Science Report for Moss excursion

Place: Molbekktjern, Moss **Date: 14th March 2019**

Map of the excursion:
https://drive.google.com/open?id=1Zmbwo4Tfj4_S_rNbUsCEHf0QyxgYvfY-&usp=sharing

Weather: -3°C to 3°C, cloudy throughout the day with 1m/s winds.

The aim of the fieldwork

The aim the day is to collect water samples in the field and then deliver them to the laboratory for further testing. This is to be done in collaboration with Rambøll and their environment monitoring project for the new Moss railway line. The objective for the water project is better understand how project work can be done with children, both as a class and in collaboration with other real world projects.

Background information

About the project "Railway".

The Norwegian Public Roads Administration are buliding a new 4-way highway from Bjørum in to Skaret. At the same time, good condition in the ecosystems must be maintained and no species or habitats eradicated.

A short version of what Rambøll is and what their role in the large railway project is

Rambøll is a global group of companies within Bygg & Arkitektur, Samferdsel & Byutvikling, Energi, Vann, Miljø & helse and management consulting. In Norway, they have 1 500 employees on 16 countries. On a global basis, they have a total of 15 000 employees, located in 35 countries.

Their goal is to work with clients to achieve scientifically defensible, risk-based solutions that support responsible and sustainable business, environmental and resource management practices.

They work in areas such as aquatic ecology, ecological risk assessment, natural resource consulting, nature restoration, rivers and wetlands, sediment management.

Ramboll Environment & health has surveyed: contaminated soil, habitats and environmentally hazardous substances in buildings. They have also created an environmental plan for follow-up of the development, and prepared the necessary applications for permits under the environmental regulations to implement the project.

The environmental authority has made the necessary demands. The developer has received the necessary permits and the foundation for avoiding fishing death in nearby river has been laid.

About the area of Molbekktjernet

The Molteich of Mosseskogen is a dammed pond in which ice for the ice cubes was produced in front of the cooling system.

It was the company M. Peterson & Søn that built the Molbekker swamp to an ice dam in 1875. They also built an ice ridge down to the sea, where the ice was stored in sawdust until it could be picked up by ship.

16 species of dragonflies live at the pond. There are also eels here.

About water, what water is and what important properties water have

Water (H2O) is a chemical compound of the elements oxygen (O) and hydrogen (H). As a liquid, water is transparent, largely colourless, odourless and tasteless. It occurs in two isomers (para- and ortho-water), which differ in the nuclear spin of the two hydrogen atoms. Water is the only chemical compound on earth that occurs in nature as a liquid, as a solid and as a gas. The term water is used for the liquid state of aggregation. In the solid state it is called ice, in the gaseous state it is called steam. It can also be classified into freshwater and saltwater (cf. Manuel C., Molles Jr. & Anna A. Sher, 2019). 97% of the earths water is salt and 3 % is fresh water.

Water is a powerful solvent, in a liquid state at most temperatures on Earth, highly stable, resistant to changes in temperature and resists change between states, less dense as a solid and buoyant and viscose (cf. Manuel C., Molles Jr. & Anna A. Sher, 2019)

It is very important for life, because it transports vital minerals and nutrients, our body consists 75% of water, it participates in photosyntesis, we would die without water, it's

important for the energy production and the industry and the core of the planet is regulated by oceans.

Water also has some important properties of water.

Universal solvent

It enables and simplifies chemical processes and makes it a good medium for vital molecular processes (cf. Manuel C., Molles Jr. & Anna A. Sher, 2019) For example salt solves in water.

Cohesion and Adhesion

Cohesion occurs, when water molecules stick to each other, and adhesion occurs when water molecules cling to other surfaces.

High surface tension

The water molecules at the water surface are more strongly attached to each other than the surface above. Water molecules cling tightly to each other.

High heat capacity

The chemical hydrogen bondings let water absorbe a great amount of heat without changing its chemical state.

Changes in density

The density of water is based on its temperature. Water expand when it freezes.

