DISSOLVED OXYGEN OF THE WATER DISCHARGED INTO BANATE BAY FROM THE THREE MAJOR RIVERS GUINTAS, TINORIAN, AND TALOKGANGAN

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by

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APPROVAL SHEET

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"DISSOLVED OXYGEN OF THE WATER DISCHARGED INTO BANATE BAY FROM THREE MAJOR RIVERS, GUINTAS, TINORIAN, AND TALOKGANGAN"

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Dissolved Oxygen of the Water Discharged into Banate Bay from the Three Major Rivers Guintas, Tinorian, and Talokgangan

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ABSTRACT

Dissolved oxygen is one of the chemical parameters that describe water quality. This study aimed to determine the concentrations of dissolved oxygen of the water discharged of the three major rivers of Banate Bay namely, Guintas, Tinorian, and Talokgangan during the months of May to November 2011. Sampling was done every 14 days during the transition of high and low tides. Winkler Method was used in determining the DO concentrations wherein the fixing was done on-site and the titration part of the method was conducted in Philippine Science High School – Western Visayas Campus laboratory. Results show that the DO ranges from 1.3 to 6.17 mg/L with a mean of 3.40 mg/L. These concentrations were lower compared to the range of the bay which is from 5.8 mg/L to 6.5 mg/L and to the standards set by the DENR which has its minimum at 5 mg/L.

Keywords: *dissolved oxygen, rivers, water quality, bay*

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CHAPTER 1

INTRODUCTION

A. Background of the Study

Banate Bay is a common fishing ground of the municipalities of Anilao, Banate, Barotac Nuevo, and Barotac Viejo, all in the province of Iloilo, Philippines. It has been recognized as one of the richest fishing grounds in Panay Island (Larroza 2009). Because of the needs of human beings answered by the bay, its water quality is frequently measured by the Banate – Barotac Bay Resource Management Council Incorporated.

There are 3 factors that influence the status of Banate Bay's water quality: depth, current and estuary. Banate Bay has 8 river estuaries, 3 of which have big river mouths (Coastal Environment and Resources Utilization Survey Report 2008). Estuaries are bodies of water that join freshwater with salt water. There is a difference between the salinity of these waters, thus the area contains less marine animals. The difference in salinity caused by the water discharge from the rivers and streams can also affect the water quality of the bay itself.

Water quality is defining the bacteriological, chemical, physical and radiological characteristics of water (DENR 1993). The chemical parameters of water quality include dissolved oxygen concentrations. By evaluating this parameter in selected areas of the bay, one may be able to determine the condition of Banate Bay during a certain period of the year.

The purpose of this study was to evaluate the dissolved oxygen concentrations of Banate Bay with regards to three selected estuaries during the rainy season, namely: Guintas, Tinorian, and Talokgangan.

B. Statement of the Problem

This study aimed to determine the dissolved oxygen concentrations of the water discharged into Banate Bay from the three rivers Guintas, Tinorian, and Talokgangan.

C. Objective

This study aimed to determine the dissolved oxygen concentrations (mg/L) of the water samples taken from Guintas, Tinorian, and Talokgangan.

D. Significance of the Study

The Banate – Barotac Bay Resource Management Council, Inc. (BBBRMCI) evaluates the water quality of Banate Bay. Unfortunately, they only have information regarding two out of three factors that affect the water quality (which includes the dissolved oxygen) of the bay. The council does not have information regarding the water quality of the river estuaries that discharge water into the bay. These river estuaries are also used for domestic purposes by households near the rivers. That is why we evaluated the dissolved oxygen concentration of selected river estuaries from the months of May to November, the rainy season.

E. Scope and Delimitation

This study was conducted in Banate Bay, Iloilo from the month of May 2011 to the month of November 2011 at the mouth or near the mouth of the rivers Guintas, Tinorian, and Talokgangan.

This study only covered the evaluation of the dissolved oxygen concentrations of water quality. The evaluation of nitrogen or the nitrate content and the phosphorus content as part of the chemical parameters of water quality was not included in the study.

