

# Pollution lab 3

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# Biological Oxygen Demand (Winkler method)

# Background Information



- ▶ Microorganisms such as bacteria are responsible for decomposing organic waste. When organic matter such as dead plants, leaves, grass clippings, sewage, or even food waste is present in a water supply, the bacteria will begin the process of breaking down this waste. When this happens, much of the available dissolved oxygen is consumed by aerobic bacteria, robbing other aquatic organisms of the oxygen they need to live.

# Background Information

- ▶ Biological Oxygen Demand (BOD) is a measure of the oxygen used by microorganisms to decompose this waste. If there is a large quantity of organic waste in the water supply, there will also be a lot of bacteria present working to decompose this waste. In this case, the demand for oxygen will be high due to all the bacteria) so the BOD level will be high. As the waste is consumed or dispersed through the water, BOD levels will begin to decline.



# Background Information

<b><u>BOD Level</u></b> <i>(in ppm)</i>	<b><u>Water Quality</u></b>
<b>1 - 2</b>	<b>Very Good</b> There will not be much organic waste present in the water supply.
<b>3 - 5</b>	<b>Fair: Moderately Clean</b>
<b>6 - 9</b>	<b>Poor: Somewhat Polluted</b> Usually indicates organic matter is present and bacteria are decomposing this waste.
<b>100 or greater</b>	<b>Very Poor: Very Polluted</b> Contains organic waste.

# Background Information

- ▶ **Nitrates and phosphates** in a Body of water can contribute to high BOD levels. Nitrates and phosphates are plant nutrients and can cause plant life and algae to grow quickly. When plants grow quickly, they also die quickly. This contributes to the organic waste in the water, which is then decomposed by bacteria. This results in a high BOD level.

# Background Information

- ▶ **The temperature** of the water can also contribute to high BOD levels. For example, warmer water usually will have a higher BOD level than colder water. As water temperature increases, the rate of photosynthesis by algae and other plant life in the water also increases. When this happens, plants grow faster and also die faster. When the plants die, they fall to the bottom where they are decomposed by bacteria. The bacteria require oxygen for this process so the BOD is high at this location. Therefore, increased water temperatures will speed up bacterial decomposition and result in higher BOD levels.



# Background Information

- ▶ When BOD levels are high, dissolved oxygen (DO) levels decrease because the oxygen that is available in the water is being consumed by the bacteria. Since less dissolved oxygen is available in the water, fish and other aquatic organisms may not survive.



# Test Procedure

- ▶ The BOD test takes 5 days to complete. The BOD level is determined by comparing the DO level of a water sample taken immediately with the DO level of a water sample that has been incubated in a dark location for 5 days. The difference between the two DO levels represents the amount of oxygen required for the decomposition of any organic material in the sample and is a good approximation of the BOD level.

# Test Procedure

- ▶ **1.** Take 2 samples of water
- ▶ **2.** Record the DO level (ppm) of one immediately using the method described in the dissolved oxygen test in the laboratory.
- ▶ **3.** Place the second water sample in an incubator in complete darkness at 20 for 5 days. If you don't have an incubator, wrap the water sample bottle in aluminum foil or black electrical tape and store in a dark place at room temperature (20 °C or 68 °F).

# Test Procedure

- ▶ **4.** After 5 days, take another dissolved oxygen reading (ppm) using the method described in the dissolved oxygen test in the last laboratory
- ▶ **5.** Subtract the Day 5 reading from the Day 1 reading to determine the BOD level. Record your final BOD result in ppm.

# NOTE

Generally, when BOD levels are high, there is a decline in DO levels. This is because the demand for oxygen by the bacteria is high and they are taking that oxygen from the oxygen dissolved in the water. If there is no organic waste present in the water, there won't be as many bacteria present to decompose it and thus the BOD will tend to be lower and the DO level will tend to be higher.

- ▶ BOD test is most common test that used to determine the degree of pollution in sewage water, waste water from factories that have organic compound, and waste water.