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TEMPERATURE STUDY: ASSESSING THE IMPACT OF ELEVATED TEMPERATURE ON KEY TESTS OVER A 48 HOUR PERIOD

One of the most common challenges when submitting environmental samples for analytical testing is ensuring that the samples are received at the laboratory at or below 10° C. This is of particular concern when samples collected in the field and placed in a cooler with cooling media are not immediately submitted to the laboratory.

The purpose of maintaining refrigerated temperatures during shipment is to mitigate any biological or chemical activity, ensuring the samples, and by extension the results, are more representative of field conditions. Storing environmental samples at elevated temperatures for extended periods could result in loss of target analytes through degradation or other chemical activity. Temperature preservation is particularly important for samples requiring organic analysis.

When samples are received by the laboratory at temperatures exceeding 10° C, it is usually only slightly above this standard and generally for only a short period of time. In these situations, the question faced by the Qualified Person (QP) is whether the temperature exceedance impacts the representativeness of the analytical results. Previously, Bureau Veritas completed a temperature study¹ focused on volatile organic compounds, submitted in methanol-preserved vials or with zero headspace.

The federal² guideline for sample temperature on receipt at the laboratory is $\leq 10^{\circ}\text{C}$ (*but not frozen*). At the provincial level, Ontario has adopted the 10° C threshold³. British Columbia and Quebec have adopted a threshold of $\leq 6^{\circ}\text{C}$ ^{4,5}, for receiving samples.

¹ For a review of this work, please refer to the [Impact of Temperature on VOC Analysis Technical Bulletin](#).

² Canadian Council of Ministers of the Environment. Guidance Manual for Environmental Site Characterization in support of Environmental and Human Health Risk Assessment – Volume 4 Analytical Methods. 2016.

³ Ministry of Environment, Conservation and Parks, Laboratory Services Branch. Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality. 2021.

⁴ Ministry of Environment and Climate Change Strategy, Knowledge Management Branch. British Columbia Environmental Laboratory Manual. 2020.

⁵ Ministère du Développement Durable, de l'Environnement et de la Lutte Contre Les Changements Climatiques. Modes de conservation pour l'échantillonnage des eaux souterraines, DR-09-09, Centre d'expertise en analyse environnementale du Québec. 2017. Centre d'Expertise en Analyse Environnementale du Québec. Modes de conservation pour l'échantillonnage des sols, DR-09-02, Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs. 2013.



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In Alberta, samples should be received at the laboratory at ~4°C⁶.

STUDY DESIGN

The purpose of this study was to assess any potential impacts to analytical results for selected and sensitive tests, when sample storage temperatures exceed 10° C for short periods of time. Real-world samples were selected, representing both soil and water matrices (*see table below*). For analysis of petroleum hydrocarbons (PHCs) and polycyclic aromatic hydrocarbons (PAHs) samples were spiked with mid-level (*relative to the method's calibration range*) concentrations of target analytes.

WATER SAMPLES	SOIL SAMPLES
Mercury	Mercury
Total Kjeldahl Nitrogen (TKN)	
Orthophosphate	PAHs*
Carbonaceous Biological Oxygen Demand (cBOD)	
PAHs*	PHCs*
PHCs (F2-F4)*	

* Samples spiked with target analytes.

** Two samples were analyzed for each test and matrix.

All samples were initially analyzed prior to incubation to establish a baseline concentration at time “zero” (T = 0). Aliquots of the samples were then separately incubated at ~15° C and refrigerated temperatures (<10°C) for 48 hours. The incubated aliquots were then retrieved, analyzed and data was compared.

⁶Quebec Environmental Quality Act, Q-2, r. 18 – Regulation respecting the burial of contaminated soils.



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RESULTS

The comparability of analytical results was evaluated based on typical laboratory tolerance limits for reproducibility between duplicate samples, i.e. relative percent difference (RPD): 30% (waters) and 40% (soils) for organic parameters; and 20% (waters) and 30% (soils) for inorganic parameters^{7,8}.