F. Definition of Terms

Bays - recesses or inlets in the shore of a sea or lake between two caps or headlands, not as large as a gulf but larger than a cove (http://www.sciencedictionary.com/).

In this study, the bay refers to Banate Bay which is our study site for water analysis.

Rivers - wide, natural streams of fresh water flowing into an ocean or a large body of water and is usually fed by smaller streams called tributaries (http://science.yourdictionary.com/).

In this study, rivers refer to the river estuaries contributing water into Banate Bay which are Guintas, Tinorian, and Talokgangan.

Dissolved Oxygen – concentrations result from the (1) diffusion of oxygen from the surrounding air, (2) the photosynthetic activity of algae and submerged plants, and (3) the respiratory activities of organisms in open water and benthos (http://www.projectsearch.org/).

In this study, dissolved oxygen refers to the amount of oxygen present in the rivers as measured per sample.

CHAPTER 2

REVIEW OF RELATED LITERATURE

This chapter covers Dissolved Oxygen, Factors Affecting Dissolved Oxygen, Winkler Method, Safety and Precautions, Banate Bay, Water Quality Guidelines and General Effluent Standards, and Related Studies.

A. Dissolved Oxygen

In a dissolved body, oxygen is available in a dissolved state. It is found in microscopic bubbles mixed in between water molecules. It can enter the system through direct diffusion and as a by-product of photosynthesis. This means that the level of dissolved oxygen in the water can be increased through mechanical aeration e.g., paddle wheels, airlift pumps, air diffusioners, liquid oxygen injection. It can also be by considerable wind and wave action, and presence of aquatic plants and algae. It can be removed through respiration and decomposition (Philminaq).

B. Factors Affecting Dissolved Oxygen

Besides mechanical aeration and the presence of aquatic plants and algae, other factors such as temperature, altitude, and salinity.

B.1. Temperature

Warmer water promotes higher metabolism and respiration rates for aquatic organisms. However, it is with colder temperatures that water holds more oxygen. With this, water

temperature indirectly influences the dissolved oxygen concentration of a body of water (Addy and Green, 1999).

B.2. Altitude

Higher altitudes reduce oxygen pressure. This causes solubility of oxygen to reduce with every increase in altitude. Low atmospheric pressure in areas with high altitudes may also be the cause of a water body's low dissolved oxygen concentration (Jenway).

B.3. Salinity

Salinity is defined as the amount of salt in a body of water. It greatly affects oxygen solubility in estuaries, rivers, marshes, and water bodies in agricultural areas. Salinity, in great amounts, reduces the amount of oxygen that can be dissolved in water (Addy and Green, 1999).

C. Winkler Method

There are two ways to measure the dissolved oxygen concentrations in water. These are the Electrode Method and the Winkler Method. Winkler Method involves fixing and titration of the sample water. A sample bottle is filled with water up to the brim; no air is left to make sure not to skew the results. The dissolved oxygen in the sample water is then evaluated by adding a series of reagents that is then titrated using a neutralizing compound. The result is indicated by a color change in water (http://serc.carleton.edu/microbelife/research_methods/environ_sampling/).

D. Safety and Precautions

Dissolved oxygen test kit was stored in a cool, dry area. Instructions and precautions were noted before test procedure was performed. The labels on all reagent bottles were read and warnings and first aid information were noted. Direct contact to the skin, eyes, nose, and mouth

with the chemicals were avoided. Safety glasses were worn during the testing of the samples (Incitec Pivot Limited, 2005).

E. Banate Bay

Banate Bay is located in the southeastern part of Panay Island. Its coastline sweeps away from Barotac Nuevo to Barotac Viejo (Coastal Environment and Resources Utilization Survey Report 2008). It covers an area of approximately 15,000 hectares, a coastline of about 28 km., and stretches for about 15 km. from the shore (Endo 2008). It is well known as one of the most productive fishing grounds in the Philippines, most especially in the island of Panay (Larroza 2009).

