Worksheet 5.1: Water Treatment

ChemistrySheets

Specification: GCSE Chemistry (AQA 5.10.1.2 / Edexcel SC26)

Core Concepts: Potable water is safe to drink, but not chemically pure. Fresh water treatment involves sedimentation, filtration, and sterilisation. Waste water treatment involves screening, sedimentation, aerobic digestion of effluent, and anaerobic digestion of sludge.

Section A: Key Terms & Concepts

1. The diagram below shows a simplified process for treating fresh water to make it potable. Label the stages A, B, and C using the terms provided.

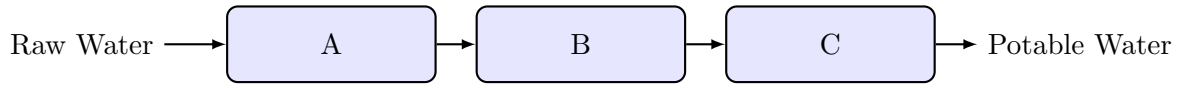

Figure 1: Potable Water Treatment Process

- **Terms:** Filtration, Sedimentation, Sterilisation
- A: **Sedimentation**
- B: **Filtration**
- C: **Sterilisation**

2. Complete the following sentences using appropriate scientific terms.

a) Potable water is water that is **safe to drink** and fit for human consumption.

b) The process of killing harmful microorganisms in water, often using chlorine or UV light, is called **sterilisation**.

c) Sludge produced during waste water treatment can be treated by **anaerobic digestion** to produce biogas, which can be used as a fuel.

Section B: Core Concepts & Explanations

1. What is meant by the term 'potable water'? Explain why potable water is not considered chemically pure.

Model Answer:
Potable water is water that is safe to drink and fit for human consumption. It is not chemically pure because it contains dissolved mineral salts and other substances, which are not harmful but mean it is not just H_2O.

2. Describe the three main stages involved in treating fresh water from rivers or lakes to make it potable.

Model Answer:
1. Sedimentation: Large insoluble particles are allowed to settle out at the bottom of tanks. 2. Filtration: Water is passed through beds of sand and gravel to remove smaller insoluble particles. 3. Sterilisation: Chlorine, ozone, or ultraviolet (UV) light is used to kill harmful microorganisms.

3. Explain why sterilisation is a crucial step in making water potable and name two common methods used for this process.

Model Answer:
Sterilisation is crucial to kill harmful bacteria, viruses, and other microorganisms (pathogens) that can cause diseases if consumed. Without this step, the water would not be safe to drink. Common methods include adding chlorine or using ultraviolet (UV) light.

4. Outline the initial physical processes used in waste water treatment before biological treatment begins.

Model Answer:
1. Screening: Waste water is passed through large screens to remove large insoluble solids such as plastic bags, rags, and grit. 2. Sedimentation: The screened waste water is then allowed to stand in large settlement tanks. Smaller insoluble solids (sludge) settle at the bottom, separating from the liquid effluent.

Section C: Exam Application & Extended Writing

1. A simplified flowchart for the treatment of waste water is shown below.

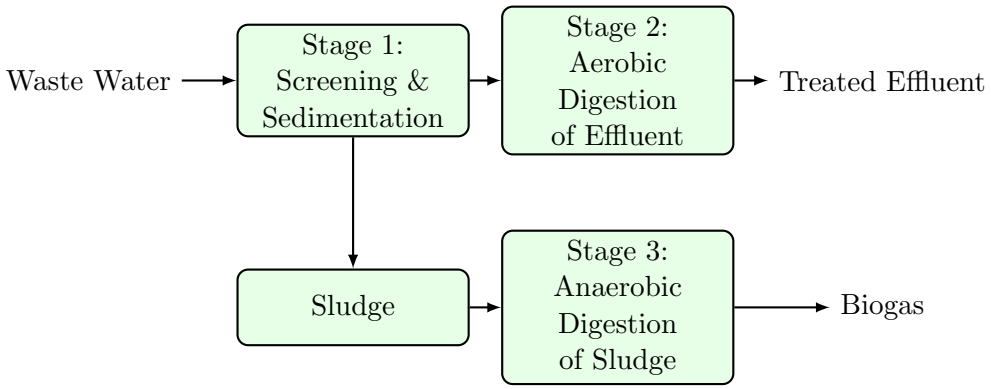

Figure 2: Waste Water Treatment Flowchart

Explain the purpose of Stage 2 and Stage 3 in the waste water treatment process.

Model Answer:
Stage 2 (Aerobic Digestion of Effluent): Microorganisms (bacteria) are used to break down dissolved organic matter and harmful microorganisms in the liquid effluent in the presence of oxygen. This purifies the water before it is discharged. Stage 3 (Anaerobic Digestion of Sludge): Sludge from sedimentation is broken down by microorganisms in the absence of oxygen. This process produces methane-rich biogas, which can be used as a fuel, and reduces the volume of sludge.

2. Compare and contrast the treatment of fresh water to make it potable with the treatment of waste water, explaining why different processes are needed. (6 marks)

Model Answer:
The treatment of fresh water to make it potable and the treatment of waste water have different starting materials and aims, leading to different processes. **Potable Water Treatment:**

- **Aim:** To make water safe for human consumption (drinking, cooking).
- **Starting material:** Relatively clean fresh water from rivers, lakes, or reservoirs.
- **Key processes:**
  i) Sedimentation: To remove large insoluble particles.
  ii) Filtration: To remove smaller insoluble particles.
  iii) Sterilisation: To kill harmful microorganisms (e.g., using chlorine, UV light).

Waste Water Treatment:

- **Aim:** To remove harmful substances from sewage and industrial waste before discharging it into rivers or the sea, preventing pollution.
- **Starting material:** Highly contaminated water containing organic matter, pathogens, and dissolved chemicals.
- **Key processes:**
  i) Screening: To remove large insoluble solids.
  ii) Sedimentation: To separate smaller insoluble solids (sludge) from liquid effluent.
  iii) Aerobic digestion: Microorganisms break down organic matter in the effluent (with oxygen).
  iv) Anaerobic digestion: Sludge is treated by microorganisms (without oxygen) to produce biogas.

Differences: Waste water is far more contaminated, requiring more extensive physical (screening) and biological (aerobic/anaerobic digestion) treatment to break down organic matter and pathogens. Potable water treatment focuses on removing suspended solids and sterilising already relatively clean water. Waste water treatment also produces valuable by-products like biogas from sludge.