With the exception of orthophosphate in water samples, all tests showed little change in the results (i.e. correlation within acceptable RPD limits) between initial concentrations and concentrations measured after storage for 48 hours at 15° C or <10° C.

TKN data for one of the water samples, as well as PAH data for one of the soil samples, varied beyond generally accepted RPD limits. In these isolated cases however, the samples were visibly heterogeneous, with this being the likely cause of the higher data variability rather than degradation of target parameters.

SUMMARY

The analytical results in this study indicate **no** appreciable change in concentration of the target parameters due to slight temperature exceedances for less than 48 hours, with the exception orthophosphate (in water). A summary of the associated results is provided below.

⁷ Canadian Council of Ministers of the Environment. Guidance Manual for Environmental Site Characterization in support of Environmental and Human Health Risk Assessment – Volume 4 Analytical Methods. 2016.

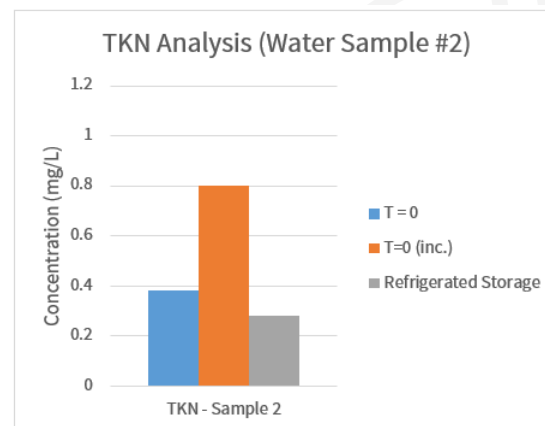
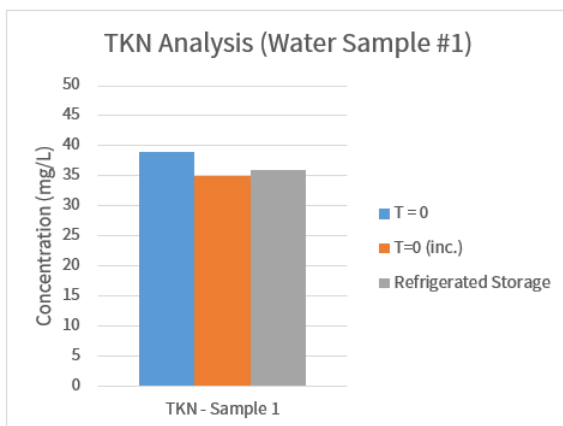
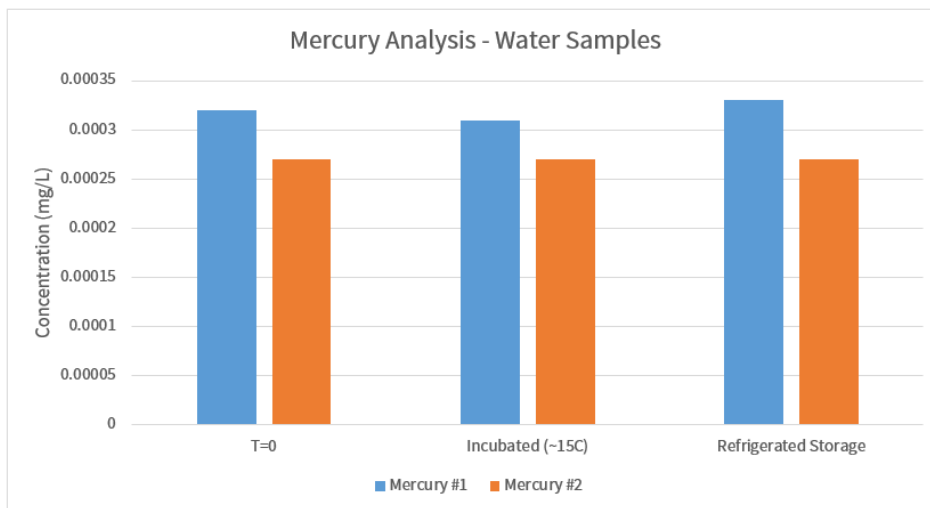
⁸ Ministry of Environment, Conservation and Parks, Laboratory Services Branch. Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality. 2021.



