Detailed SW Clean Water Treatment Process

The Southwest Wastewater Treatment Plant is capable of continually treating 42.5 million gallons per day of Springfield's wastewater and 100 million gallons per day for short periods. The average daily flow at this time is approximately 35 million gallons per day. The plant is designed to produce a high quality effluent for discharge into Wilson's Creek. The plant removes approximately 70,000 pounds of pollutants from the wastewater per day before it is discharged.

Headwork's & Pump Station (Mechanical Treatment) The 1st step is to remove debris, sand and gravel that are present in the wastewater stream. This material would damage machinery in the plant if not removed. Removal is accomplished in a covered and odor controlled influent facility. The wastewater enters the plant through a structure called a trash rack. This consists of a series of parallel 3/8 inch steel bars spaced at three inches apart.
This rack physically screens out larger material such as pieces of broken pipe, large rocks, lumber and similar material.

Bar Screens

Next, the wastewater passes through 4 automatic bar screens. Since the openings between the bars of these screens are 3/8 of an inch, much smaller materials such as rags, small rocks and sticks are captured and removed from the flow.

Grit Removal

The next step is grit removal, which is the removal of heavy particles such as sand. This is accomplished in an aerated grit chamber. The velocity of the wastewater is reduced to approximately 1 foot per second. This causes the grit carried in the wastewater to settle to the bottom of the tank, where it is removed. All of these materials are transported to Springfield's Sanitary Landfill for environmentally safe disposal.

Floating Material Removal

Any material that floats is also removed in the head works by a skimming process. The material removed consists primarily of solid grease and oils which are then pumped to the anaerobic digesters for further treatment.

Primary Clarifiers additional mechanical treatment occurs in the primary clarifiers where larger insoluble material is allowed to settle out. This material is then removed by utilizing large mechanical scrappers.

The scrappers continually remove the primary sludge from the bottom of the clarifiers to pumps which transfer the material to the anaerobic digesters. This process allows the two plants to more efficiently treat the incoming wastewater. The primary clarifiers can also act as large flow equalization basins in the event of unnaturally heavy flow situations.

Flow Equalization System At times, flow entering the plant is greater than 100 million gallons per day, the peak capacity of the plant.

Under these circumstances, 100 million gallons per day receive full treatment while the remainder flows into equalization basins. These basins are capable of holding 41 million gallons. When they become full, the excess diluted wastewater is treated in a peak flow clarifier and discharged to Wilson's Creek.

Activated Sludge Process (Biological Treatment) Activated sludge treatment is the most important part of the wastewater treatment process. Wastewater from the influent structure is split between 2 biological treatment systems according to each system's capacity. The processes are similar in nature as they both employ naturally occurring microorganisms to remove suspended and dissolved organic matter from the wastewater.

Microorganisms

Examples of the microorganisms are:

- Bacteria
- Flagellates
- Nematode
- Rotifers
- Stalked Cilliates
- A host of other similar organisms

Conditions in the activated sludge treatment system are carefully adjusted to produce an ideal environment for the growth and proliferation of these simple animals.

Biological Phosphorus Removal

In Plant #2 biological phosphorus removal (BPR) is also achieved. This is done by exposing the mixed liquid to an anaerobic / aerobic sequence. Phosphorus is removed in the activated sludge process of Plant #2 when the microorganisms are subjected to an anoxic / anaerobic zone or area devoid of oxygen that contains food material. This stresses a certain type of bacteria present in the process and causes them to release stored phosphorus.

When they return to the aerobic zone, oxygen rich area of the plant, they take in more phosphorus than they released. This results in a lower concentration of phosphorus in the water leaving the plant. The advantages of the BPR are a reduced sludge production, improved sludge settle-ability and dewatering characteristics, reduced oxygen requirements, and reduced process alkalinity requirements. Biological removal of phosphorus is not applicable to Plant#1 because of process differences. In this plant phosphorus is removed by addition of aluminum sulfate (ALUM). The aluminum combines with phosphorus to form an insoluble material that is removed with the waste biosolids.

Clarifiers After the microorganisms are produced, they must be removed from the treated water before it goes to the next treatment process. This is accomplished in large settling tanks called clarifiers. The microorganisms settle to the bottom of the clarifiers where they are drawn off. Most of them are recycled back to the aeration or oxygen tanks unless their concentration in these tanks has become too great.

