WASTEWATER AND BIOSOLIDS TREATMENT

In this brief chapter, we'll explore the treatment processes that result in biosolids deemed acceptable for application on agricultural land. It all begins with wastewater.

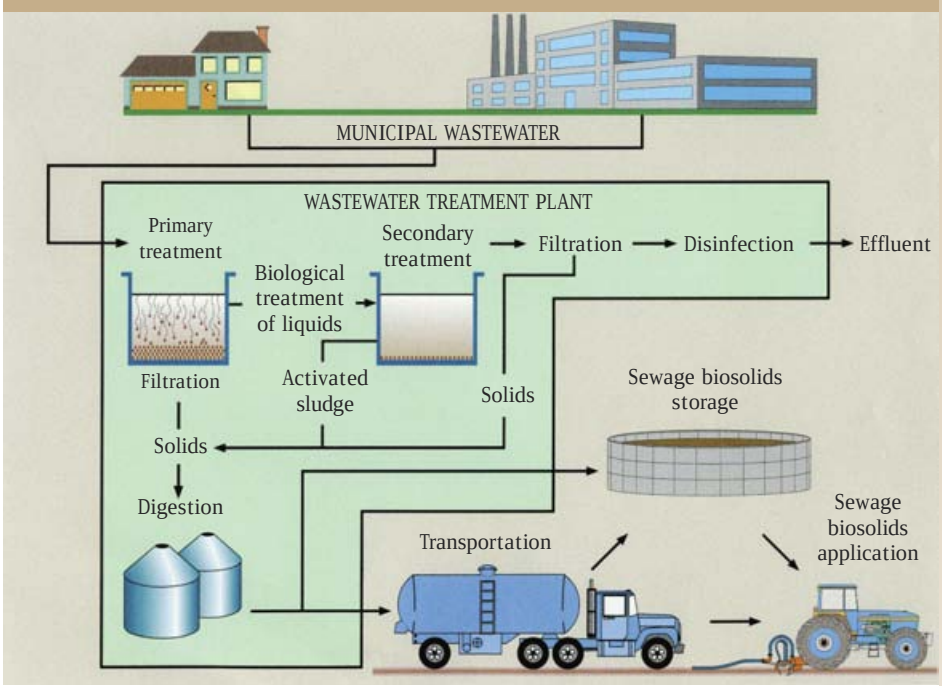
WASTEWATER TREATMENT

Before a municipality or industry can release wastewater into a river, lake or stream, it must remove a certain amount of suspended solids and other contaminants in the wastewater. Effluent discharge quality limits are specified in a Certificate of Approval. These limits must be met.

Biosolids are produced primarily through the biological treatment of domestic wastewater. They are the solids or sludge removed from wastewater before the treated water can be released into streams, lakes or rivers.

Municipal wastewater treatment results in discharged effluent and sewage biosolids.

WASTEWATER TREATMENT PROCESS



5-STEP PROCESSING

Wastewater treatment is done in five stages.

1 – Pre-Treatment
The first stage involves screening to remove coarse solids such as sticks, paper, and rags in addition to grit removal of the finer inorganic solids. This material is usually dewatered and landfilled, and does not contribute to the production of sewage biosolids.

2 – Primary Treatment
Roughly half of the remaining solids are removed by allowing solid particles to settle to the bottom of a settling structure, as floating materials are skimmed from the surface. These solids or raw sludge contribute to the production of biosolids.

3 – Secondary (Biological) Treatment
Wastewater is then subjected to secondary (i.e., biological treatment). In this stage, micro-organisms (bacteria and protozoa) consume the remaining organic matter. The microbial biomass (organic residue) is then allowed to settle and is separated from the wastewater. The microbial biomass from the secondary sedimentation stage is typically combined with raw sewage sludge from the primary stage to contribute to the production of sewage biosolids.

4 – Tertiary Treatment
Tertiary treatment for the most part involves filtration of the secondary treatment effluent to remove almost all of the remaining suspended solids. These solids also contribute to the production of biosolids.

5 – Wastewater Disinfection
Treated wastewater is disinfected to kill remaining pathogenic bacteria prior to the wastewater being discharged to a water body. Methods of disinfection include UV radiation, chlorination or ozonation.

BIOSOLIDS TREATMENT

Physical processes are most commonly used to improve biosolids quality. The raw sewage solids or sludge generated during the wastewater treatment process are digested by micro-organisms in the presence of oxygen (aerobic digestion) or without oxygen (anaerobic digestion) and varying degrees of heat.

Chemical processes such as those involving pH adjustment can also be used as a method of treatment or stabilization.

These stabilization methods reduce the number of disease-causing microbes (pathogens) in the sewage biosolids, and reduce odour potential.

Municipal sewage treatment plants use physical and biological processes to clean wastewater. One million gallons of sewage result in a ton of dry sewage biosolids or 12,000 gallons of liquid biosolids. This is equivalent to about 91–136 grams (0.2-0.3 lb) of dry solids per person per day. These solids can then be recycled on agricultural lands as sewage biosolids.

The type and extent of processes used to treat the solids will affect the degree of pathogen reduction attained and the potential for odour generation. Common treatment processes and their effects on biosolids properties and land application practices are summarized in the next chart.

BIOSOLIDS TREATMENT PROCESSES AND THE IMPACTS ON LAND APPLICATION PRACTICES

TREATMENT PROCESS AND DEFINITION	IMPACT ON BIOSOLIDS	IMPACT ON LAND APPLICATION PRACTICES
SECONDARY TREATMENT or STABILIZATION		
DIGESTION (ANAEROBIC AND AEROBIC)		
• involves biological stabilization through conversion of organic matter to carbon dioxide, water, and methane	• reduces the biodegradable content (stabilization by conversion to soluble material and gas) • reduces pathogen levels and odour	• enhances the quality of biosolids
TERTIARY TREATMENT – FURTHER PROCESSING METHODS		
DEWATERING		
• involves high-force separation of water and solids • includes methods such as vacuum filters, centrifuges, filter and belt presses, among others	• increases solids concentration by 15%–40% • lowers nitrogen and potassium concentrations • improves ease of handling	• lowers transportation costs • limits application method options • lowers nutrient dispersal potential when spread
ALKALINE STABILIZATION		
• involves stabilization through the addition of alkaline materials (e.g., lime, kiln dust)	• raises pH • decreases biological activity • reduces pathogen levels and controls odour	• immobilizes metals through high pH, as long as pH levels are maintained • raises soil pH (of typically acidic soils)
COMPOSTING		
• involves aerobic, thermophilic, and biological stabilization in a windrow, aerated, static pile or vessel	• lowers biological activity • destroys most pathogens • converts sewage biosolids to humus-like material • decreases odour concerns	• fosters excellent soil-conditioning properties • contains less plant-available nitrogen than other biosolids • enjoys greater stakeholder acceptance • enhances aesthetics
HEAT DRYING (PELLETIZATION)		
• uses heat to kill pathogens and evaporate most of the water content	• disinfects sewage biosolids • destroys most pathogens • lowers odours and biological activity	• greatly reduces sewage biosolids volume • makes for easier handling and spreading • offers potential to blend with commercial fertilizer

Dewatered biosolids are easier and less expensive to handle for land application.

Stabilized biosolids contain fewer pathogens – making them suitable for land application.

Pelletized biosolids are nearly odour-free and can be used like commercial fertilizer.