Banate Bay has 14 main river estuaries. However, this study will be conducted in its three major rivers. These rivers are Guintas of Barotac Nuevo, Tinorian of Anilao, and Talokgangan of Banate and are marked in purple as seen in Figure 1.

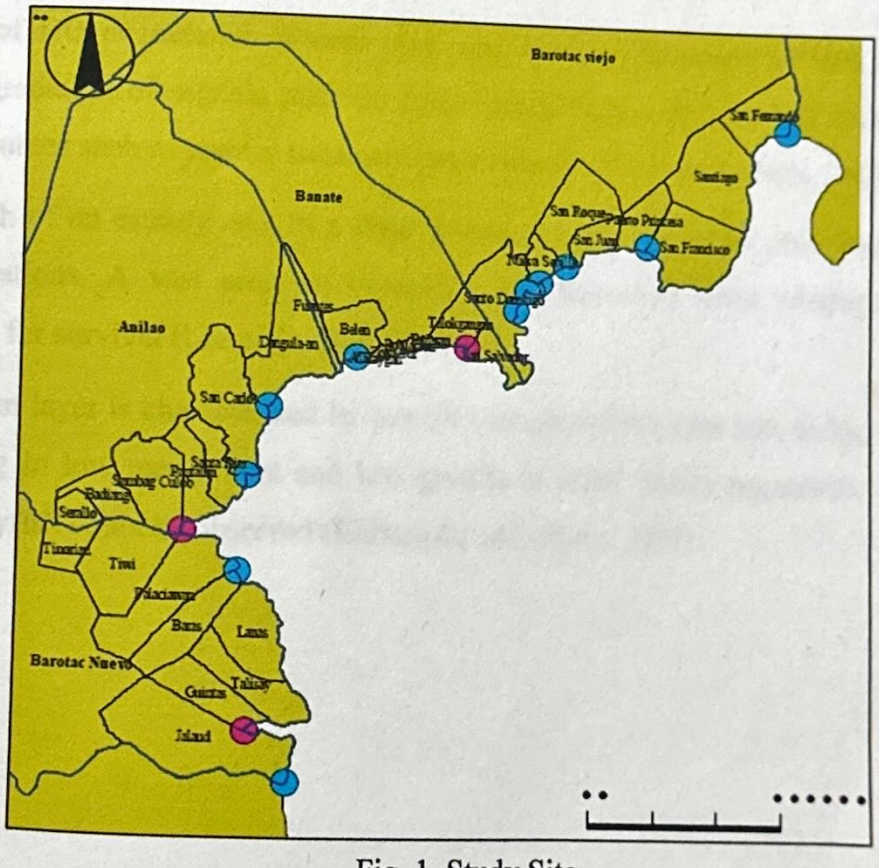

Fig. 1. Study Site

F. Chemical Parameters Criteria under Class C for Fresh Waters (DENR Administrative Order 2009 - XXXIV)

Chemical Parameters	Unit	Standards
Dissolved Oxygen (minimum)	% satn	60.0
	mg/L	5.0
Nitrate as Nitrogen	mg/L	10.0
Phosphate as Phosphorus	mg/L	0.4

Table 1. DENR Standards under Class C for Dissolved Oxygen

G. Related Studies

There were several studies conducted concerning the measurement of the water quality of bays.

Sources of DO degradation include plant and animal respiration as well as bacterial processes of degradation of organic material from natural inputs such as leaf litter and from anthropogenic sources such as sewage treatment plant effluents (Cain and others, 2007).

The health of an estuary can, to a large degree, be determined by observing dissolved oxygen concentrations. A vast array of organisms are dependent upon adequate levels of dissolved oxygen for survival (Lee and others, 1997).

The bottom layer is characterized by low DO concentrations that turn to hypoxia during summer, resulting in low recruitment and low growth of other sessile organisms. Also, mass occurrence of jellyfish could be observed (Kobayashi and others, 2007).

CHAPTER 3

METHODOLOGY

A. Overview of the Study

This study was conducted to evaluate the dissolved oxygen content of the water discharged into Banate Bay. This was conducted in the chosen sampling sites within the months of May 2011 to November 2011. Sampling was conducted twice a month, during the hours between low tide and high tide, in the rivers Guintas, Tinorian, and Talokgangan.

