

Determining Water Quality by Measurement of Dissolved Oxygen

B.Sc. (Honours) in Environmental Science and Sustainable Technology



Department of Physical Sciences

Student Name: Jonathan Hickey

Supervisor: Eva Norris



Project Background

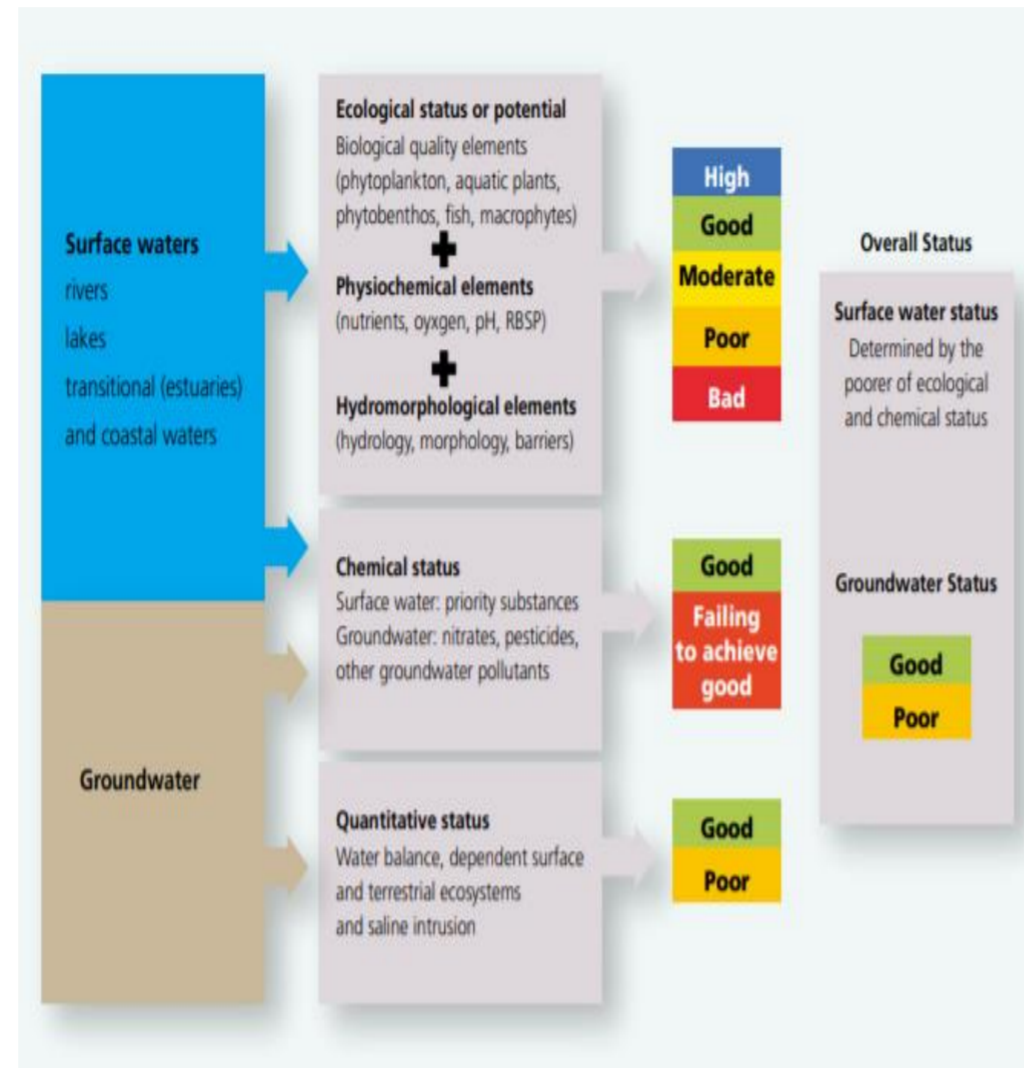
Water Quality

One of the world's most important resources is under threat from pollution. The quality and health of the earth's water is declining. Ecosystems and habitats are at risk as changes to the physical and chemical aspects of the water continue to take a toll on aquatic life.

There are many factors which determine the quality of water. The ecological status, chemical status, physiochemical elements and hydro-morphological elements will determine the overall status of the surface waters. While chemical and quantitative status determine groundwater quality.

