



Determination of the Effect of Activated Carbon in Water Treatment Processes

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Introduction:

Potable water quality is an important determinant factor for human health. If water is contaminated with diesel, it needs to be removed to avoid health effects. One of the methods involves using activated carbon due its porosity and surface properties- large surface area for adsorption per gram(Activated Carbon, n.d)

Normal Parameters Measured:

residual chlorine, pH, turbidity, Coliform/E-coli concentrations, Dissolved Oxygen content

Parameters not routinely measured:

trihalomethane, pharmaceuticals and other organics such as diesel

Toluene $C_6H_5CH_3$, ethylbenzene $C_6H_5CH_2CH_3$, and xylenes, $C_6H_4(CH_3)_2$ (along with benzene, C_6H_6) are part of the aromatic fraction in gasoline and diesel fuel.

Health effects:

Maximum allowable limit 1 mg/L in water and in air 0.1 mg/L. Health effects: neurological, renal, hepatic and other tissues, reproductive and developmental disorders (Health Canada, 2014),

Sources of Organics/Diesel:

soil/ground or surface water contamination from the past diesel spill or an accidental leak from the diesel engines or tanks.

Pukatawagon (Mathias Colomb): Diesel spill

North Saskatchewan River- husky oil spill

Shamattawa First Nation- fuel spill

Sayisi Dene First Nation- fuel spill

PHC= petroleum hydrocarbons-oil, gas, diesel and other petroleum based products

Removal of Diesel:

- remove the organic/diesel particles using activated carbon.
- Removing organic matters before disinfection is recommended(Health Canada, September 2014)
- Controlled experiments will be done by preparing emulsions of diesel -water mixture and the removal of diesel using activated carbon as a filter medium.

Procedure: eight samples were prepared with the following concentrations:

0.011 ml of diesel in 1L water(11 ppm)

0.033 ml of diesel in 1L water

0.066 ml drops of diesel in 1L water

100 μ l (0.1 ml) of diesel in 1L water(100 ppm)

0.5 ml of diesel in 1L water

1.0 ml of diesel in 1L water

5.0 ml of diesel in 1L water

10.0 ml of diesel in 1L water

Procedure continued:

- Samples were stirred for 7 mins to make the emulsion.
- 70 ml of these samples were taken to pass through a 70 g of activated carbon filter bed/medium.
- the vacuum pump was started and the filtrate collected

Procedure continued:

- A drop of filtrate was placed on a microscopic slide and examined.
- The corresponding untreated drop of sample was placed on a slide and examined



Filtration Setup

Vacuum pump on the left

Filter unit with activated carbon on the right.

Results:

Qualitative

There is no smell of gasoline in the activated carbon treated samples except for the 10 ml in IL.

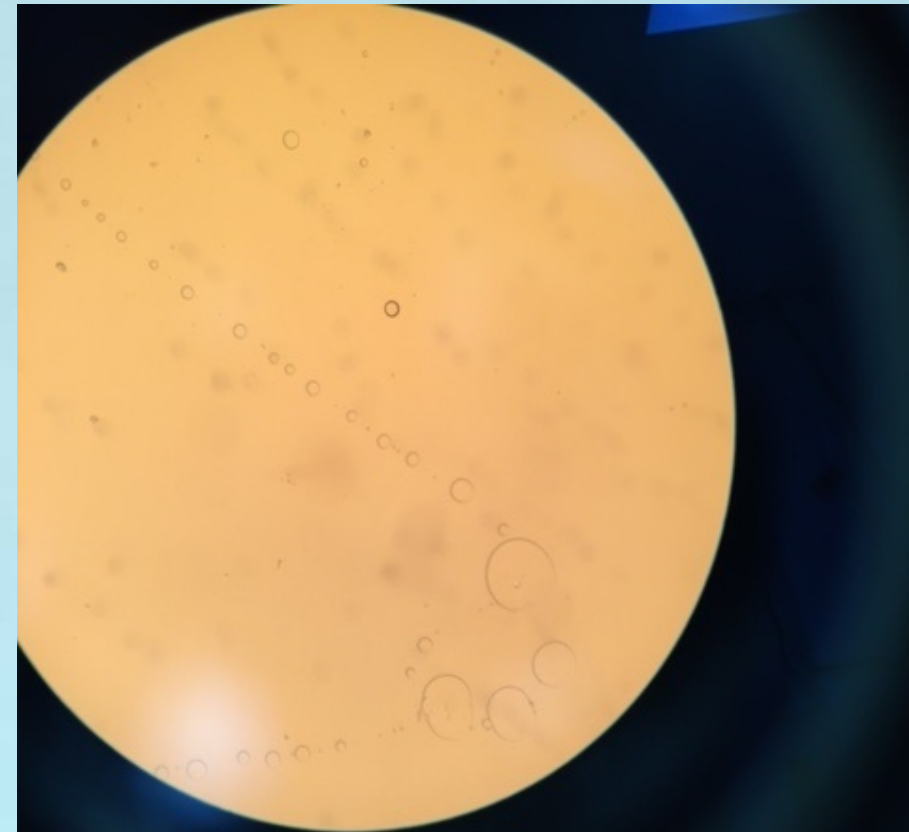
Semi- Quantitative:

Under microscope before and after treatment were compared.

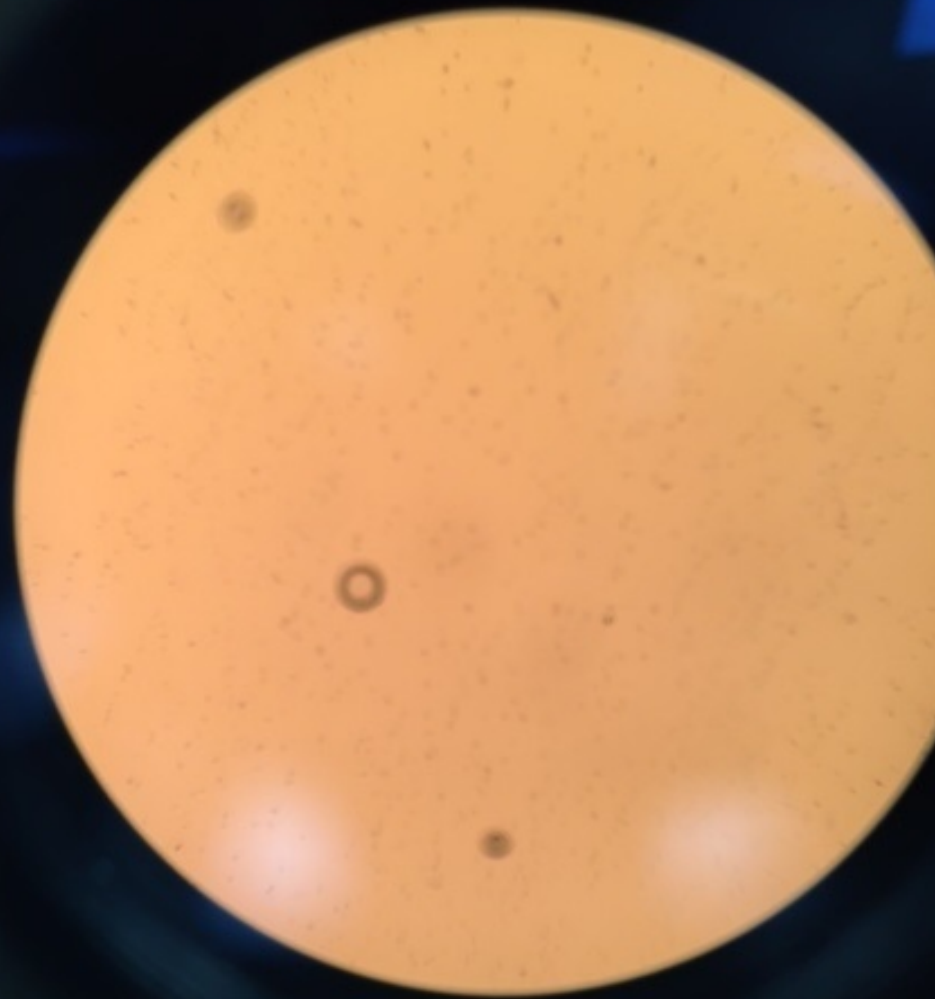


100 µl diesel in 1L
water-before...