B. Materials and Equipment

In this study, a Dissolved Oxygen Kit 5860 by Lamotte was used. Reagents under this kit are as follows:

- Manganese sulphate
- Alkali-iodide-azide
- Concentrate sulfuric acid
- Starch solution
- Sodium thiosulfate

Other materials such as gloves, goggles, and masks are used to abide with the laboratory safety rules and regulations.

C. Proper Analytical Techniques

Test tube caps or stoppers were used and fingers were not used to cover the tubes during shaking or mixing. Dropper bottles were held vertically upside down, and not at an angle, when a reagent was dispensed. Spills were immediately wiped up. Test tubes were rinsed thoroughly before and after each test. Containers were tightly closed after use and caps were not interchanged from respective containers. Prolonged exposure of equipment and reagents to direct sunlight was avoided (Incitec Pivot Limited, 2005).

D. Collection of Samples

Water samples were collected with every analysis done. Clean 60-mL glass Biological Oxygen Demand bottles were prepared and were rinsed four times prior to sampling. Rinse water was not disposed of so that it will not contaminate the water sample. Each sample bottle was submerged into the river until it was filled up to the brim. Afterwards, each was capped while being submerged in water. Each sample was made sure to not have any space left. This was manifested by the presence of bubbles in the samples. Samples with bubbles were disposed and the collection process was repeated with an unlimited number of times until proper sampling was achieved (Incitec Pivot Limited, 2005).

E. Winkler Method

E.1. Fixing the sample

The cap was removed from the bottle. Immediately, 8 drops of manganese sulphate solution and 8 drops of alkali-iodide-azide were added to the sample. The bottle was capped and mixed by inverting several times. A precipitate was formed and was allowed to settle below the

shoulder. 8 drops of sulphuric acid solution was added afterwards. The bottle was capped and mixed, making the precipitate disappear and the solution to turn orange from clear yellow.

E.2. Titration process

The titration tube was filled with the fixed sample up to the 20 ml line. 8 drops of starch solution were added, making it turn into dark blue. The titrator was inserted into the plug of sodium thiosulfate solution. The bottle was inverted slowly and the plunger was withdrawn until the bottom of the plunger is opposite the zero mark on the scale. However, it was made sure that air bubbles were not present. The bottle was, then, turned upright and the plunger was removed. The titrator was inserted into the opening of the titration tube cap and was slowly depressed to dispense the titrating solution. The titration tube was swirled gently while titrating to mix the reagent and the solution until the fixed solution turns colorless. After it has turned colorless, the titrator was removed. The result was recorded where the bottom of the plunger meets the scale.

F. Waste Disposal

A poison bottle in the form of an empty 5-gallon plastic bottle was used to dispose of the water sample – titrated or not – after being used. Excess sodium thiosulfate solution, on the other hand, wasn't disposed and was, instead, dispensed back into its original container. The gloves and other materials, such as tissues, were disposed in the proper trash cans.

CHAPTER 4

RESULTS AND DISCUSSION

This study aimed to assess the dissolved oxygen concentrations of the water discharged into Banate Bay from the three rivers Guintas, Tinorian, and Talokgangan during the months of May to November 2011. Sampling was conducted every 14 days during the transition of high and low tides and on specific locations in the rivers determined using the GPS.

A dissolved oxygen test kit that uses Azide modification of the Wrinkler Method was used to determine the dissolved oxygen concentrations. Samples were collected and fixed on-site while titration was conducted in the PSHS-WVC laboratory.

A. Results

The dissolved oxygen concentrations generally declined until October. The highest concentration was of the sample from Guintas with a concentration of 6.17 mg/L during the 13th sampling while the lowest concentration was of the sample from Tinorian with a value of 1.3 mg/L during the 8th sampling. The dissolved oxygen concentrations recorded are generally lower compared to those of the bay which ranges from 5.8 mg/L to 6.5 mg/L. These concentrations are also lower than the standards given by DENR which has a minimum starting at 5 mg/L.