In this case, they are wasted from the system to the anaerobic digesters. The SWCWP produces approximately 16 dry tons of waste solids per day.

Nitrification Process In Plant#1 ammonia is converted to nitrate in this process. In Plant#2 this occurs in the aeration basins of the activated sludge process. At this point in the process more than 95% of the ammonia nitrogen in the influent to this activated sludge system will be converted to nitrate-nitrogen.

Polishing Filters The polishing filters are the next step in the treatment process. They are designed to remove any remaining suspended solids from the wastewater. The filtration media is sand for one portion of the plant, and mixed media of various sizes of sand and coal for the other portion of the plant. As suspended solids are removed from the wastewater, the filter media becomes dirty and the water cannot flow through the filter as fast.

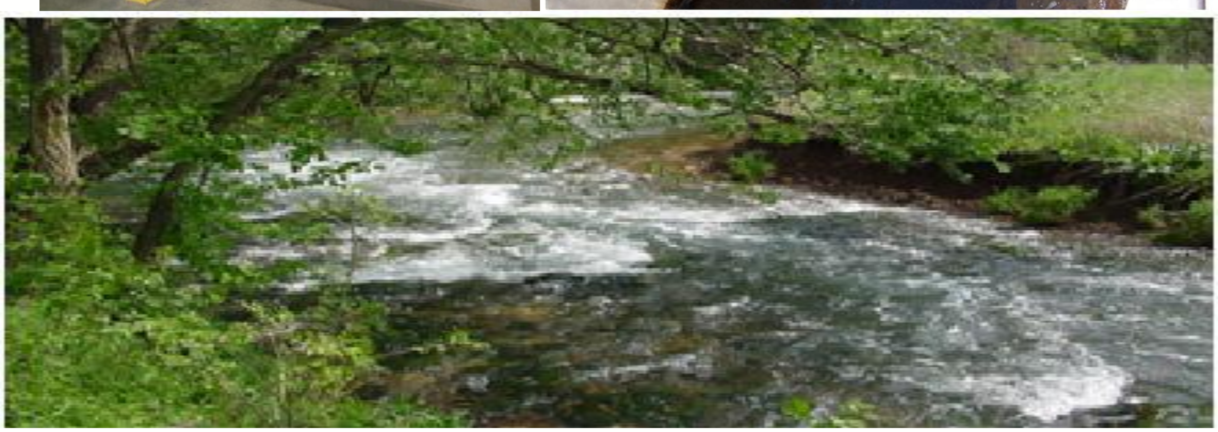
The filter must then be cleaned by forcing clean water through from the bottom of the filter up through the filter media which washes the solids out of the filter. The dirty backwash water is pumped to the head of the plant for retreatment.

Nitrate Removal Nitrate is present in groundwater and surface water in agricultural areas from fertilizer use or in municipal and industrial waste steams after the aerobic degradation of ammonia. Dissolved nitrate may be removed from water through the action of denitrifying bacteria, which converts nitrate to nitrogen gas. The SW Plant uses this biological treatment process for nitrate removal.

Ozone Contactor The flows from the 2 treatment systems come together again for disinfection, the last step in the treatment process. Ozone, which is produced on site, is used as the disinfection agent. The production of ozone consists of 2 stages.

First Stage

The 1st stage is to produce the pure oxygen. This is accomplished by compressing, cooling and liquefying air, removing contaminants and distilling the liquid to separate nitrogen from the oxygen.



Both liquid and gaseous oxygen with greater than 95% purity can be produced. The liquid oxygen is stored in two 25,000-gallon tanks for use when gaseous oxygen cannot be produced. The Cryogenic Oxygen (CRYO) generation plant can produce 50 tons of oxygen per day.

