

Evaluation of TOC in Water Samples

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

Department of Physical Sciences

Seamus Doyle

Supervisor: Eamonn Butler



Comparing the performance of two instruments at measuring TOC

Introduction:

There are several different ways to measure TOC in a water sample. Each method relies on a different principle in order to attain a TOC value. The basis of this project is to analyse and compare two different TOC measuring instruments.

These devices are:

- The Hach Lange DR3900 Spectrophotometer
- Endress and Hauser Viomax CAS51D.

Hach Lange DR3900 and LCK385 Test Kit:

Instrument Type: UV Spectrophotometer
Wavelength range: 320nm-1100nm
Measurement Method: A sample is mixed with a digestion solution and is then heated. TOC becomes oxidized into CO₂. The quantity of CO₂ produced results in a colour change within the TOC kit. The intensity of the colour change then allows the spectrophotometer to determine the TOC value
Measuring Range of TOC kit: 3-30mgC/l

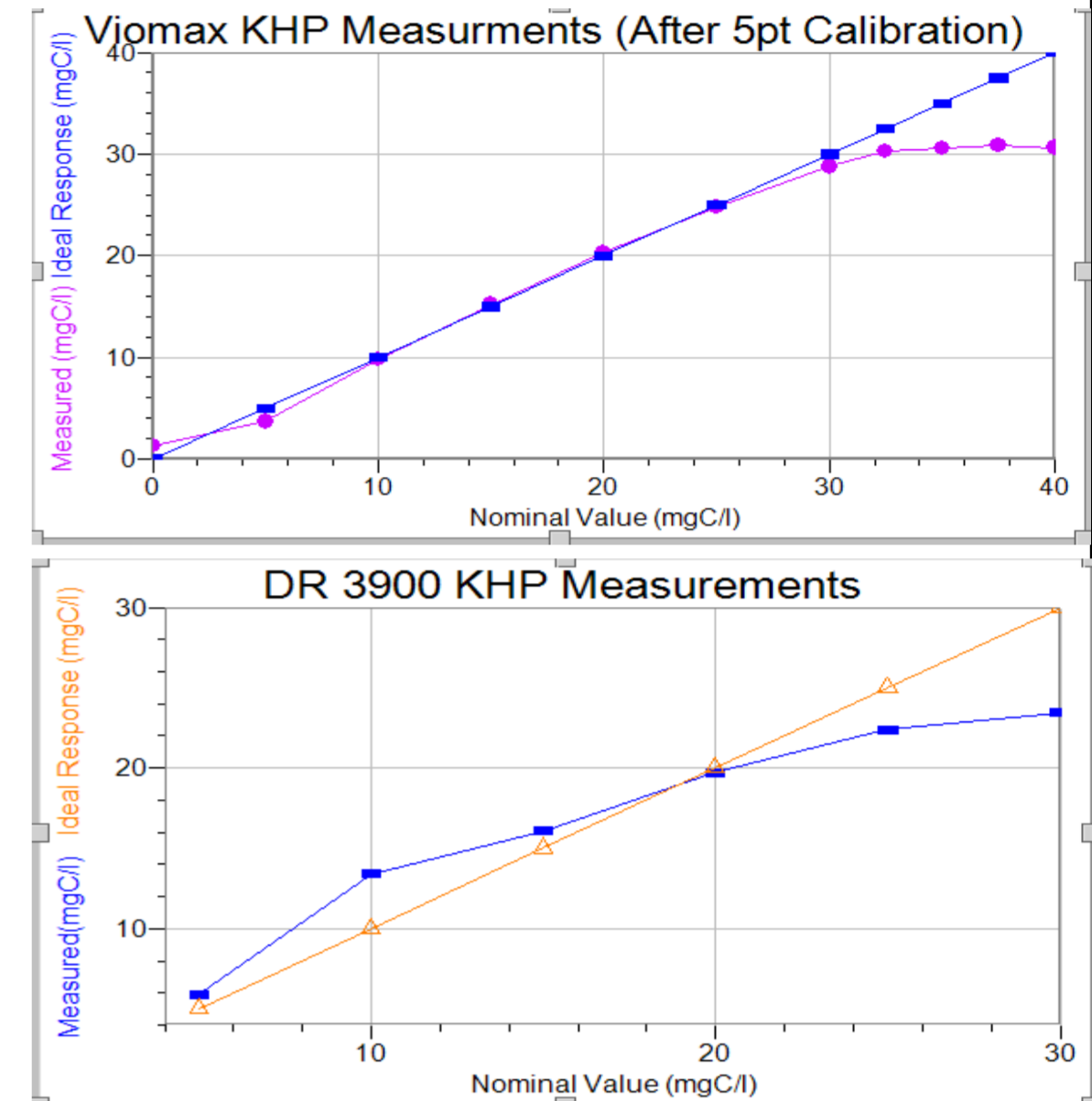


Endress and Hauser Viomax CAS51D:

Instrument Type: UV SAC Sensor
Wavelength Range: Single Wavelength of 254nm
Measurement Method: Measures the Spectral Absorption Coefficient of a sample. This can be converted to a TOC value
Measuring Range: 0-30mgC/l



Linearity Test Using KHP Standards:



Testing the instruments ability to measure different types of TOC

Linearity Tests with Various Chemicals on Both instruments.

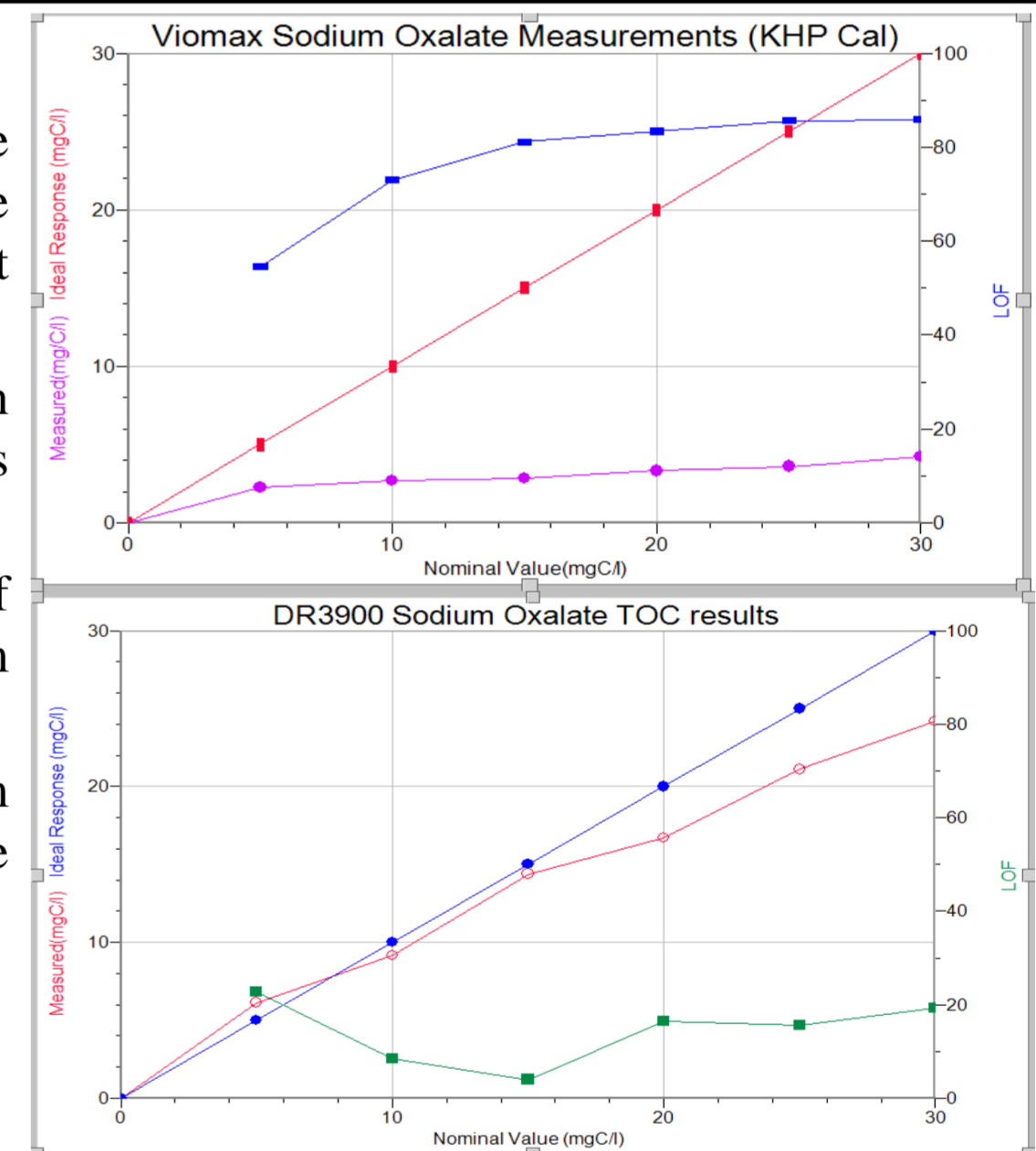
- To test the instrument's ability to test varying carbon contents, standards solutions were made in the following chemicals
 - Glucose
 - Urea
 - Sodium Oxalate
- Linearity Tests were carried out on both instruments and the results are shown on the following tables.