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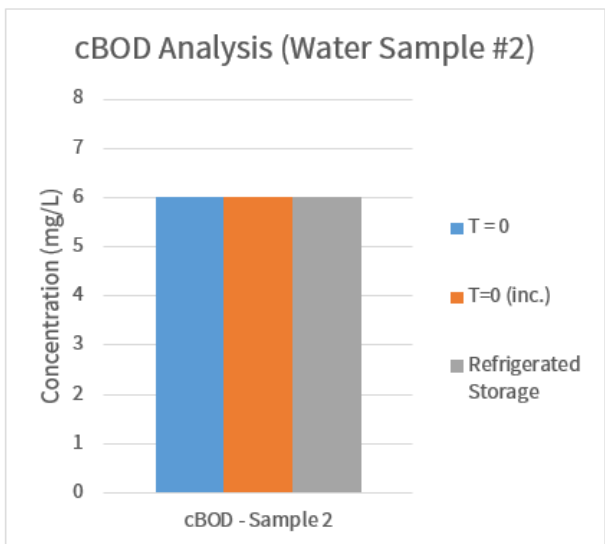
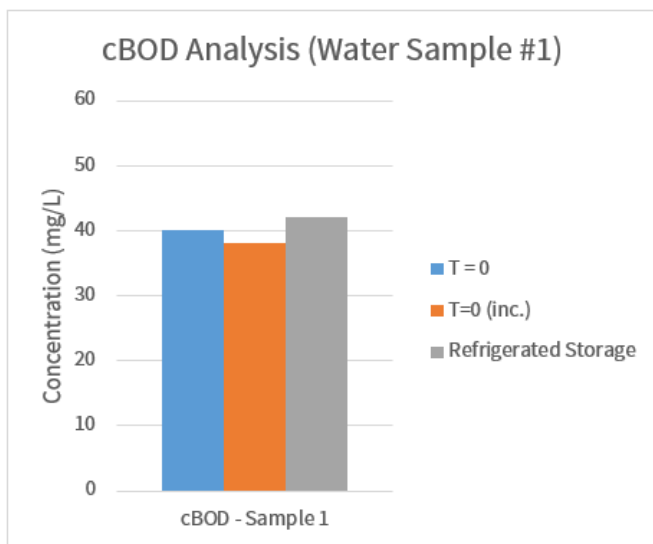
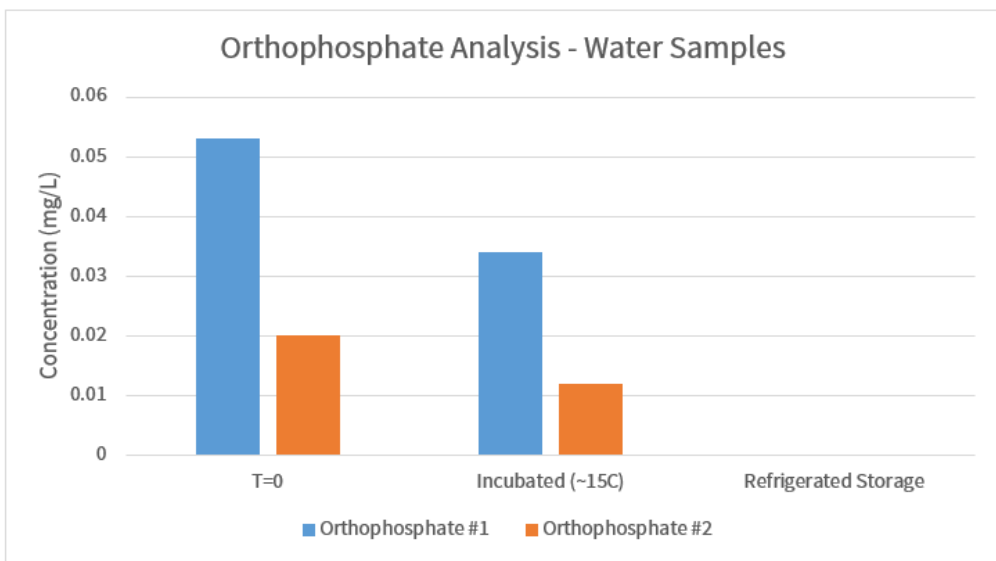
RESULTS FROM WATER SAMPLES