The concentrations were graphed in a line curve. By far, Tinorian has the lowest mean while Guintas has the highest. The graph doesn't necessarily follow a specific path or curve however, it has shown that only two concentrations were able to be included above the standard range of dissolved oxygen concentrations.

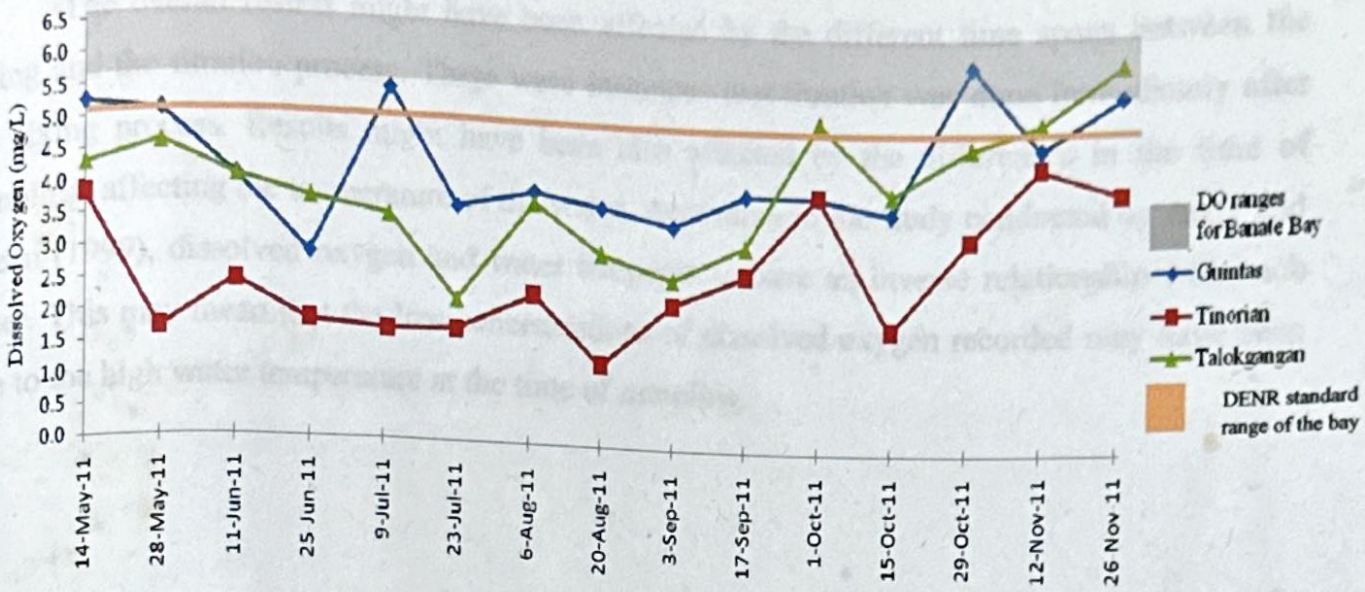

Fig. 2. Dissolved Oxygen of the Water Discharged from the three rivers

B. Discussion

The dissolved oxygen concentrations of the water discharged from the three river estuaries were generally lower. Based on the DENR standard for DO under class C, the rivers are less suitable for fishery and recreation (boating etc.).

By far, Guintas has the highest DO concentrations among the three sampling sites. The recorded temperatures for this site were generally low and according to Wu and others (2009), water temperature and DO have an inverse relationship making warm water become easily saturated with oxygen and therefore can hold less DO. Guintas also has the highest DO concentrations due to its large river width, faster flow rate, and abundance of mangroves, factors that can greatly increase the dissolved oxygen in the water.

Tinorian, on the other hand, has even lower temperatures than Guintas. Despite this, the river still has low DO concentrations. According to Kennedy and Breisch, a study by Haven and others (1978) remarked that oxygen-poor water may be an important factor in oyster larvae mortality in Rappahannock River in Virginia, U.S.A. This may be the reason why DO is low in the area due to the presence and abundance of oysters.