The water cycle

The oceans are the largest water reservoirs on earth, covering most of the earth's surface. Solar energy heats the water. Evaporation, especially at the sea surface, and to a minor extent on the mainland, creates humidity. The wind transports the humid air to the mainland. When the humid air meets cold layers of air, it pushes over them and rises (warm front), as well as when it meets mountain flanks or is heated over warm ground (convection). When the air rises, it cools down. However, cold air can absorb less water vapour than warmer air, so the water vapour contained in the air condenses at a certain height. This creates clouds. If the water drops become large enough, precipitation occurs and the water falls back to earth in the form of rain, snow or hail. The form of precipitation depends on the temperature. If the precipitation falls directly into the water, the cycle closes and can start again from the beginning. If the water falls to the ground, it seeps into the groundwater. It then drains into the oceans through groundwater streams or springs and rivers.

Methods used in the fieldwork

When it comes to this part of the report, it has been divided into two sections. The first section is the fieldwork, collection of samples and in field data collection. Then section two is where we deliver the samples to the laboratory, Eurofins. At the laboratory the samples will be processed and tested. The results from this laboratory are estimated to take a week before delivery. There is also one test, that will be sent to Sweden for analysis.

Section 1: Fieldwork

What methods were used sample collection from 3 points of reference (up-stream, mid-stream and down-stream). During the winter months, sample from the lake is taken from the shoreline, concretely at the stream because is the way they can obtain concurrent surface water. During the summer it is taken from the deepest point at the lake.

To do the fieldwork we divided the group into three small groups. Each group focused on analyzing water from three different stations (up-stream, mid-stream and down-stream). It is important to know how the characteristics studied differ from one part of the lake to another. The differences that these results show us are important to know in which state the water is and if it is contaminated or not.

One of the reasons why professionals focus on water to know if the area is contaminated or not is because it usually shows more homogeneous results than soil does. Another reason is the ease of collecting water, since it can be collected by pumps and sleeves.

Although it depends on the analysis made of the water, it is not recommended that the water collected exceeds 6 hours before it is analyzed, being a maximum of 24 hours.

To take the water samples we use a metal container, a plastic container, and a glass bottle. With a pH meter, we analyze the pH, the amount of dissolved particles, conductivity, salinity, and temperature of the water collected with the metal container. The next day in the university classroom we had the opportunity to look at the pH of the water we took from the sample the day before. We used litmus paper.

We also wanted to see if the stream water had heavy metals. To do this we took a small sample of water and mixed it with mercury. The main problem is that heavy metals are

dangerous because they tend to bioaccumulate. It means that heavy metals increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Then the metal compounds accumulate in living things any time they are taken up and stored faster than they are broken down (metabolized) or excreted. Because of that, Ramboll take the water samples and mix it with mercury and Eurofins analyse them. According to Eurofins, Arsenic and other heavy metals such as cadmium, lead, and mercury are all considered toxic and have adverse health effects in human metabolism.

Data results: Taken from collection point in the field.

Field collection results	**Sample 1 - Up stream**	**Sample 2 - Mid stream**	**Sample 3 - Down stream**
Temperature/ °C	**0.6**	**0.3**	**1.0**
Salinity	**0**	**0**	**0**
Conductivity/ µS/cm	**68.2**	**100 (? unsure about this result)**	**77.5**
pH/ppt	**?**	**?**	**6.3**
Suspended particles/ mg/L	**49.1**	**71.6**	**55.4**

pH/ppt	**6.7**	**6.9**	**6**
Smell			**None**
Colour			**White wine yellow**

*** Samples tested in the classroom, roughly 23 hours after collection**

Section 2: Delivery to the laboratory

Once the fieldwork has been done, the water samples are delivered to the Eurofins laboratory in Moss. In our case there are 3 plastic containers, 3 glass containers and one test tube

container. Before going into the process and testing methods used by the laboratory, we will provide some information about this facility.

Eurofins was established in 1987, currently has 650 laboratories in 45 different countries and performs 400 million tests per year. Within Norway, Eurofins only has food and environment divisions. They do not have pharmaceutical or clinical divisions. Most of their testing is about quality control, set by the Norwegian government and the EU directive, with collaboration with programs like the UN sustainable development GOALS.

Once the samples have arrived at the laboratory, they are processed into levels of testing urgency, and all relevant information is placed into the computer, before a barcode is created for all test tubes to be used. The relevant information includes, who owns that sample, temperature when collected, what tests are to be run, the parameters for the sample etc. It should also be noted that the water samples must be processed and tested within 24 hours in order to be accredited. Tests done after after 24 hour period cannot be accredited. Once the relevant information is done, it is then placed in a plastic container and placed on a conveyor belt to the inorganic laboratory.

