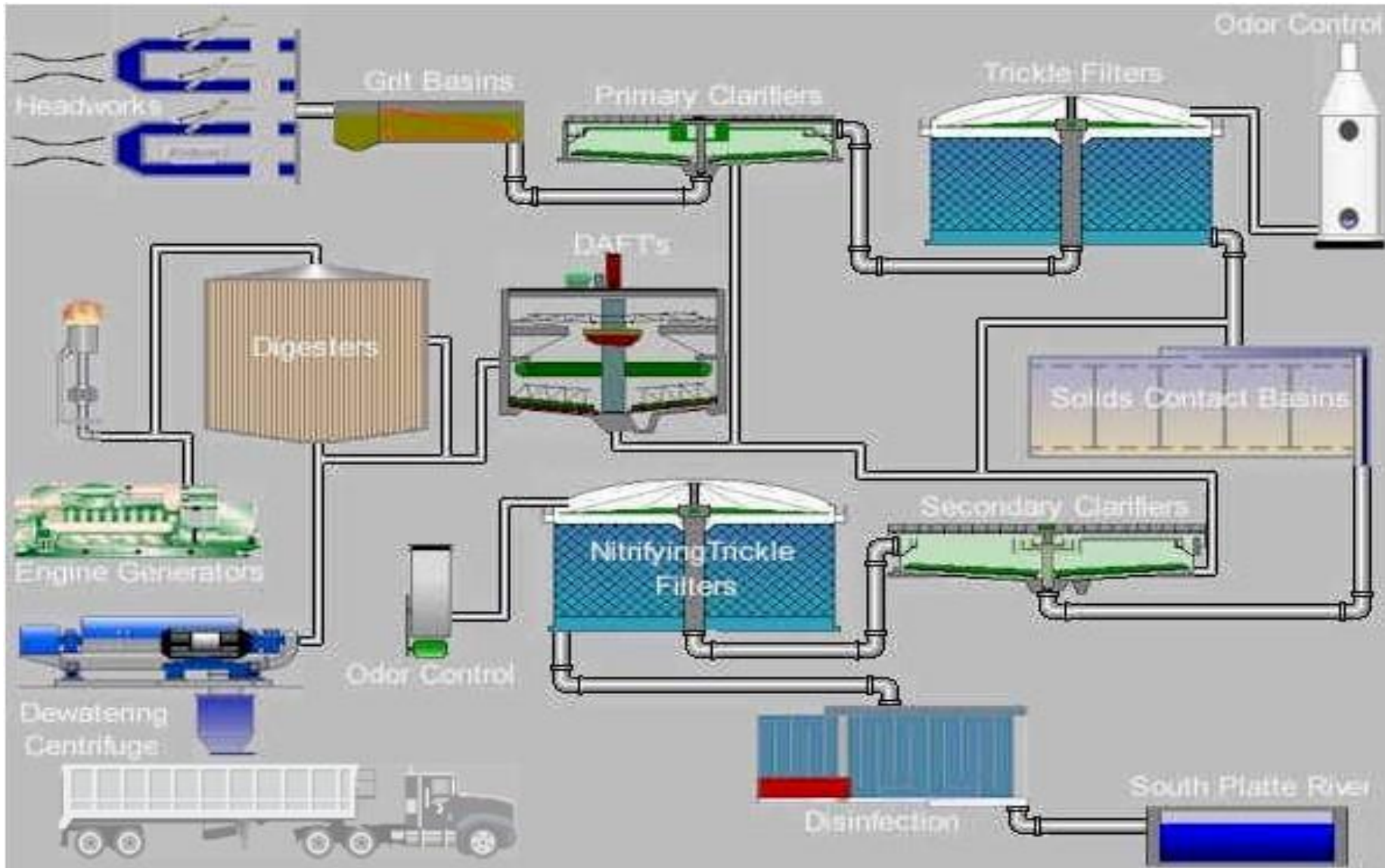
Contaminant removal is accomplished by a series of unit processes or unit operations. (In a strict sense "unit operation" is a physical treatment process and "unit process" is a chemical or biological process. But, these terms are often used interchangeably). The system of integrated unit processes or unit processes used to treat a water or wastewater is called a **treatment train**.

Now look at some typical treatment “trains”.

Treatment “trains” are composed of a series of unit processes (or operations) each designed to remove a specific waste component or class of waste components. Arrangement and sizing of these unit processes is critical to their satisfactory and efficient operation. One of the objectives of this course is to develop an understanding of the unit processes, to know when to use a particular process, and how to size it to meet a certain performance level.

Treatment processes are usually divided into two trains: liquid train, and the solids (sludge) train. The reason for this is that we usually take a rather dilute waste and through a series of phase separation processes create a more concentrated waste (sludge). The sludge then has to be treated accordingly.

An example of a typical wastewater treatment plant is:



An example of a water treatment plant:

