Sundog Wastewater Treatment Plant

Liquid Treatment Processes

Flow Measurement

The efficiency of a wastewater treatment plant in removing pollutants is a function of the rate of flow entering the plant. Therefore, knowledge of the wastewater flow rate into the plant is vital to the determination of the adequacy of the plant and proper operation.

Screening

Influent wastewater frequently contains large objects such as boards, rags, and miscellaneous debris which could seriously damage equipment in the treatment plant.

The mechanically cleaned bar screen removes these items from the influent wastewater. Screenings are dumped into containers and then hauled to a sanitary landfill.

Grit Removal

In addition to the large objects removed by screening, the influent wastewater also carries grit. Grit is heavy inorganic material such as sand, silt, stones and cinders. If not removed, the grit can interfere with the treatment processes, cause excessive wear on pumps, valves and piping and use up space provided for treatment of organic materials.

At the Sundog WWTP, grit is removed using a forced vortex type "pista grit" unit. Heavy inorganic solids are directed to the center of the chamber into a hopper while lighter organic solids are hydraulically kept in suspension. The settled grit is removed from the basins by pumping to the grit concentrator. The grit falls from the concentrator into a grit dewatering screw where the grit is washed and conveyed into a grit container. The grit is removed by truck to a sanitary landfill.

Flow Distribution

A flow distribution chamber is provided to distribute flow to each primary settling basin. In case of emergencies or mechanical problems with the primary settling basins, gates can be closed to isolate one of these basins.

Primary Settling

The pollutants in wastewater are in two forms: dissolved and particulate. The dissolved pollutants are similar to sugar in a well-stirred cup of coffee -- they do not settle to the bottom, even after standing for a long time. On the other hand, most particulate pollutants (suspended solids) will settle if they are not excessively disturbed. The concentration of particulate pollutants in the wastewater is reduced by settling in the primary settling basins. Floating pollutants (primary scum) are skimmed off the surface of the basins, deposited in the scum pits and pumped to a dewatering container. A slurry containing most of the settled particulate pollutants (primary sludge), is pumped from the bottom of the basins to the primary anaerobic digester. A relatively clear fluid (primary basin effluent) containing the dissolved and some of the particulate pollutants is taken from the top surface of the basins. The effluent from the primary settling basins flows by gravity to the settled sewage pump station and is pumped to the two aeration basins (oxidation ditches).

Biological Treatment

Simply stated, biological treatment removes dissolved and particulate pollutants from the wastewater by converting them to settleable solids (biological sludge) which can be removed by settling. The conversion is accomplished by bacteria naturally present in the wastewater. Biological treatment processes typically concentrate large numbers of these bacteria in a relatively small volume while controlling those environmental conditions (such as available oxygen) that are necessary for efficient treatment. Biological treatment at the Sundog WWTP is provided in the aeration basins and final settling basins.

Normal domestic wastewater contains everything needed by the bacteria for growth, except enough dissolved oxygen. Sufficient bacteria need to be in contact with the wastewater to consume the pollutants within a few hours. To provide sufficient bacteria, some of the bacteria collected in the final settling basins is returned to the aeration basins (return activated sludge). The remainder of the final settling basin sludge (waste activated sludge), which should approximately equal the amount of solids produced, is "wasted" to the gravity belt thickeners.

Oxygen is added to the aeration basin by forcing air through coarse bubble diffusers. The oxygen serves two purposes, to provide oxygen for the bacteria to live and it keeps the contents of the basins stirred up so that the bacteria can come in contact with the pollutants more frequently. To also aid in mixing, mechanical submersible mixers are located in the aeration basins to provide non-settling velocity and to establish anoxic zones for removal of nitrates by nitrification-denitrification.

In the controlled environment of the aeration basins, dissolved and particulate organic pollutants are used by bacteria as food to grow and multiply. These bacteria, along with their waste products, are then removed by settling in the final settling basins.

Final Settling

The biological sludge produced in the aeration basins is settled out in the two final settling basins. This sludge, called activated sludge, is either returned to the aeration basins or wasted to the gravity belt thickeners prior to pumping to the primary anaerobic digester.

Effluent Filtration

Filtration reduces the suspended solids left in the plant effluent after the final settling basins. The suspended solids are removed by the combined effects of straining, sedimentation, adsorption, and flocculation. The filtered effluent then flows to the chlorine contact basin.

The filter media consists of a layer of sand and a layer of anthracite. The solids removed from the wastewater are captured in the filter until the media becomes clogged. The filter is then backwashed (forcing clean water through the media in the reverse direction) using filtered effluent to remove the captured solids. The backwash water is discharged to the basin drainage pump station which discharges to the settled sewage pump station.

Disinfection

Chlorine solution is added to disinfect the effluent from the filters before it is discharged to the effluent ponds and then to the percolation ponds. The flow is kept in the chlorine contact basins for a short period after the chlorine is added to give the chlorine enough time to destroy pathogenic (disease-causing) and nonpathogenic organisms.

Solids Treatment Processes

Sources

The overall objectives of solids treatment is to decompose or digest the highly organic matter removed during the treatment process. These solids must be converted to relatively stable compounds prior to final disposal. There are four sources of solids in the treatment process: primary sludge and scum from the primary settling basins and waste activated sludge (WAS) and scum from the final settling basins. The primary sludge and waste activated sludge is pumped to the primary anaerobic digester for treatment.

Sludge Thickening

For optimum utilization of the digesters, gravity belt thickeners are used to concentrate waste activated sludge prior to digestion. By removing water and increasing the solids content of the sludge, the volume required in these sludge treatment and disposal facilities is greatly reduced. Less energy is then needed to heat the digester contents.

Also, the thickening process increases the solids retention time in the digesters, resulting in a better stabilized digested sludge. The gravity belt thickeners can also be used to remove water from the digested sludge to reduce the total volume of sludge requiring storage or disposal.

Anaerobic Digesters

The sludge from the primary settling basins and the waste activated sludge from the secondary settling basins are digested in the primary anaerobic sludge digester. The highly decomposable sludge is converted to relatively inert and non decomposable solids. Greatly simplified, the anaerobic digestion process is similar to the biological treatment process, except that these bacteria require the total absence of oxygen. The bacteria work most efficiently at a temperature of 96-98° F, so the digester is heated using methane gas produced in the primary digester. In an ideal or nearly ideal environment, anaerobic sludge digestion requires about two to three weeks.

The anaerobic digestion process is two-staged. Most of the digestion is accomplished in the primary digester (first stage) where the sludge is well mixed and gas production is rapid. Relatively stable sludge from the primary digester is transferred to the secondary digester (second stage) where digestion proceeds at a slow rate. After digestion, the sludge is pumped to a belt press for dewatering.