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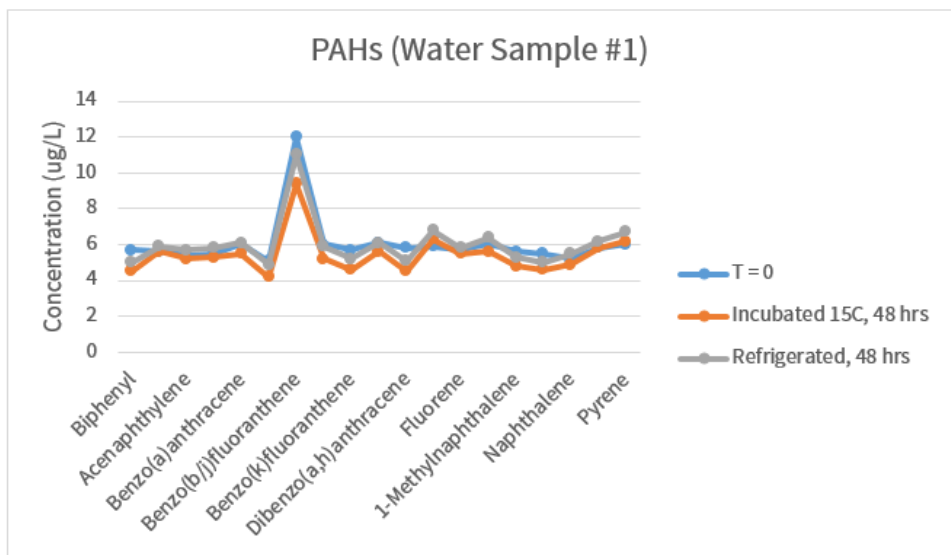
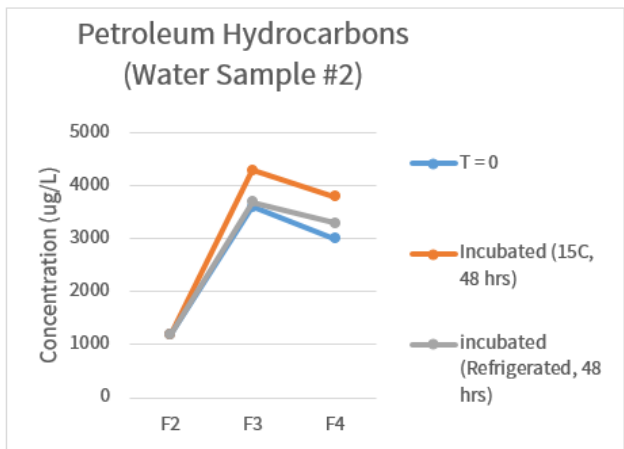
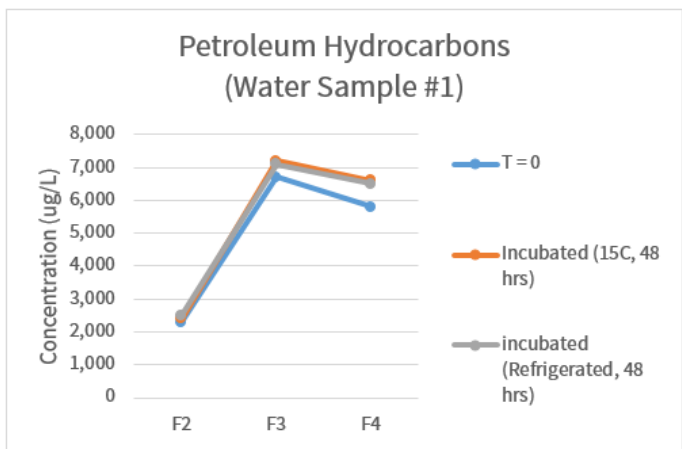
