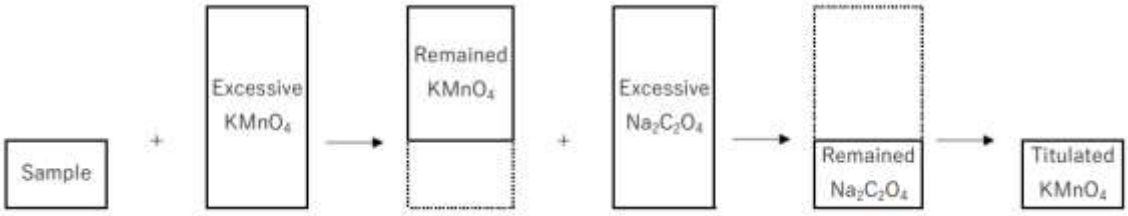
Determination of chemical oxygen demand (COD)

[Introduction]

Chemical oxygen demand (COD) is recognized as one of the most important parameters in assessing organic pollution in aquatic systems. The COD is defined as the amount of oxygen equivalent consumed in the oxidation of organic compounds by strong oxidants. Potassium permanganate is usually applied as an oxidizing reagent, and the COD determination is mostly achieved by titration method. The objective of this experiment is to measure the COD of pond water in Takada park and to learn the redox reaction.

[Principle]

1. The organic matter present in sample gets oxidized completely by potassium permanganate ($KMnO_4$) in the presence of sulphuric acid (H_2SO_4).
2. Remained oxidant is reduced completely by sodium oxalate ($H_2C_2O_4$).
3. Remained sodium oxalate($H_2C_2O_4$) is titrated by potassium permanganate ($KMnO_4$).
4. The amount of O_2 required to oxidize the sample is calculated by using the amount of potassium permanganate ($KMnO_4$).



[Apparatus]

Burette / Burette stand /100 mL conical flask / Whole pipettes / Pipette bulb (Safety pipette filler) / Mater glass

[Chemicals]

Potassium permanganate / Sulfuric acid / Silver nitrate / Sodium oxalate

[Procedure]

1. Take 50.0mL of the sample in conical flask.
2. Add 10 drops of silver nitrate to the conical flask.
3. Take 5.00mL of sulfuric acid in mater glass, and add it to the conical flask.
4. Take 10.0mL of 2.00×10^{-3}mol/L potassium permanganate in whole pipette, and add it to the conical flask.
5. Set the Bunsen burner. Take about 100mL of hot water to 300mL flask. Cover the top of the conical flask with aluminum foil. Put the conical flask into the 300mL flask. Heat the water to 80°C. React the

solution for 10 min.

6. Take out the conical flask form the 300mL flask. (Be careful. It is hot. Use tweezers)
7. Take 5.00×10^{-3}mol/L sodium oxalate in whole pipette, and add it to the conical flask.
8. Titrate the solution with 2.00×10^{-3}mol/L potassium permanganate. The time when the color of potassium permanganate is unchanged is the last point. Measure the amount of potassium permanganate solution used.
9. Repeat the procedure 1 to 8 to measure the accurate value. (We do not repeat today duo to time constrains)

[Results and calculation]

1. The amount of potassium permanganate using for the titration.

2. Calculate the COD(mg/L) of the sample.

[Problems]

1. Write the half reaction formula of permanganate ion (MnO_4^-)as oxidant.

2. Write the half reaction formula of oxygen (O_2) as oxidant.

3. Silver nitrate is added
   a) as oxidizing agent b) as reducing agent c) as redox agent d) to remove Cl^-

4. Sulphuric acid is added
   a) as it assists in oxidizing the nitrogen compounds b) to provide H^+
   c) to neutralize d) as catalyst

[Discussion on the sources of error and improvements, and write your thoughts on this experiment]