Basic Wastewater Review

Intro to Wastewater Treatment

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The primary purpose of wastewater treatment is to protect the health and well being of our community. State and federal legislation govern to what extent or completeness of treatment is necessary to accomplish this purpose.

A community consists primarily of private dwellings with some commercial and industrial contributors which may use from 100 to 200 gallons/day/capita which equals 379 to 757 liters/day/person. Communities use their water supply to flush and transport a variety of wastes from homes and industries. The wastewater created normally, consists of more than 99.9% water and less than 0.1% solids which are significant because of their volume and potential impact on the environment.

For a community of 100,000; 10 to 20 MGD would be demanded. The resulting wastewater would contain approximately 20 to 60 tons of solids/day. Annually this is 7,000 to 20,000 tons of solids/day, with approximately 50 to 70% organic content and the remaining percentage being inorganic material. Without proper collection, treatment, solids reduction, and reuse of the products created by the treatment processes the health of the community and the environment would suffer.

The objectives of wastewater treatment include some of the following:

1. Prevention of Disease
2. Prevention of nuisance odors
3. Avoidance of water supply contamination
4. Avoidance of silting of waterways
5. Maintaining clean water for propagation and survival of fish
6. Maintaining clean water for swimming and recreational uses
7. Conservation of water for all users

The quality of effluent required to achieve these objectives generally is fixed; the volume, physical, chemical, and biological characteristics of the treatment plant influent are constantly changing due to the constantly changing influent loads.

WASTEWATER COLLECTION SYSTEM

Getting wastewater to a treatment facility

The plant influent system consists of a network of subsurface pipes and conduits called sewers. Their purpose is to collect the wastewater and convey it to the treatment plant; generally, the force of gravity enhances flow through the collection system. Except when topography does not permit gravity flow, pumping stations are necessary to lift and help convey the wastewater.

Sewers that receive waste flow from residential, commercial, and industrial sources are called sanitary sewers. Sewers that convey storm water and other drainage excluding sanitary wastes are called storm sewers. Sewers that convey both sanitary wastes and storm drainage are called combined sewers.

Remember that sewage flow rate should never drop below 2^{ft}/sec.
What happens if it does?
Grit will start to settle and create problems with plugging.
If sewage flow rate drops below 1.5ft/sec?
Then organics start to settle out and then odor and sewer line deterioration issues will start.

PRELIMINARY TREATMENT

First stage of treatment

Preliminary treatment means conditioning of the wastewater at its source before discharge to the plant influent system. The purpose of preliminary treatment is to remove or neutralize substances that might be harmful to the influent system or adversely affect the operation of the treatment plant.

Such material includes lumber, plastics, rags, and grit. Methods and equipment used to remove these items are bar racks, screens, occasionally shredding devices and various grit removal systems.

PRIMARY TREATMENT

Primary Clarifiers

The purpose of primary treatment is to remove suspended and floating material, following preliminary treatment. A well-operated primary treatment facility may remove as much as 98% of settleable solids, 60% of the influent suspended solids and 20% to 50% of BOD.

However, colloidal solids and dissolved solids will not be removed. Therefore, primary treatment processes need to be supplemented by additional treatment.

SECONDARY TREATMENT

Ponds, Trickling Filters, RBCs, Oxidation Ditch and Activated Sludge

The main objective of secondary treatment is to reduce the concentrations of dissolved and colloidal organic matter in the wastewater stream. This is not removed significantly in primary treatment.

Microorganisms (bacteria) doing the work.

BIOLOGICAL TREATMENT

Secondary treatment processes are biological in nature. Most processes can be classified as fixed-film or slurry, although the overall organic strength reduction is very much the same.

In a mixed population of microorganisms, the presence of oxygen, trace amounts of nutrients, the consumption of organic material in the wastewater to sustain their life processes and produce new microorganisms. In the fixed-film systems, the mass of microorganisms affecting treatment is attached to a supporting medium. Examples are trickling filters and the rotating biological contactors.

Slurry systems include the many variations of activated sludge processes and lagoons. The effluent from slurry and fixed-film systems has a high concentration of biological solids in suspension.

Before further treatment or final disposal, the solids must be removed by means of a liquid-solids separation process, usually with secondary clarifiers.

DISINFECTION

Safe Effluent

The importance of disinfection in the wastewater treatment systems cannot be overemphasized. When required, it is used to destroy pathogenic bacteria, viruses, and amoebic cysts commonly found in wastewater.

Pathogens may cause serious outbreaks of waterborne diseases such as typhoid, cholera, paratyphoid, bacillary, dysentery, poliomyelitis, and infectious hepatitis.

Disinfection processes may be classified as natural, chemical, mechanical, or radiation substances.

These may include:

- Sunlight
- Chlorine
- Filtration
- UV

EFFLUENT DISPOSAL

Where does the reclaimed water go?

The methods of treatment plant effluent disposal and the required effluent quality are the essential factors in the selection of a process to treat a type of wastewater.

Disposal methods consist of, direct discharge to receiving waters, percolation, deep well injection, land application, and groundwater discharge.

SLUDGE TREATMENT

and disposal

Sludge referred to the settled solids accumulated and subsequently separated from the liquid stream during various phases of wastewater treatment.

Generally, sludge handling and disposal are the most difficult and costly part of the wastewater treatment process.

Digestion – allows for volatile solids reduction. Anaerobic digestion in the Mesophilic range should be at least 15 days with a temperature between 70 ◦ and 113 ◦F with the best temperature utilization between 95◦ and 98◦ F. Heating digesters costs money !!!

Dewatering – allows for the removal of water from sludge to be disposed. Drying beds, belt press and centrifuges. What percent solids is your target?

Disposal – what does your permit state? Landfill, Land application, composting, range land application.

Questions???

Are you ready for the Exam?
Make sure that you use units for math answers.
Go with your first answer, unless you are positive to change it.