

Chapter Study Questions

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**Chapters 19 and 21 Study Questions****Chapter 19 - # 7**

**Describe the major steps in wastewater treatment (primary, secondary, advanced). Can natural ecosystems perform any of these functions? Which ones?**

Primary treatment is the first step in treatment. As sewage enters the treatment plant, it flows through a series of screens removing large floating organic matter. In the next step, the grit chamber, sand, small stones, and grit are removed. The primary sedimentation tank is the next step. Settling of particulate matter creates sludge at the bottom of the tank and sometimes chemicals are added. The sludge is moved, for additional treatment, into the “digester”. By volume, 30% - 40% of BOD (biochemical oxygen demand) is removed through the primary treatment, (Botkin and Keller, 2013).

Activated sludge is the most common treatment in secondary treatments. The sludge is moved from the sedimentation tank, in the primary treatment, to the aeration tank where air is pumped in along with some of the active sludge from the final sedimentation tank. It is active sludge because living organisms, mostly bacteria, are added in the aeration tank. That sludge is recycled continually into the aeration tank but most goes straight to the digester. Sludge from the primary and final sedimentation tanks are treated with anaerobic bacteria which is living organisms that can survive without oxygen. The sludge is further degraded through this process, (Botkin and Keller, 2013).

Methane is a by-product of the above mentioned process. It can be used as fuel for running machines in industry or heating and cooling of buildings. In some cases it is just burned off. To eliminate disease-causing organisms, chlorination is used to disinfect the wastewater run-off from the final sedimentation tank. It is then discharged into rivers, lakes, and/or oceans. Secondary

treatment removes 90% of the BOD's from the wastewater sewage that originally enters, (Botkin and Keller, 2013).

The "digester" sludge is dried out and put into landfills or used to improve soil. In some cases, heavy metals and other pollutants are still in the dried sludge. This sludge is still too polluted to use and is disposed of. Some industries are required to pre-treat the sewage before treatment to remove these pollutants, (Botkin and Keller, 2013).

Although the above steps get most of the pollutants out of the wastewater, there are still pollutants that are in it that go through an advanced step. Sand filters, carbon filters, and chemicals are used to assist in the removal of these additional pollutants which could be phosphates, nitrates, organic chemicals, and heavy metals. This water is then discharged into surface water that is used for irrigation. Advanced treatments are used when treated<sup>1</sup> discharge might cause damage to the natural environments that they are let into. This is eutrophication and added treatments are used to remove these nutrients, (Botkin and Keller, 2013).

## Chapter 19 - # 9

**How does water that drains from coal mines become contaminated with sulfuric acid? Why is this an important environmental problem?**

Not only coal mines, but also copper, lead, and zinc mines as well, are known to have water high in sulfuric acid. Pyrite, otherwise known as "Fool's Gold", is associated with mostly coal mines but the others as well. When it comes into contact with oxygen, it weathers. This is chemical weathering and creates sulfuric acid. The acid is produced when water runs in and out of the mines. These run-off acid waters flow into streams, ponds, and lakes. This is toxic to plants and aquatic life. It can also seep into ground water. Thousands of kilometers of streams and waterways

### 1. Although the above steps get most...

No information on natural sources of wastewater treatment ability. [Brian Maybruck]

have been damaged. Even mines that are unused still create additional toxins for the environment, (Botkin and Keller, 2013).

### Chapter 19 - # 10

#### What is eutrophication, and why is it an ecosystem effect?

Eutrophication is the process by which a body of water develops a high concentration of nutrients, such as nitrogen and phosphorus (in the form of nitrates and phosphates). This condition allows algae to grow blankets of itself on the surface of the water blocking any sunlight from reaching the underwater plant life. When this happens the vegetation under the surface dies. The oxygen content is reduced through the increased BOD's to the point that organisms such as fish can die. It is not the phosphates that kill them but the interaction of different species in the environment and effects of the species on chemical developments in their environment and the environmental conditions, (Botkin and Keller, 2013).<sup>1</sup>

### Chapter 21 - # 2

#### What are the differences between primary and secondary pollutants?

Primary pollutants arise from a source. Secondary pollutants are the product of chemical reactions that take place within waters. Primary pollutants also have a mass generally. Secondary pollutants will need a series of steps to be removed and treated. Chemicals can be added to create addition chemical reactions that can remove them. Screens will not remove secondary pollutant as they will for primary pollutants.<sup>2</sup>

### Chapter 21 - # 8

**Discuss the processes responsible for stratospheric ozone depletion. Which are more significant? Where? Why?**

#### 1. blankets of itself on the surface...

Good work!!! [Brian Maybruck]

#### 2. Primary pollutants arise from a...

Thank you for the thoughts but a little more detail is needed about primary and secondary pollutants. Primary pollutants are pollutants that come directly from a source that due to its quantity can negatively alter the health of the ecosystem. Secondary pollutants are those that are altered primary pollutants due to chemical reactions that the primary pollutants experiences [Brian Maybruck]

Stratospheric ozone depletion starts in the lower atmosphere. In the lower atmosphere ozone is a pollutant produced by photochemical reactions involving sunlight, nitrogen oxides, hydrocarbons, and diatomic oxygen (two oxygen atoms bonded together), (Botkin and Keller, 2013). In the stratosphere the ozone acts as a shield because it protects from most of the potentially hazardous ultraviolet radiation that enters Earth's atmosphere from the sun, (Botkin and Keller, 2013).

Ultraviolet radiation is divided into subdivisions that are labeled as UVA, UVB, and UVC. UVA has the least amount of energy of the three but can still be somewhat damaging to living cells. UVB is hazardous to living cells. Ozone is the only thing that is known to absorb UVB. Depletion of the ozone would allow these UVB waves of radiation to reach the surface which would be deadly for living things, (Botkin and Keller, 2013).

In the process of creating ozone, photodissociation takes place in which UVC in the stratosphere splits oxygen molecules (diatomic) into individual atoms. Those atoms can then react with other molecules to create ozone (triatomic). Natural conditions in the stratosphere allow for the creation and destruction of ozone with a dynamic balance. In contrast, all UVC's and most UVB's are absorbed in the stratosphere by ozone. CFC's have a long life cycle in the troposphere, but once they reach higher altitudes above most of the stratospheric ozone, it is destroyed. Once destroyed, it releases chlorine which is deadly to the ozone and increases ozone depletion, (Botkin and Keller, 2013).<sup>1</sup>

**1. absorbed in the stratosphere by...**

What alters the CFC reactant into chlorine? [Brian Maybruck]

### References

Botkin, D. B., & Keller, E. A., 2011, *Environmental science: Earth as a living planet* (8th ed.).  
New Jersey: John Wiley & Sons, Inc.