

Field Evaluation of Cellulose-Based Functional Materials to Sample Bacteria in Groundwater

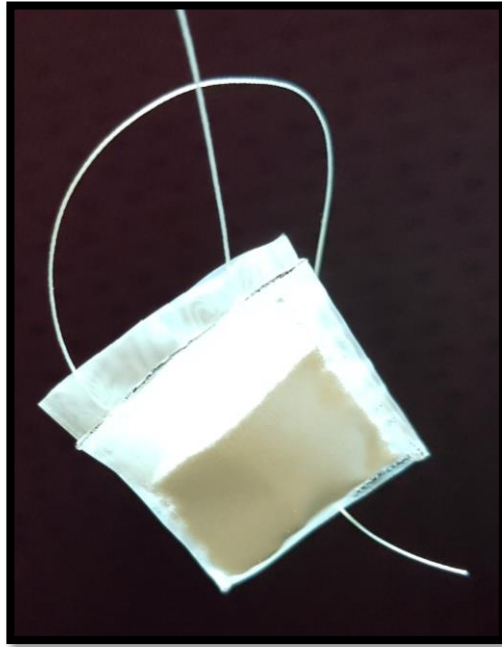
PRESENTER: DR. VICTORIA COLLINS



BACKGROUND



PREVIOUS WORK



~1.5 cm

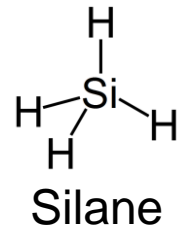
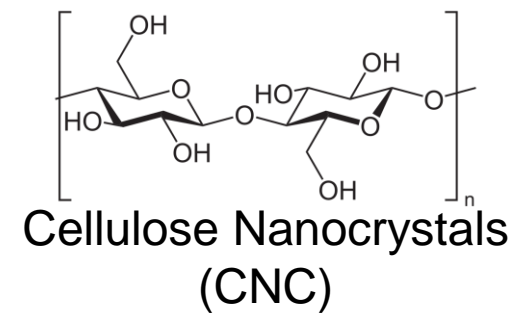
BACTERIA SAMPLERS

- Tenax beads
- Diatomaceous earth
- Biochar
- Zeolite
- Activated carbon
- Silica microsphere

SUITABLE CANDIDATES

- Non-toxic
 - Non-soluble in water
 - High surface area and porosity
 - Stable at temperatures required for heat sterilization
 - Support microbial colonization
 - Yield recoverable DNA for downstream analyses
 - Must not significantly alter the microbial community
 - Preferably hydrophobic
-