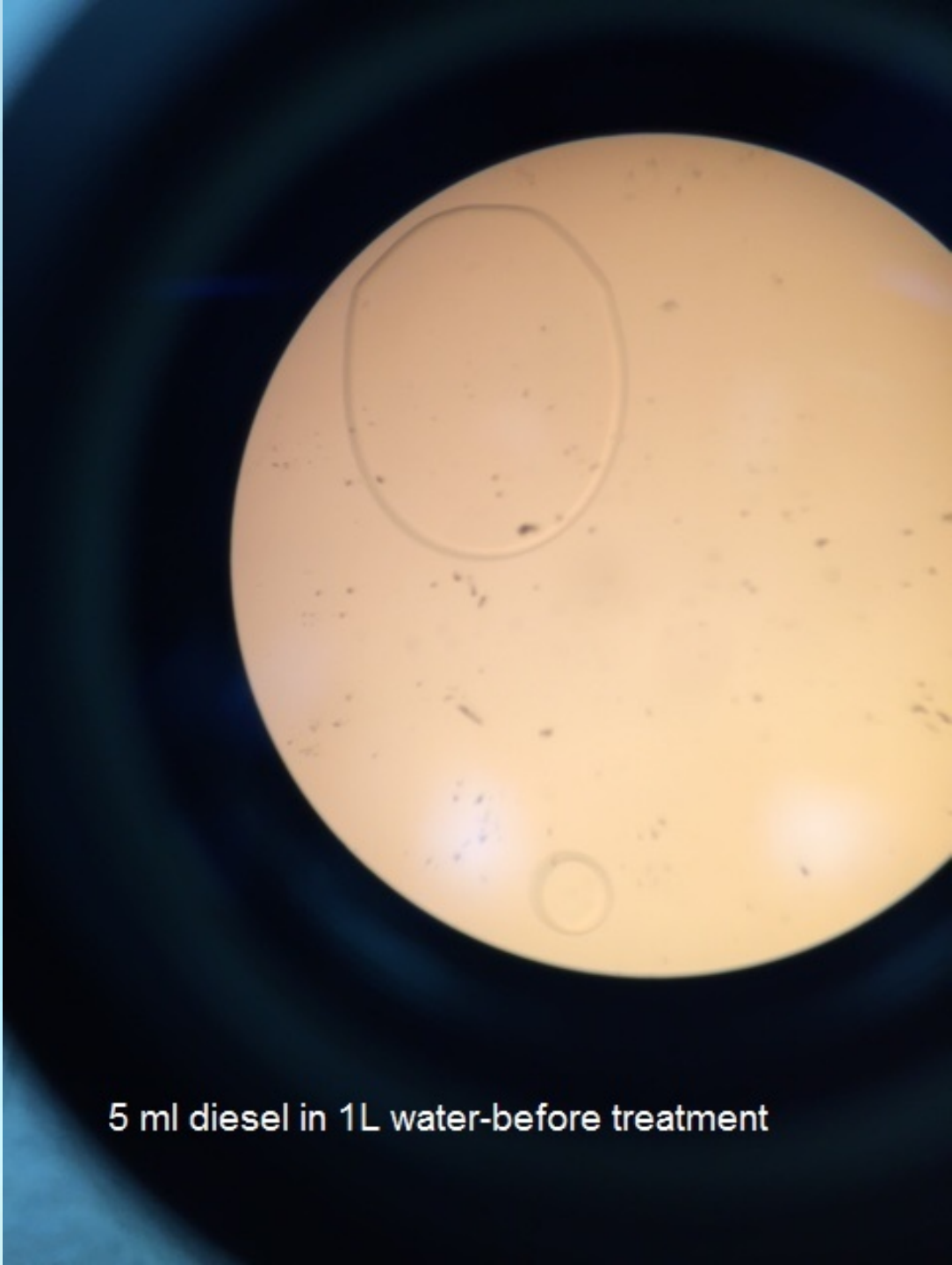
Experimental Results:



100 µl diesel in 1L water-before treatment

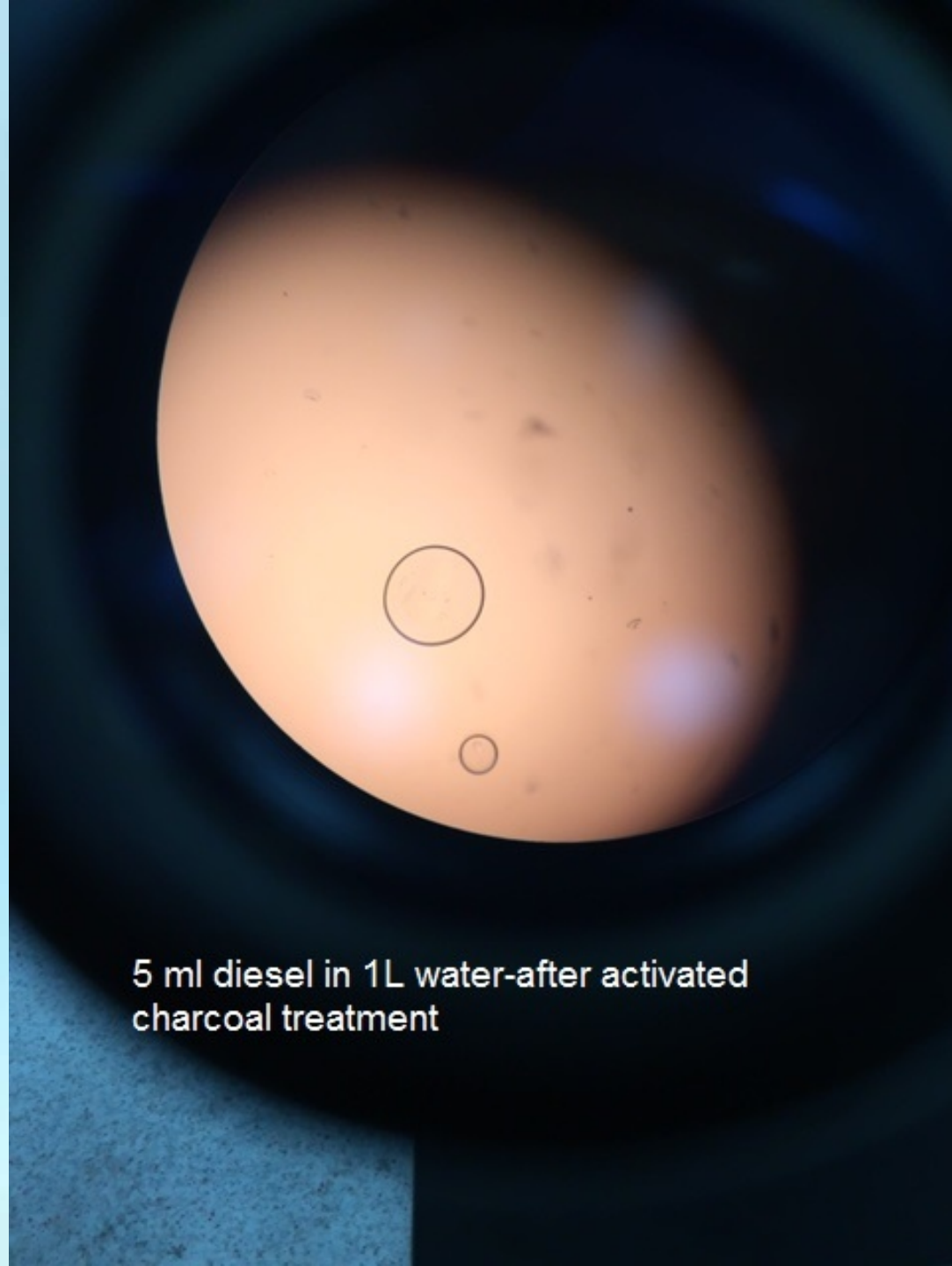


100 μ l diesel in 1L water-after activated charcoal treatment



5 ml diesel in 1L water-before treatment

-
-



5 ml diesel in 1L water-after activated charcoal treatment

Particle Analyzer:

- Comparison of Obscuration of untreated versus activated carbon treated
- For example, 5% obscuration means 5% of the incident laser beam has been lost through scattering or absorption.
- 0% obscuration for the activated carbon treated water indicating no diesel present
- Detector captures scattering

Result Analysis Report

Sample Name:
5 ml before treatment - Average

SOP Name:
RakeshD

Measured:
Wednesday, May 17, 2017 11:42:36 AM

Sample Source & type:
Factory = Paris

Measured by:
Mastersizer 2000

Analysed:
Wednesday, May 17, 2017 11:42:37 AM

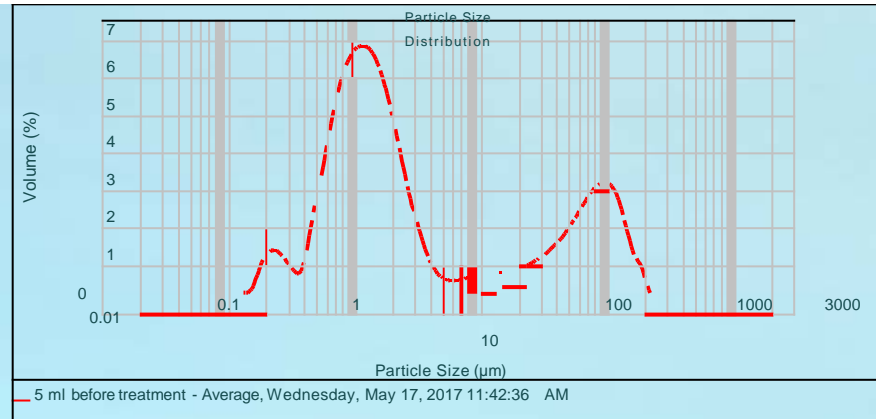
Sample bulk lot ref:
123-ABC

Result Source:
Averaged

Particle Name: Waterdroplets	Accessory Name: Hydro 2000S (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.330	Absorption: 0.01	Size range: 0.020 to 2000.000 um	Obscuration: 4.73 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 17.055 %	Result Emulation: Off