The focus of this project was on a physiochemical element of oxygen.

Water Quality Assessment



(1)

Dissolved Oxygen (DO)

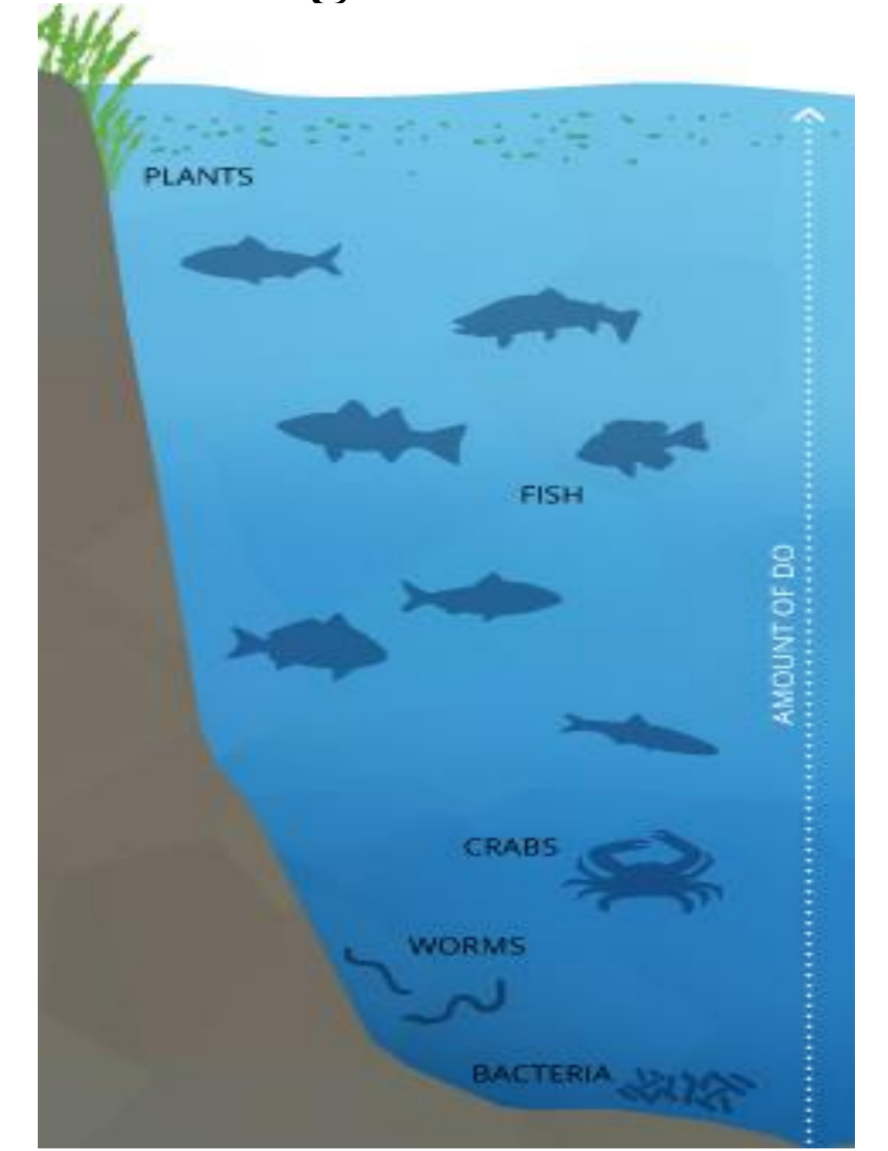
Required by aquatic creatures to survive, oxygen concentrations in water must be kept at safe levels. Flowing water bodies such as rivers are likely to have more dissolved oxygen present than standing water (i.e. lakes) as the turbulence of the water allows for a higher rate of interaction with the atmospheric oxygen.

Reductions in DO levels are caused by respirations of animals, BOD and COD.

DO can be replenished through aeration techniques, photosynthesis of underwater plants and diffusion from the atmosphere.

Temperature, pressure, salinity, and altitude also effect the DO concentrations in water.

Heading: Size 29 Font



(2)

Equipment, Detection and Testing

Probes

The dissolved oxygen concentrations were detected using DO probes through a process of fluorescence quenching.