SYNTHESIS



Wikipedia.com



Reaction



Addition to mold



Freeze with liquid nitrogen



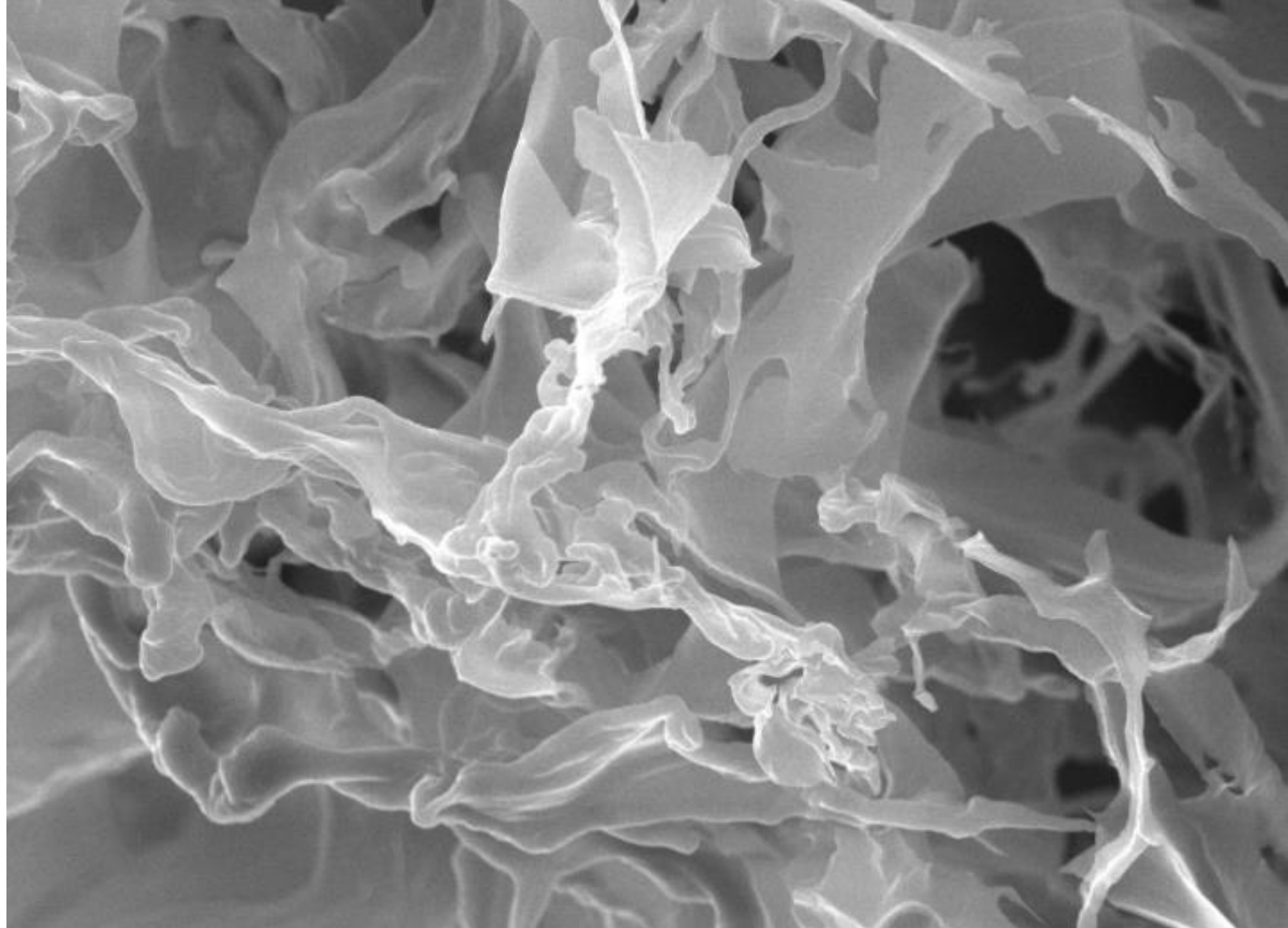