The overall results might have been affected by the different time spans between the fixing and the titration process. There were instances that titration was done immediately after the fixing process. Results might have been also affected by the differences in the time of sampling, affecting the temperature of the water. According to the study conducted by Addy and Green (1999), dissolved oxygen and water temperature have an inverse relationship with each other. This may mean that the low concentrations of dissolved oxygen recorded may have been due to the high water temperature at the time of sampling.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study determined the dissolved oxygen concentrations (mg/L) of the water samples taken from the three major rivers of Banate Bay namely Guintas, Tinorian, and Talokgangan.

A. Summary

The dissolved oxygen concentrations range from 1.3 to 6.17 mg/L with a mean of 3.40 mg/L.

B. Conclusions

The dissolved oxygen concentrations are relatively low compared to the standard dissolved oxygen range of values given for Banate Bay as well as 1the dissolved oxygen range given by the Department of Environmental and Natural Resources (DENR).

Recommendations:

The researchers recommend that:

- All river estuaries that discharge water into the bay be included in future studies;

- Gathering of samples from the rivers be conducted simultaneously;
- Future studies about the bay or its river estuaries be conducted for longer periods of time and shorter interval between sampling dates;
- Future researchers include other water quality properties (color, odor) in the study;
- Future researchers explore the effect of aquatic organisms on the water quality of the rivers or bay;
- Future researchers evaluate the water quality of upstream water;
- Future studies be conducted during the dry season or summer.

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APPENDIX A

RAW DATA

Location	Trial	May 14	May 28	Jun 11	Jun 25	Jul 9	Jul 23	Aug 6	Aug 20	Sep 3	Sep 17	Oct 1	Oct 15	Oct 29	Nov 12	Nov 26
Guintas (mg/L)	1	-	5.30	4.00	3.10	4.80	3.90	4.00	3.80	3.70	4.00	4.20	4.20	5.90	4.80	5.70
	2	5.00	5.20	4.10	2.80	5.80	3.60	4.00	3.80	3.40	4.20	4.00	4.00	6.20	4.80	5.60
	3	5.50	4.80	4.10	2.80	6.00	3.60	4.00	3.80	-	4.00	4.00	4.00	6.40	4.90	5.60
	AVE	5.25	5.10	4.07	2.90	5.53	3.70	4.00	3.80	3.55	4.07	4.07	4.07	6.17	4.83	5.63
Tinorian (mg/L)	1	4.00	1.65	2.40	2.00	1.80	1.80	2.30	1.10	2.30	2.80	4.20	1.90	3.20	4.60	4.00
	2	3.70	1.80	2.50	1.80	1.60	1.70	2.40	1.40	2.40	3.20	4.00	2.00	3.25	4.60	4.20
	3	3.80	1.60	2.40	1.70	1.80	1.70	2.40	1.40	2.20	2.40	4.10	2.00	2.80	4.40	4.10
	AVE	3.83	1.68	2.43	1.83	1.73	1.73	2.37	1.30	2.30	2.80	4.10	1.97	3.08	4.53	4.10
Talokgangan (mg/L)	1	4.00	4.20	4.00	3.60	3.50	2.40	3.70	3.20	2.70	3.20	5.40	3.90	5.00	5.20	6.20
	2	4.40	4.80	4.20	3.80	3.50	2.30	3.80	3.00	2.70	3.20	5.00	4.60	4.80	5.40	6.00
	3	4.50	4.80	4.00	3.90	3.60	2.20	4.00	3.00	2.70	3.40	5.40	3.90	4.80	5.10	6.20
	AVE	4.30	4.60	4.07	3.77	3.53	2.30	3.83	3.07	2.70	3.27	5.27	4.13	4.87	5.23	6.13