Urea		
	DR3900	Viomax
Chemical Measured	Urea	Urea
Slope	0.4284	0.05
Correlation	0.9871	0.961
Lack of Fit % Reading	47.73	93.2055

Glucose		
	DR3900	Viomax
Chemical Measured	Glucose	Glucose
Slope	0.9534	0.02232
Correlation	0.8024	0.5537
Lack of Fit % Reading	27.51	80.73

Sodium Oxalate		
	DR3900	Viomax
Chemical Measured	Sodium Oxalate	Sodium Oxalate
Slope	0.7861	0.1145
Correlation	0.9945	0.9095
Lack of Fit % Reading	14.438	77.25

- The measurements on the DR3900 were much closer to the ideal response line which is a representation of how a perfect instrument would perform.
- The most noticeable difference in performance between the two instruments came when measuring Sodium Oxalate.
- The average lack of fit as a percentage of the reading was observed when sodium oxalate was being measured.
- The following graphs show the sodium oxalate measurements as well as the percentage lack of fit for each reading.

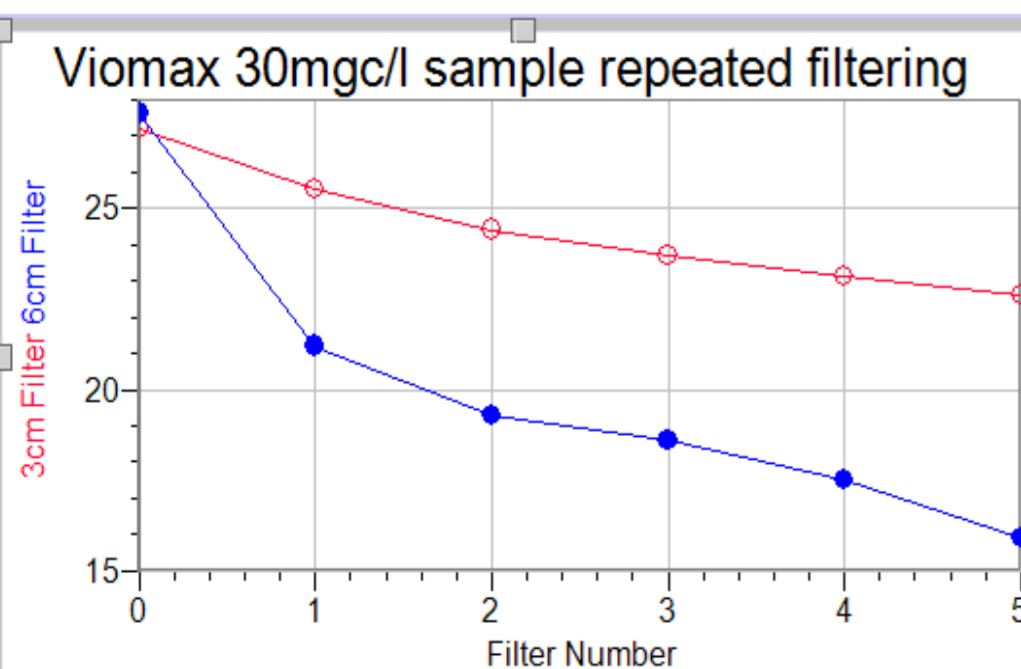


Filtration analysis and river sample analysis

Viomax Filtering:

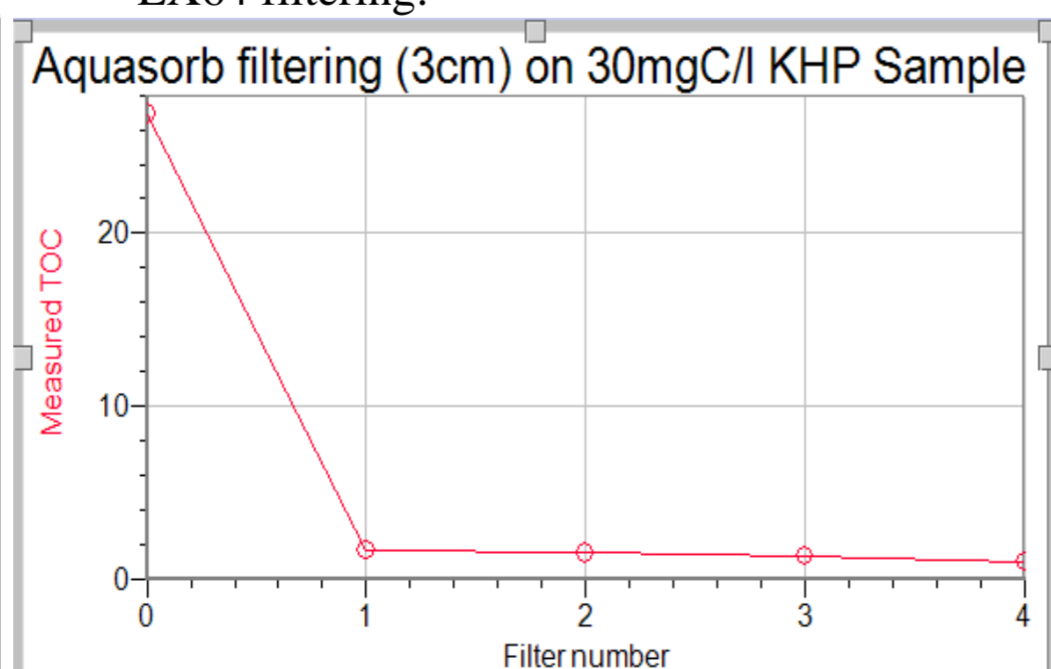
Activated Carbon Filtracarb EX64:

- At first, the active carbon sample filtracarb was used on a 30mgC/l KHP sample and this same sample was repeatedly filtered.
- The first measure was 3cm of filter in the cassette and the second was 6cm. The results are shown on the graph below.



Aquasorb CX Filtering

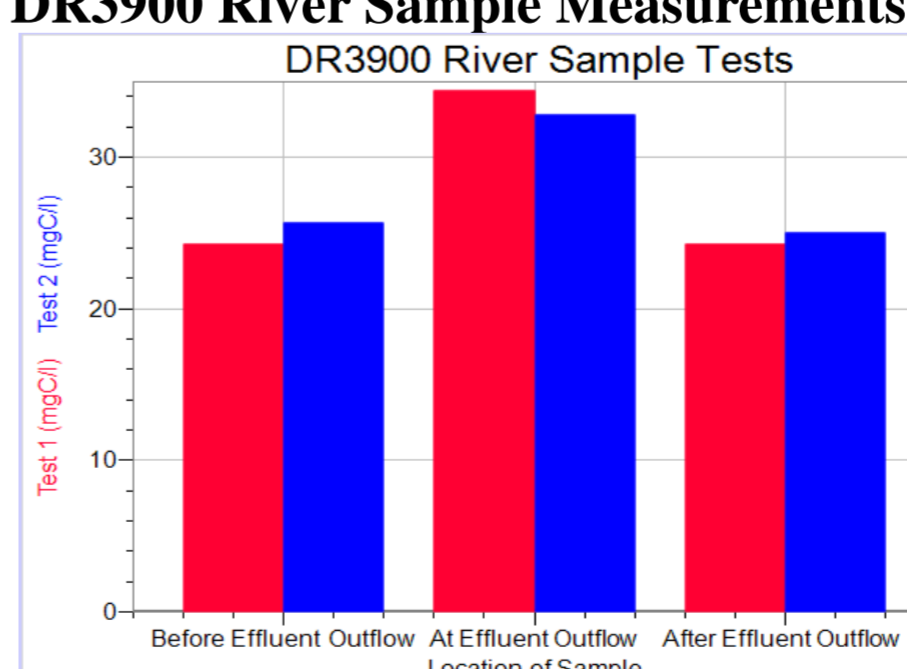
- The second carbon filter used was the Aquasorb CX activated carbon filter.
- Another sample of 30mgC/l was used for this test.
- The Aquasorb filters more of the carbon at a faster rate when compared to the Filtracarb EX64 filtering.