Freeze-dry



Nanocomposite

SEM

- Highly porous
- High surface area



SEM HV: 30.0 kV

WD: 15.39 mm

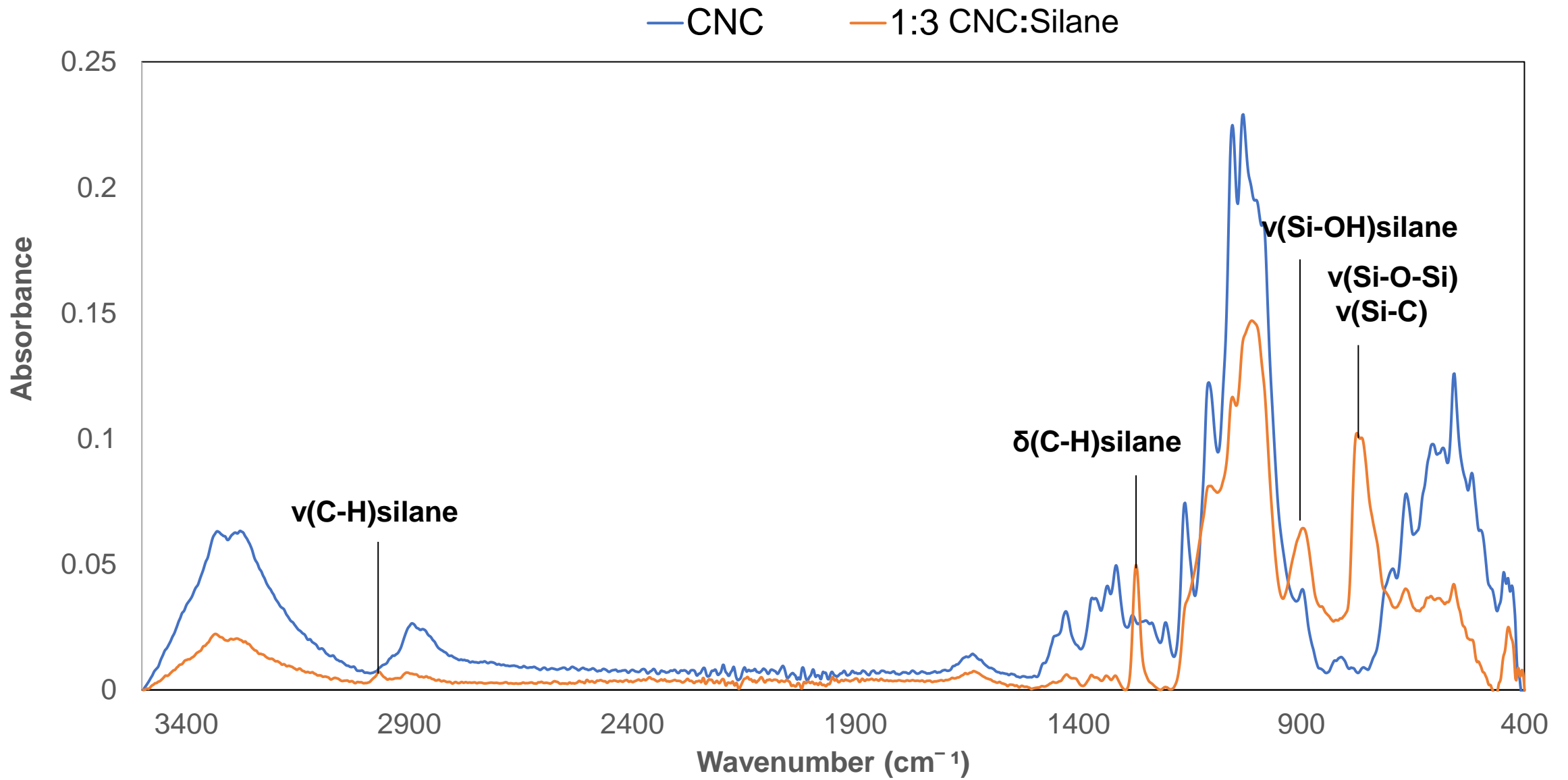