Concentration: 0.0139 %Vol	Span: 55.630	Uniformity: 13.5	Result units: Volume
Specific Surface Area: 5.02 m ² /g	Surface Weighted Mean D[3,2]: 1.194 um	Vol. Weighted Mean D[4,3]: 22.511 um	

d(0.1): 0.564 um d(0.5): 1.600 um d(0.9): 89.569 um



Operator notes:

Result Analysis Report

Sample Name:
5ml after treatment - Average

Sample Source & type:
Factory = Paris

Sample bulk lot ref:
123-ABC

SOP Name:
RakeshD

Measured by:
Mastersizer 2000

Result Source:
Averaged

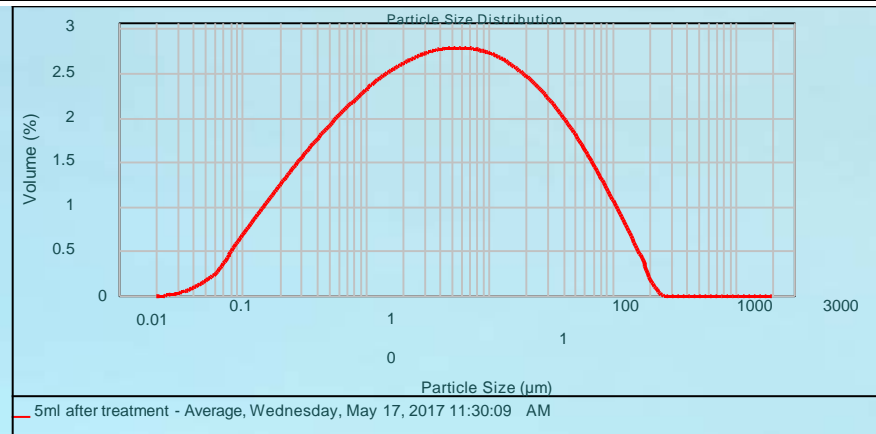
Measured:
Wednesday, May 17, 2017 11:30:09 AM

Analysed:
Wednesday, May 17, 2017 11:30:10 AM

Particle Name: Waterdroplets	Accessory Name: Hydro 2000S (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.330	Absorption: 0.01	Size range: 0.020 to 2000.000 um	Obscuration: 0.00 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 22.158 %	Result Emulation: Off

Concentration: 0.0000 %Vol	Span: 11.368	Uniformity: 3.55	Result units: Volume
Specific Surface Area: 7.34 m ² /g	Surface Weighted Mean D[3,2]: 0.818 um	Vol. Weighted Mean D[4,3]: 16.548 um	

d(0.1): 0.300 um d(0.5): 4.284 um d(0.9): 49.002 um



Operator notes:

Further Work:

- Pilot scale activated carbon column for the study (McCabe et al., 2005).
- Plant Data Analysis.

Pimicikamak First Nation- Uses Activated Carbon; however, the system is down.

Moose Lake (Mosakahiken) : No activated carbon bed as part of the treatment process

Pine Creek and Pukatawagon(Mathias Colomb) – no activated carbon bed

- **Theoretical Analysis and Simulation**

Effect of porosity of the particles, porosity of the bed and the bed height



References

Health Canada (2014). Guidelines for Canadian Drinking Water Quality: Guideline Technical Document — Toluene, Ethylbenzene and Xylenes. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No H144-20/2015E-PDF).

Activated Carbon- Properties of GAC(n.d) extracted from <http://www.tigg.com/Library/Activated-Carbon-Properties-of-GAC.pdf>

Health Canada(September, 2014) Field Reference Manual: Non- Microbiological Drinking Water Quality Parameters .Health Canada First Nations Inuit Health Branch

McCabe, W.L . Smith, J.C and Harriet, P (2005) Unit Operations of Chemical Engineering , 7th Edition, McGraw Hill, Toronto



Any questions? Please contact:

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