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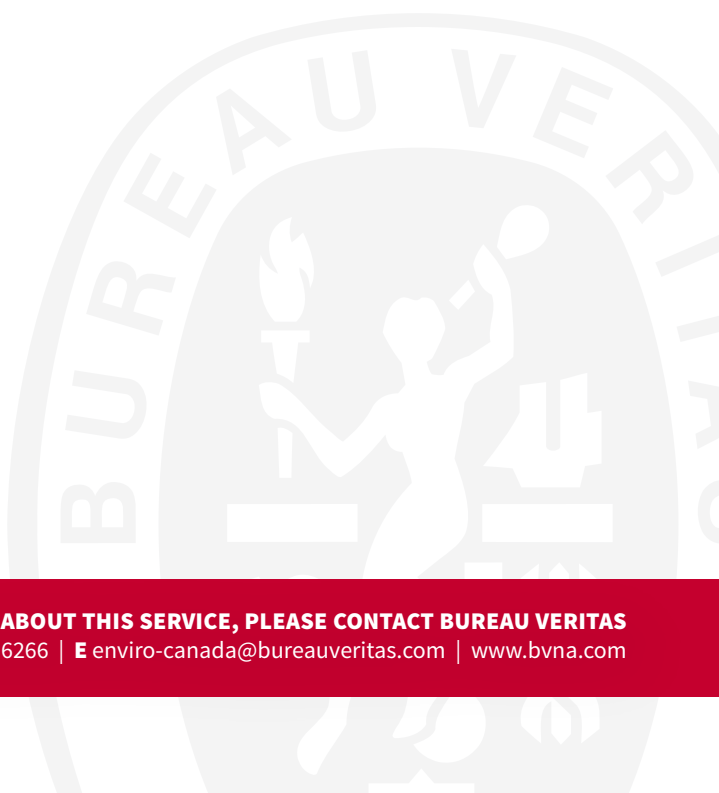
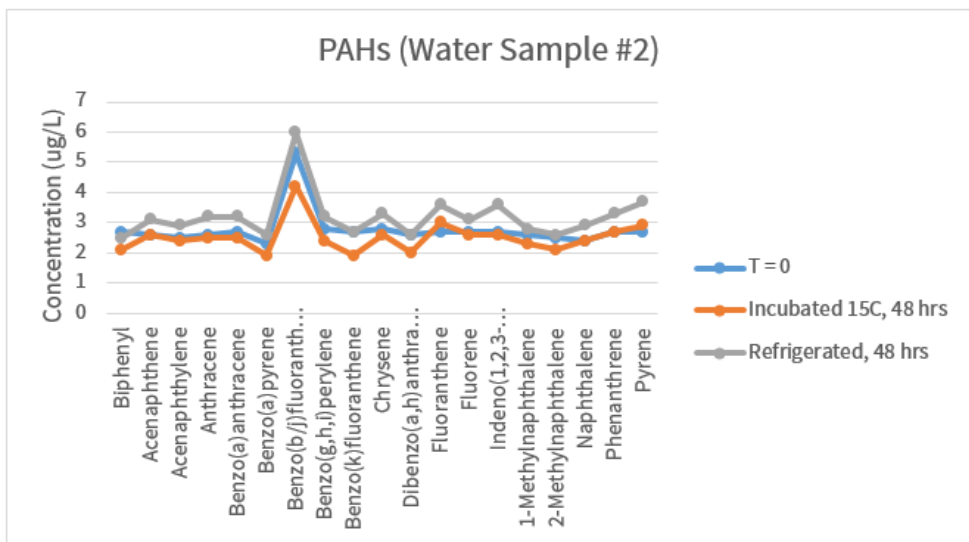