View field: 199 μ m

Det: SE

50 μ m

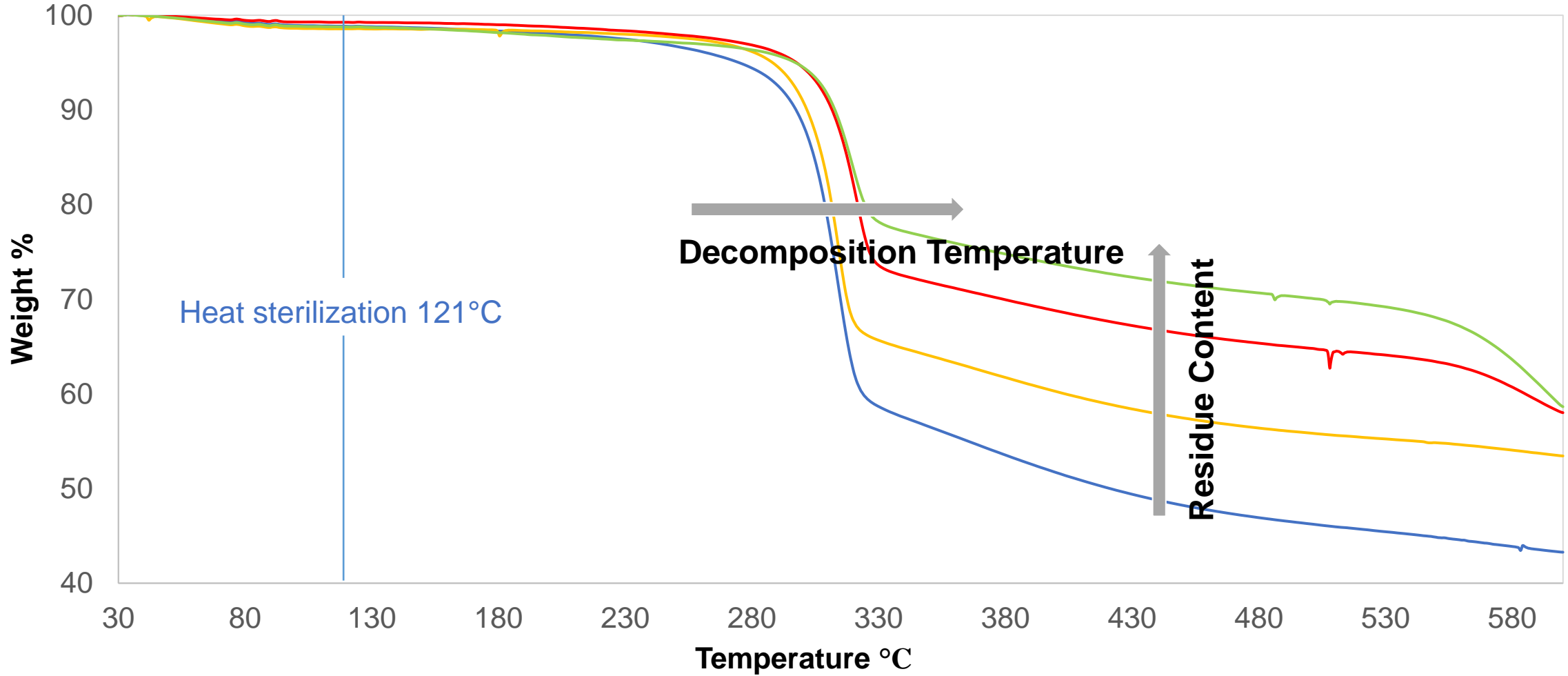
VEGA3 TESCAN





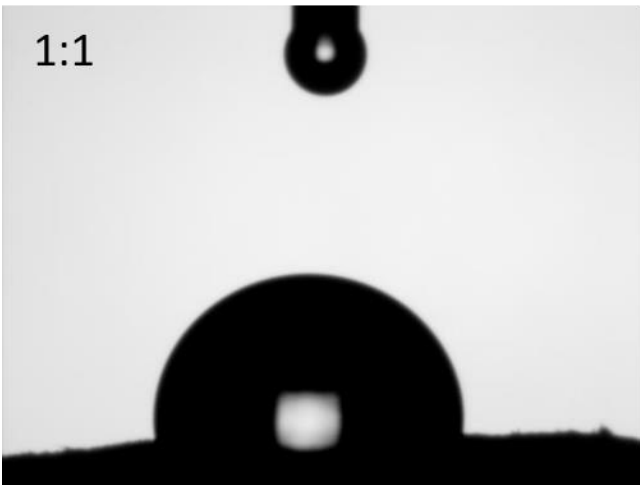