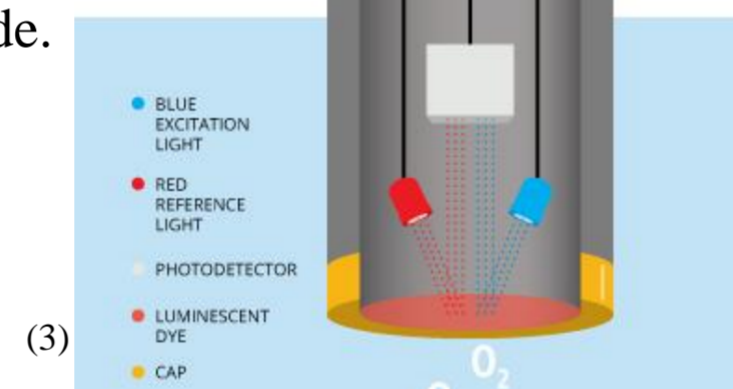
The Endress + Hauser probe combined with the Liquiline allowed for measurements of Partial Pressure, Saturation, Concentration, Raw values and Temperature.

The Vernier probe recorded values of either concentration or saturation.



Quenching Principle

Blue light emitted from a diode collides and transfers its energy to a luminophore/marker molecule. The Luminophore releases that energy as red light which is detected by a photodiode.



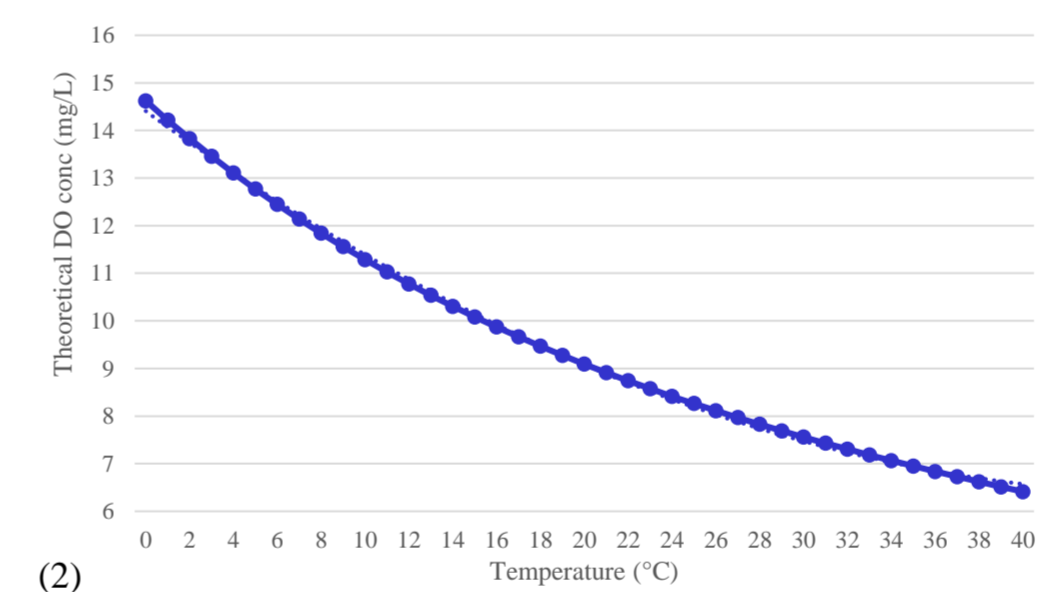
Energy is transferred to oxygen molecules when present. The raw value measured by the probes is time between the emitted blue and red light for the Vernier and the length and intensity of emitted light for the E+H probe.

(3)

Temperature

Temperature is inversely related to DO concentrations in water. The temperature of the water samples were influenced through refrigeration and gas flame heating methods.

The theoretical values available gave an indication of what to expect during experiment.



(2)

Aeration

The most effective way for oxygen to enter the water is through aeration. Either naturally, by introducing flowing water or turbulence and artificially through air pumps/diffuser.

A small puncture created in the underside of a bottle allowed for the introduction of flowing water.