Second Stage

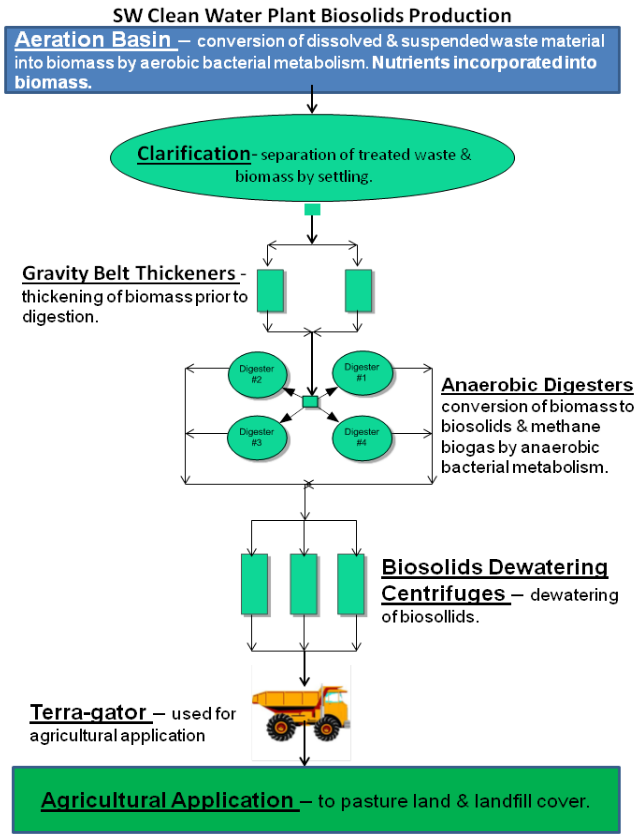
The 2nd stage is the production of ozone. Passing the pure oxygen through an electrical discharge in an Ozone Generator produces the ozone. This process converts 6 - 8 % of the oxygen to ozone. The oxygen and ozone mixture is fed to the ozonation tanks for disinfection. The process takes place in the covered ozone contact tank where a mixture of oxygen and 6 - 8 % ozone is diffused into the wastewater.

Ozone is a very effective disinfecting agent and has the added benefit of breaking down chemically into oxygen. This along with the dissolved oxygen from contact with the oxygen atmosphere produces finished water with high dissolved oxygen. The finished water is clear, colorless, non-polluting, odor free water which can be safely discharged into Wilson's Creek.

Permit Monitoring

The treatment processes are continuously monitored through a program of sampling and testing by our laboratory. Our laboratory staff of Biologists and Chemists analyze over 5,800 samples per month to ensure that all federal and state standards are met by both treatment facilities. Our goal is to improve the water quality in the James River Basin.

BIOSOLIDS



The Southwest Plant generates approximately 16 dry tons of biosolids per day. The biosolids are processed and utilized as a soil conditioner and fertilizer. Biosolids hauled from the Northwest Clean Water Plant are also processed at the Southwest Plant. See the biosolids page for more information.

Biomass Thickening

The biomass or excess microorganisms from the activated sludge biological treatment processes are first pumped to gravity belt thickeners (GBT). In this process, the waste biomass, which is about 1% solids, are conditioned with water-soluble polymers to flocculate the solids. The GBT process works by filtering free water from the flocculated biomass by gravity drainage through a porous belt. This produces a final product with approximately 5% total solids which is then pumped to the anaerobic digesters.

Anaerobic Digestion

Anaerobic digestion is accomplished by employing microorganisms in the absence of oxygen in one million gallon covered tanks called "anaerobic digesters." Conditions are carefully controlled in order to produce an environment where anaerobic biological activity can flourish. This breaks down solids, reducing their concentration by about one-half. This process transforms the biomass into biosolids an inoffensive humus type of substance, which can be safely spread on land for soil conditioning and fertilization. Thus, the biosolids produced by the treatment processes are beneficially reused and recycled in an environmentally safe manner.

Anaerobic digestion results in the generation of methane gas, a valuable source of energy. This methane gas is used as a fuel for large engine driven plant equipment and to produce building heat, reducing the use of electricity and other fuels.

Biosolids Dewatering

The clean water plant's disposal option for biosolids recycling is to dewater the digested biosolids using polymer and high-speed centrifuges. The centrifuges are used to take the digested biosolids from 3% solids to 23% solids. The dewatered biosolids are then transported to area farms to be land applied as fertilizer. Thus, the biosolids produced by the treatment processes are beneficially reused and recycled in an environmentally safe manner according to the Envioronmental Protection Agency (EPA) Part 503 Biosolids Regulations.