Once it reaches the inorganic department, you will notice that everyone is using lab coats and gloves. This is to minimise cross-contamination. One type of common cross-contamination is Zinc. Zinc is found in many personal beauty products used daily, and if the sample requires a Zinc analysis, it is easy to cross-contaminate the sample, resulting in false results. From the larger sample collections bottles, the water samples are transferred using sterilised syringes into smaller test tubes for further testing. For every parameter to be tested there are 30 samples for analysis done. This allows for more accurate results, within the standard deviation. The smaller samples are them distributed to different technicians for testing. Within the samples distributed the technicians and machines will look for different levels of pollutants. One test that is found to differ from field measurements is the pH level. The results tend to vary roughly by 0.3ppt from field results. It is found that the laboratory results are more accurate than the field results, this can be due to the instruments used in the field and how they are calibrated.

The results will then be analysed for measurement uncertainty. This can also be seen as standard deviation. Meaning that there can be a slight variation in results, even from the same batch. But as long as they are with in the standard deviation or measurement uncertainty. The

results are to all intent and purpose the same. Once the tests are done, it is important that they are accredited.

Laboratory accreditation is a means of determining the technical competence of laboratories to perform specific types of testing, measurement and calibration. To maintain this recognition, laboratories are re-evaluated periodically by the accreditation body to ensure their continued compliance with requirements, and to check that their standard of operation is being maintained. Laboratory accreditation uses criteria and procedures specifically developed to determine technical competence, thus assuring customers that the test, calibration or measurement data supplied by the laboratory or inspection service are accurate and reliable.

The reason why it is important to check all the characteristics that we have been studying (pH, temperature etc.) before, during and after the Moss station was built is to see if the water has been contaminated, either with any of the materials used in the construction of this as well as by some gas, liquid...

- What are the 5 things we look for and why.

1. Temperature/ ºC: to see if it changes according to where we are, even if it is the same lake.
2. Salinity: the measuring device showed us the level of salt in the water, but since it is a lake (so it is fresh water), the level of salt was 0 at all three places.
3. Conductivity/ µS/cm: electrical conductivity reflects the ability of water to convey electrical current, and is directly related to the concentration of dissolved salts in water. This is why it was very curious that from one point to another there were such different measures.
4. pH/ppt: the pH shows the acidity or alkalinity, in this case of a liquid as it is the water, but it is in fact a measure of the activity of the potential of hydrogen ions (H +). Generally, water with a pH < 7 is considered acidic and the one with a pH > 7 is considered basic or alkaline. The normal pH range for surface water is 6.5 to 8.5 and for groundwater 6 - 8.5. It is for this reason that we can deduce that, after analyzing the pH of our sample and observing that it is around 6.3 we can say that it could be acidic and corrosive water.
5. Suspended particles/ mg/L: is the accumulation of tiny pieces of solids or droplets of liquids in the environmental atmosphere, produced from some anthropogenic (caused by "man") or natural activity.

3. Why are these samples required? -

The main objective of collecting water samples is to check that the water is not affected by the construction of the new Moss railway line. The analysis of the water is very important in order to obtain a diagnosis in case a problem arises.

As we have said, it is the chemical, physical, biological and radiological characteristics that determine whether it is suitable for a particular use and not for another. It is evident that it is not necessary for it to meet the same requirements, for example, water intended for human consumption as water intended for irrigation.

The most important source of its pollution is the lack of proper management and treatment of human, industrial and agricultural waste. Therefore, to avoid this, this company is responsible for establishing the necessary treatments and limits for different uses and activities, and thus ensure a good quality of life for all citizens and in turn for the environment.

The company is in charge of carrying out the samples before, after and during the construction with the aim of regulating the environment and avoiding possible problems with which they can be found.

What implications does this have on the environment

The construction sector is considered worldwide as one of the main sources of environmental pollution, as it produces enormous negative effects on the environment either directly or indirectly. the construction can generate gases which can affect the composition of air and water, the growth of plants and trees and also the specific conditions in which animals are found.

What implications does this have on the project

Water is a limited and essential resource for human beings, so it is necessary to be aware of it from an early age. As future teachers, it would be convenient to teach the children the care of water and its importance.

References

- Manuel C., Molles Jr. & Anna A. Sher (2019). Ecology. Concepts & Application. McGraw-Hill Education: New York.
- Myers M (2006). Collection of water samples. National Fiel Manual for the Collection of Water-Quality Data. EEUU