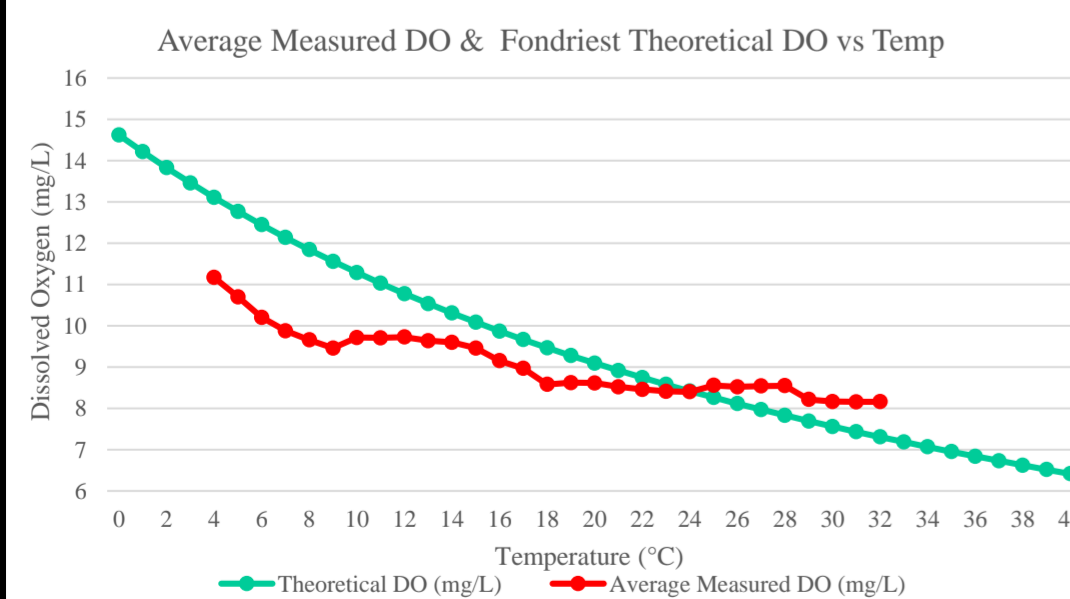


An aquarium diffuser shown above provided air bubbles to the water sample.

Results and Conclusion

Temperature

The graph below shows the average of all the DO concentrations values compared to the theoretical values.

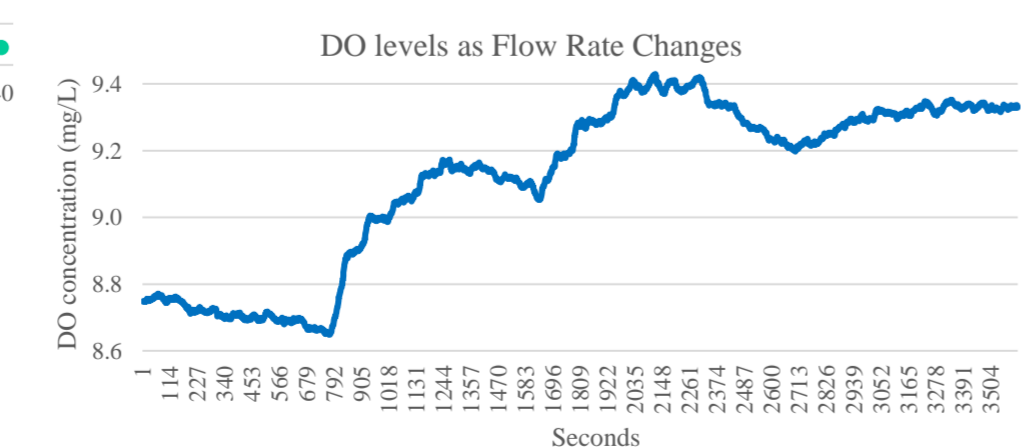


Natural temperature changes resulted in values following the theoretical trend, while catalyst influenced temperature changes were erratic.

Aeration

The air pump/diffuser method of aeration while intended to increase DO levels, showed reductions in concentration. This may have been due to air bubbles covering the sensors.