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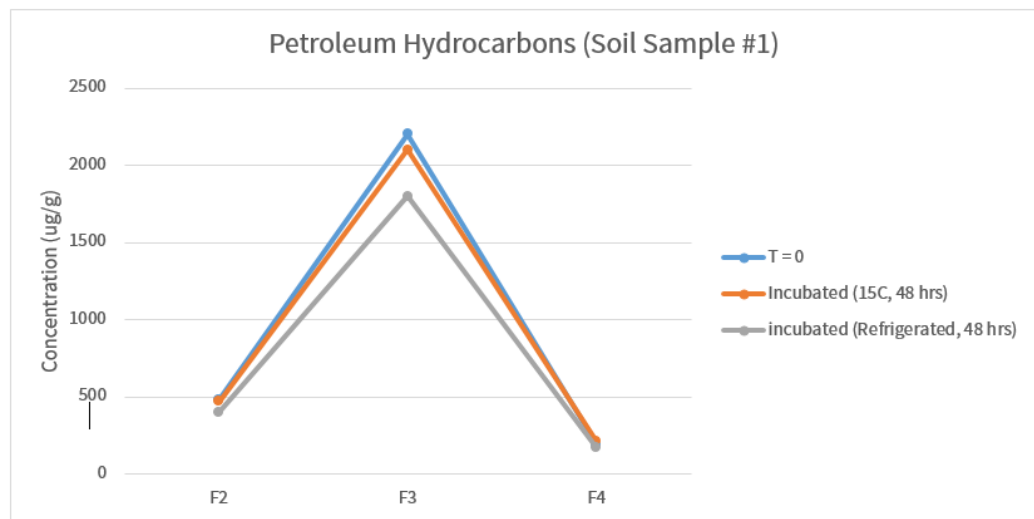
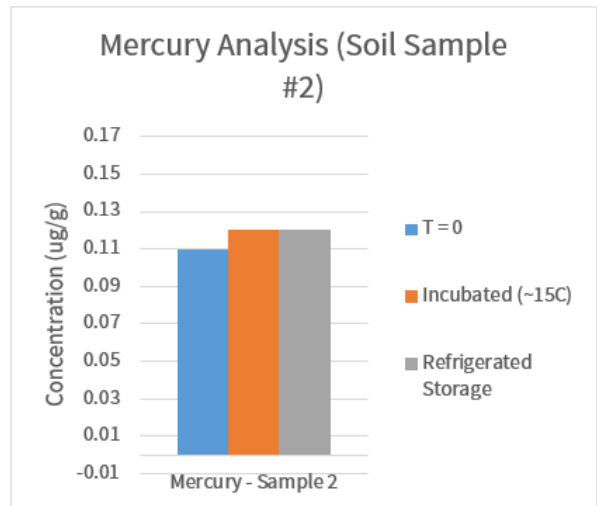
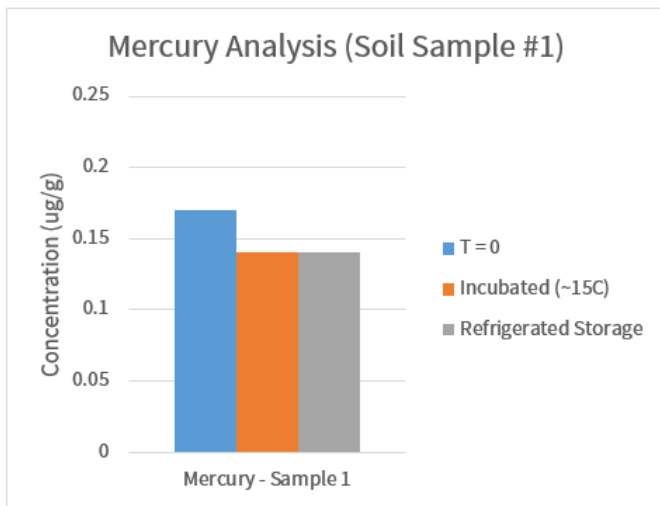