Thermal Stability

— 1:1 — 1:2 — 1:3 — 1:4 CNC:Silane



HYDROPHOBICITY

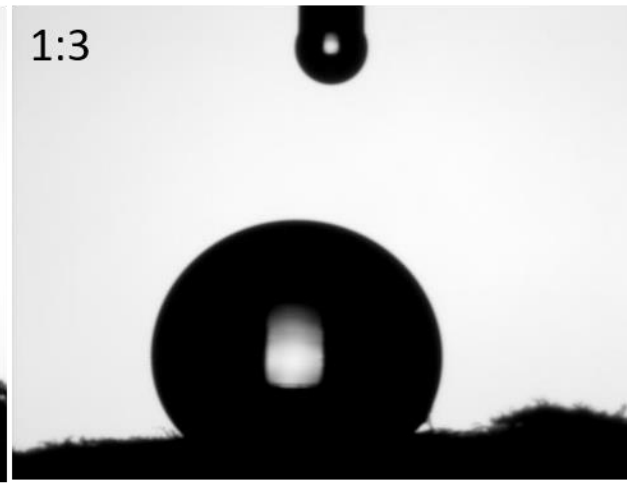
CNC:Silane



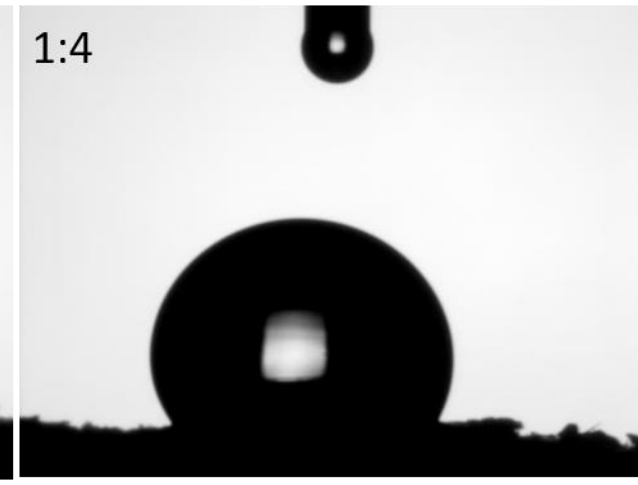
90°



110°

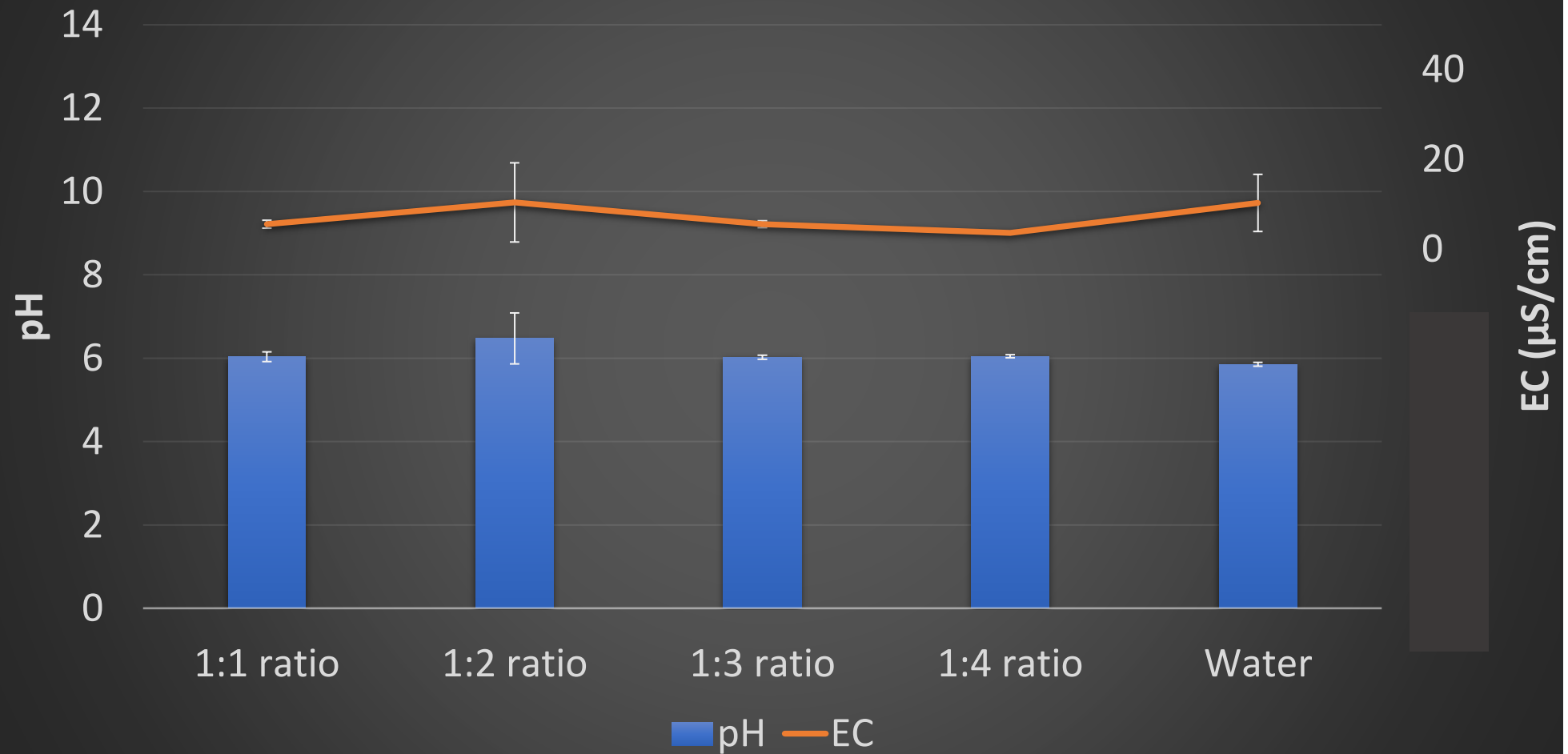


124°

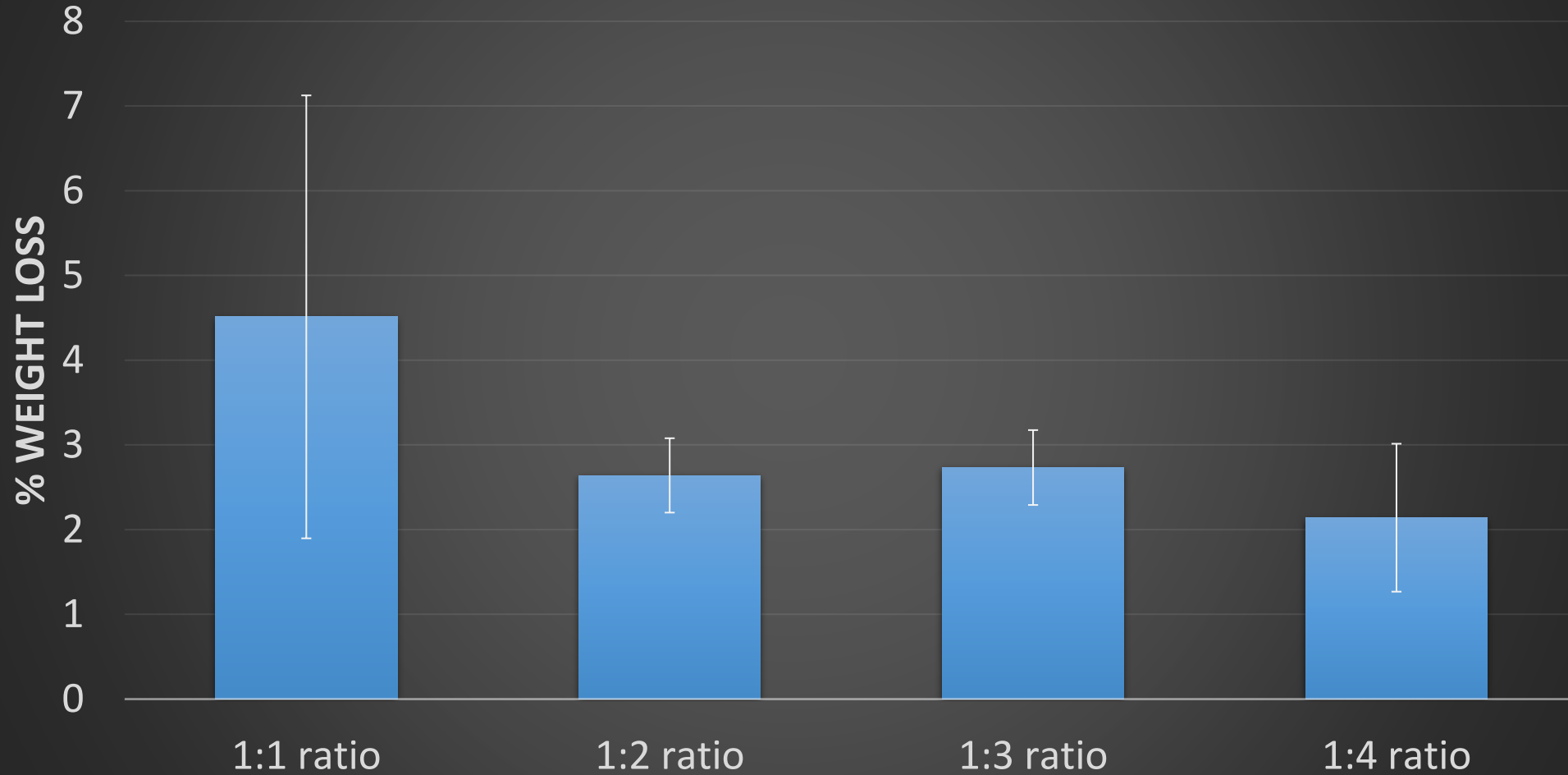