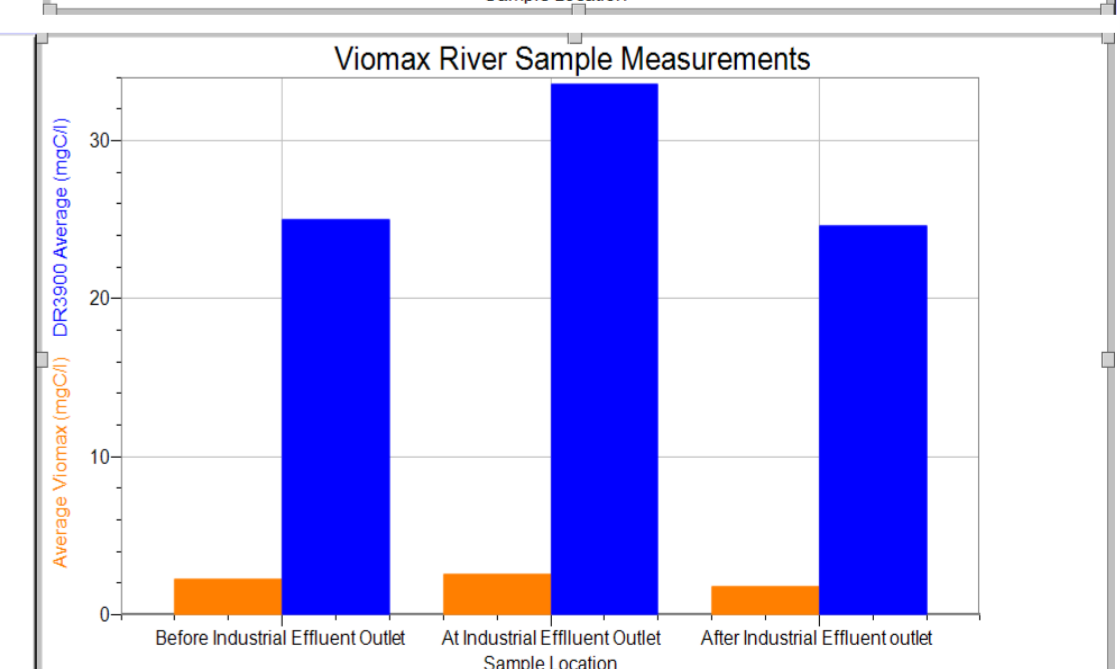
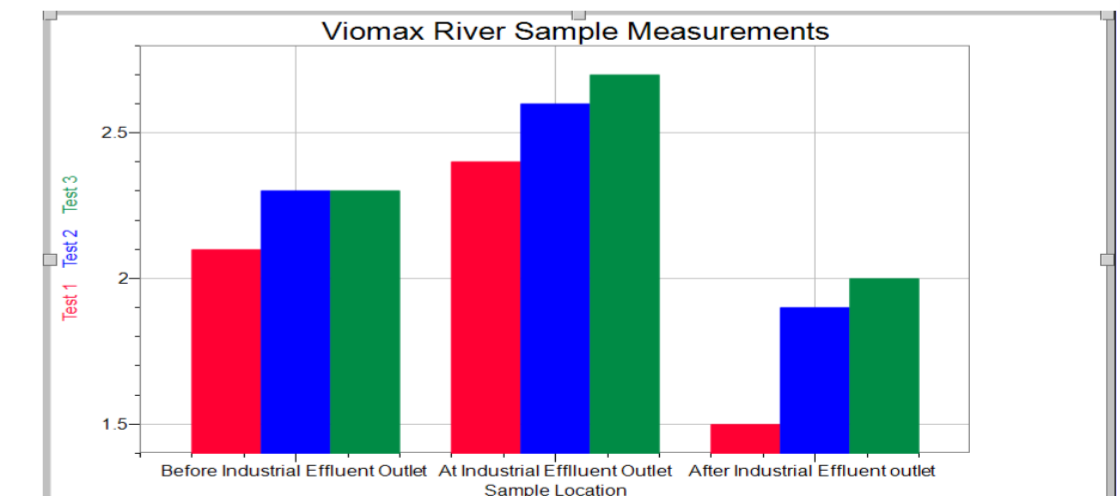
River Sample Analysis:

- On the 21/4/22 samples were taken from the Owenabue River in Carrigaline, Cork.
- Samples were taken before, at and after a large industrial plant

DR3900 River Sample Measurements:



Viomax River Sample Measurements:



References

Hach Lange <https://de.hach.com/asset-get.download.jsa?id=25593618344>

Endress and Hauser

https://portal.endress.com/wa001/dla/5000316/2021/000/03/B/A00459CEN_1417.pdf