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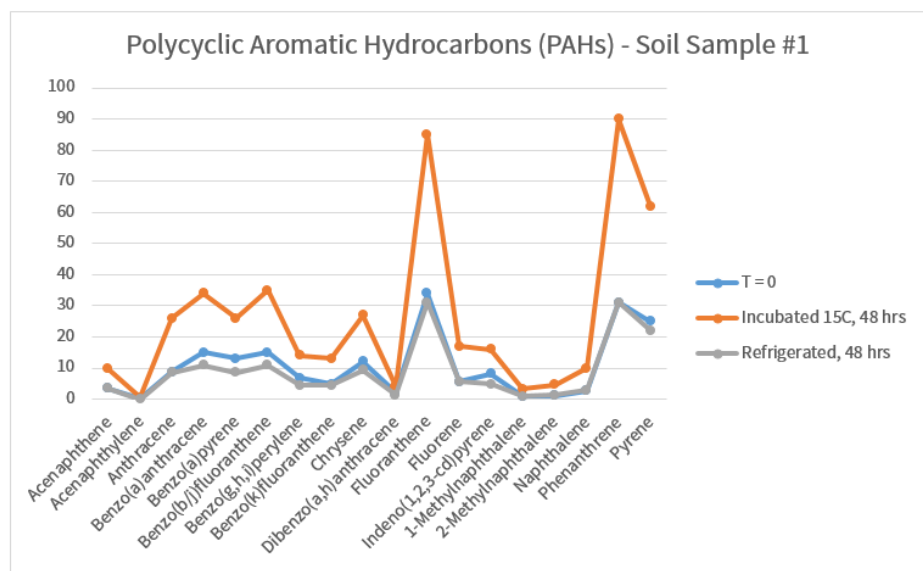
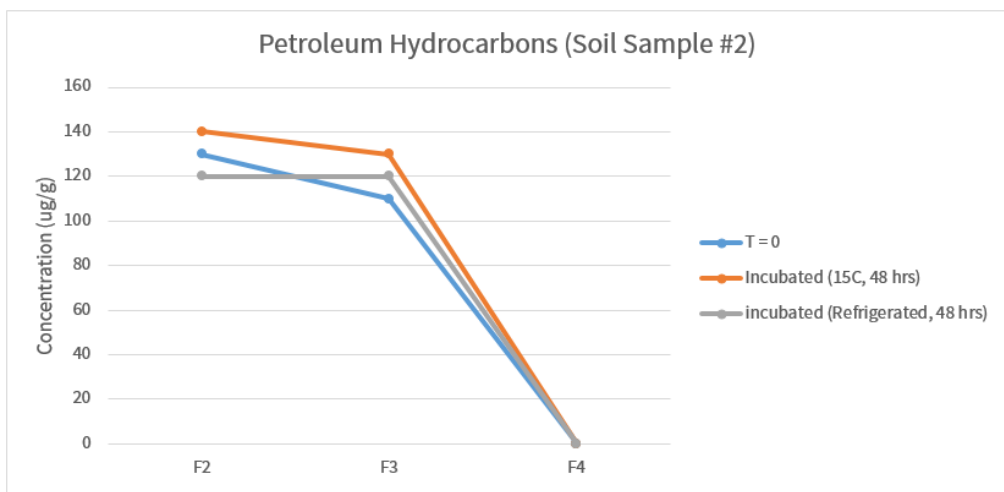
RESULTS FROM SOIL SAMPLES





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