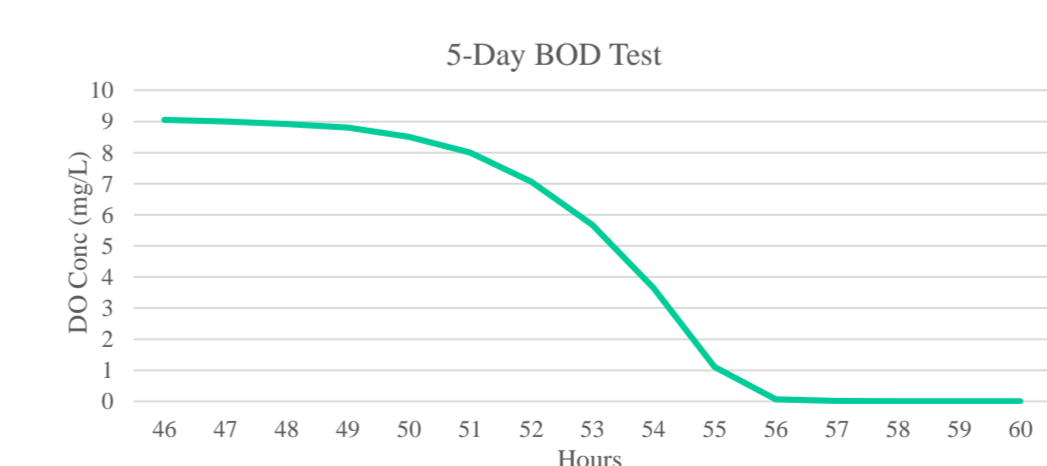
Water flow aeration successfully increased DO levels in water samples. Variations in flow rate were applied and showed consistent increases in DO concentrations.



BOD

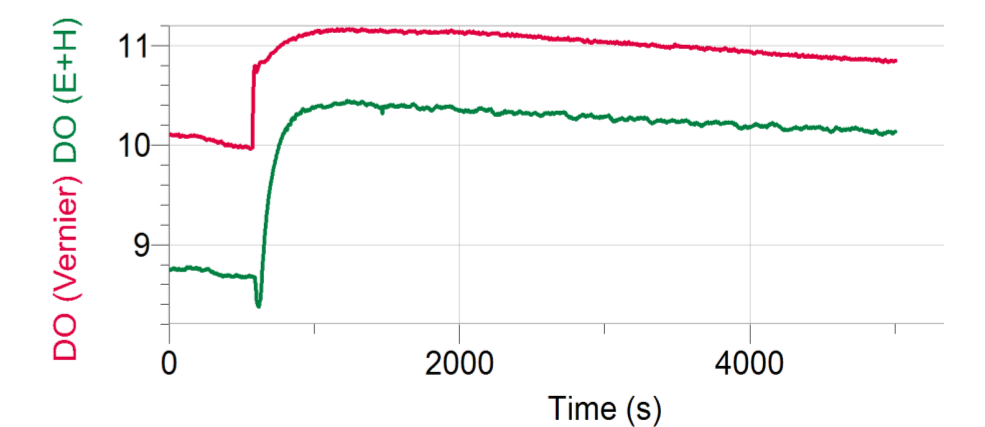
5 day BOD tests are conducted in wastewater treatment under strict conditions. No light must be present, STP, and in an airtight container.

An improvised version was conducted. Milk was added to water. Probe in situ. Film to make airtight. Container placed in cardboard box. Temp and Pressure regulation was not possible.



Conclusion

The measured DO concentration varied between the two probes. Vernier probe recorded consistently higher values than E+H probe.



DO significantly affected by pressure and temperature.

Flowing water very effective as an aeration method.

References

- 1). Water Quality in Ireland Report 2013-2018 ([https://www.epa.ie/pubs/reports/water/waterqua/Water%20Quality%20in%20Ireland%202013-2018%20\(web\).pdf](https://www.epa.ie/pubs/reports/water/waterqua/Water%20Quality%20in%20Ireland%202013-2018%20(web).pdf))
- 2). Fondriest Environmental Learning Centre – Dissolved Oxygen (<https://www.fondriest.com/environmental-measurements/parameters/water-quality/dissolved-oxygen/>)
- 3). Fondriest Environmental Learning Centre – Measuring Dissolved Oxygen (<https://www.fondriest.com/environmental-measurements/measurements/measuring-water-quality/dissolved-oxygen-sensors-and-methods/>)