APPENDIX B

PLATES

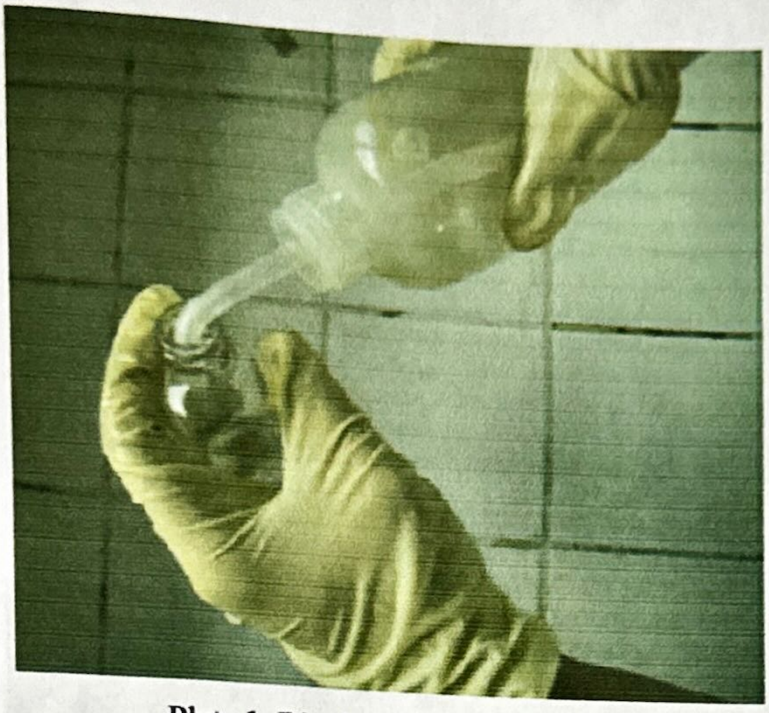

Plate 1. Rinsing Sampling Bottle

Plate 2. Water Sampling for Dissolved Oxygen

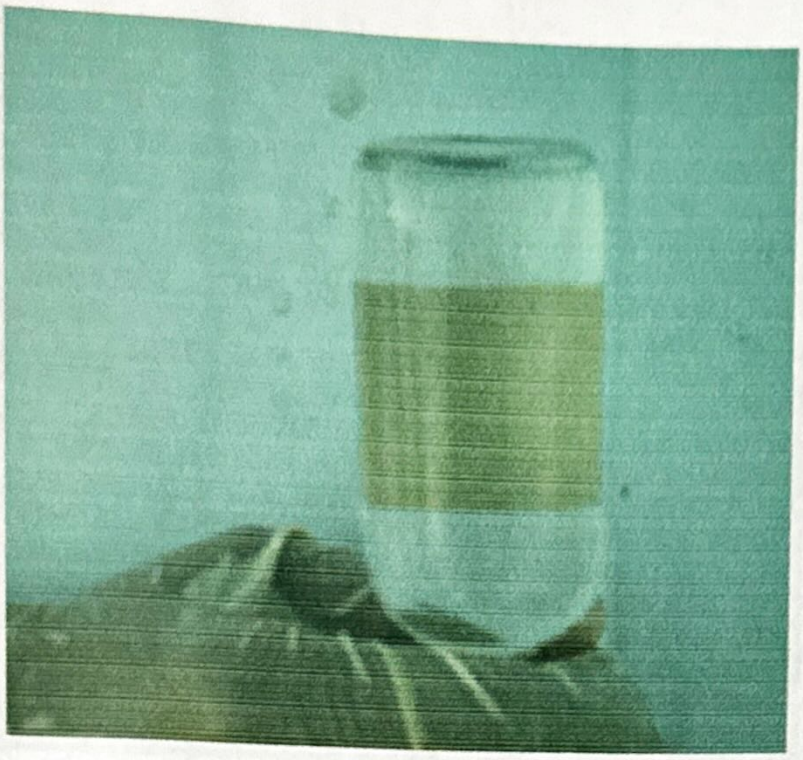

Plate 3. Checking for Air Bubbles

Plate 4. Fixing Sample

Plate 5. Titrating the Water Samples

Plate 6. Reading Dissolved Oxygen Concentration