Wastewater Treatment - Down the Drain

Water that goes down the drain, called waste water, is not the most pleasant topic to discuss, but most students are very curious about this water that goes down their sinks, showers, and toilet drains. What happens to it after it leaves our homes and businesses?

Wastewater treatment plants today are seldom sources of point source pollution. Wastewater travels through many steps to be cleaned before it is discharged back into rivers. The **Wastewater Reclamation Authority (WRA)** in Des Moines is located in southeastern Des Moines. The facility covers an area along the Des Moines River that is about one mile long and over ½ mile wide. It receives water through sewer pipes from home, schools, and businesses throughout the Des Moines area. Some storm sewers located in older areas of Des Moines also lead to the WRA, but most storm sewers lead directly to our rivers. Each community in our region operates its own wastewater collection system, which then feeds into interceptor sewers that lead to WRA. Approximately 50 million gallons (mgd) of wastewater arrive at the treatment plant each day, with peak amounts rising to 100-200 mgd.

What happens to the wastewater once it arrives to WRA? Let's take a tour:

1. Pipes carrying water to WRA first arrive at the ***bar screen room***. Fork-like structures lift and separate larger pieces of debris that have entered the water through the sewer system, such as sticks, rags, leaves, diapers, coins, and other debris, and deposit them in large garbage bins to prevent damage to plant equipment. Lime is added to the garbage bins to kill bacteria and reduce odor. This solid waste is then trucked to the landfill.
2. Water then travels to two wet wells where ***six pumps*** pump the wastewater to a height of about 50 feet into an open channel flume. The water is pumped upwards to give it momentum for traveling by gravity through the remaining treatment processes.
3. Water enters an elevated ***open channel flume*** where water volume can be measured before it enters ***grit chambers***. In the grit chambers, water is aerated to create a rolling action that causes lighter materials to float and heavier materials, like sand and gravel, to sink to the bottom so they can be removed.
4. Wastewater moves on to the next step, the ***primary clarifiers***. Six elevated, circular 130-foot diameter primary clarifiers. Suspended solids settle by gravity and oil and scum that has risen to the top is skimmed off by rotating skimmers. The settled solids (***sludge***) are scraped from the bottom by a rotating collector arm and sent to the sludge processing tanks (***digesters)*** for further treatment (and to be recycled).
5. Water is sent from the primary clarifiers to the other side of the plant for ***secondary treatment*** in the ***aerators.*** Just like in the human body, air, water and food are necessary for processing waste***.*** ***Microorganisms*** contained in the activated sludge will use the organic matter present for their food and change the ammonia-nitrogen into less harmful nitrate-nitrogen. These microorganisms need plenty of oxygen to live, so oxygen is dissolved in the water through hundreds of diffusers in the bottom of the

tanks. The water winds through four channels (six sets, each holding 6.5 mg) before being sent to the next treatment step.

6. Many wastewater treatment plants use ***trickling filters*** in their secondary treatment. The WRA also has trickling filters that are sometimes used before wastewater is sent to the aerators. In these large, circular structures, bacteria live on the rocks where they feed on organic materials in the water. Water sinks down through the rocks and moves on to aeration and/or the final clarifiers.
7. Also a part of secondary treatment, are the ***final clarifiers.*** Water enters the 12 cylindrical clarifiers where the microorganisms, along with the organic material they have ingested, can clump together and settle to the bottom, taking most of the remaining suspended matter with them. Some of this settled material is returned to the aeration tanks to provide a continual supply of microorganisms for the aeration process, and some is removed as ***waste sludge*** and sent to anaerobic digestion to be recycled.
8. ***Disinfection*** is the last step in the wastewater treatment process. From April to November, ***chlorine*** is added to kill any remaining harmful bacteria before being discharged into the Des Moines River. The water that is discharged is cleaner than the river water it enters.
9. ***Sludge,*** the semi-solid waste material that settles and is collected from both the primary and secondary clarifiers during the treatment process is further processed in the ***sludge treatment process*** so it can be recycled. Sludge from the secondary clarifiers is put in ***centrifuges*** that spin the sludge to remove much of the water content. This thickened sludge is then combined with sludge from the primary clarifiers and pumped to the anaerobic digesters. The sludge remains in the digesters for 80 days where most disease-causing bacteria are killed. The millions of microorganism present in the six anaerobic digesters do not require free atmospheric oxygen for this process, but they feed on the organic material, the major component of sludge. One type of bacteria converts the organic matter to organic acids. Then, a second type of bacteria consumes the acids and converts them to methane and carbon dioxide gases. These gases are collected and used for energy or stored for later use. The remaining solid material is de-watered by belt filter presses.
10. Gases produced during the sludge digestion process are stored in a large sphere to provide power for large engines that produce electricity for running treatment plant operations. This saves the utility about $350,000 per year in energy costs.
11. Sludge produced during the sludge digestion process is sent on to further ***sludge treatment*** on ***belt filters.*** The sludge is spread on a fine screen where gravity can remove much of the water. A second belt sandwiches the sludge and transports it through a series of belts that travel around a series of rollers to squeeze out more water. This de-watered sludge, called ***sludge cakes*** or ***biosolids,*** travels along conveyor belts to be collected for later recycling. Much of this sludge is applied directly to farmland as a fertilizer. It can be stored onsite until farmers can utilize it.
12. The ***WRA laboratory*** continually monitors the plant's effectiveness at each step of the wastewater treatment process.