128°

pH and EC of Leachate



% Weight Loss After 3 Days





1:1

1:2

1:3

1:4



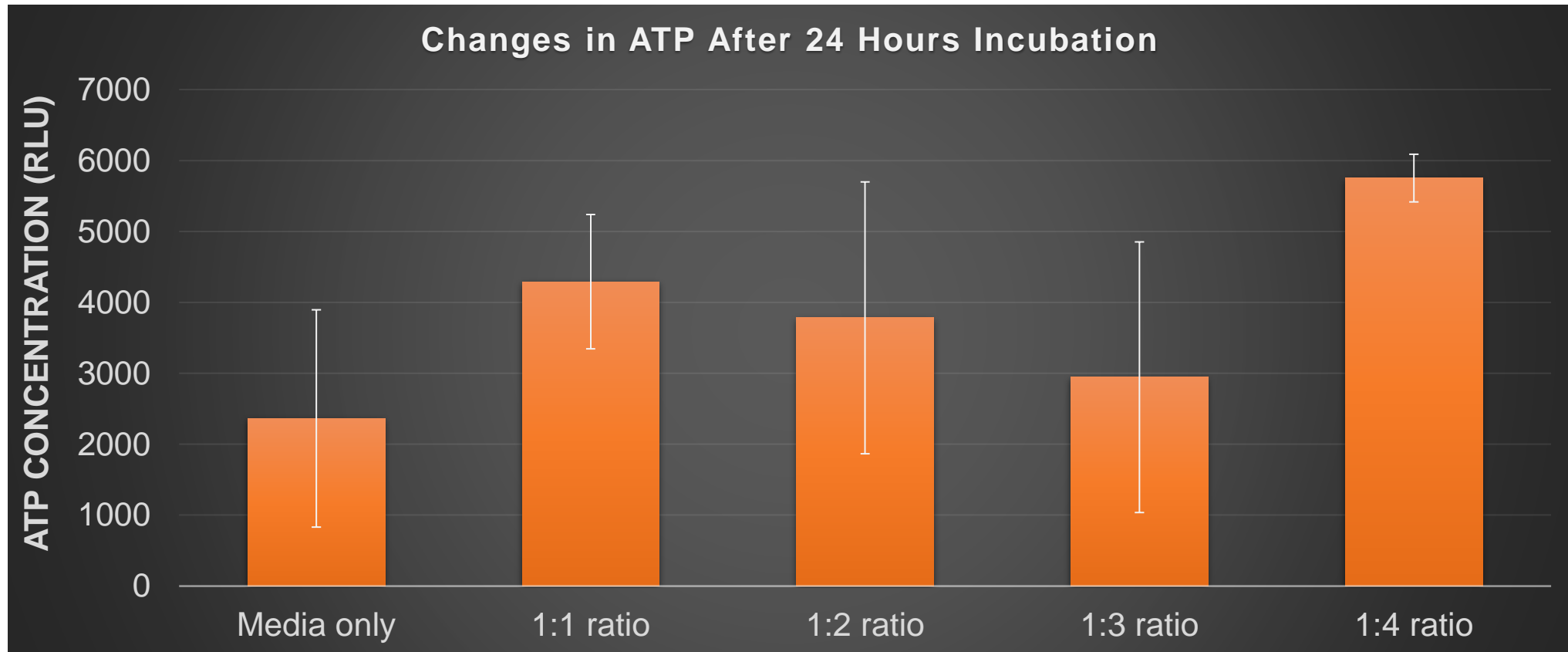
1:1

1:2

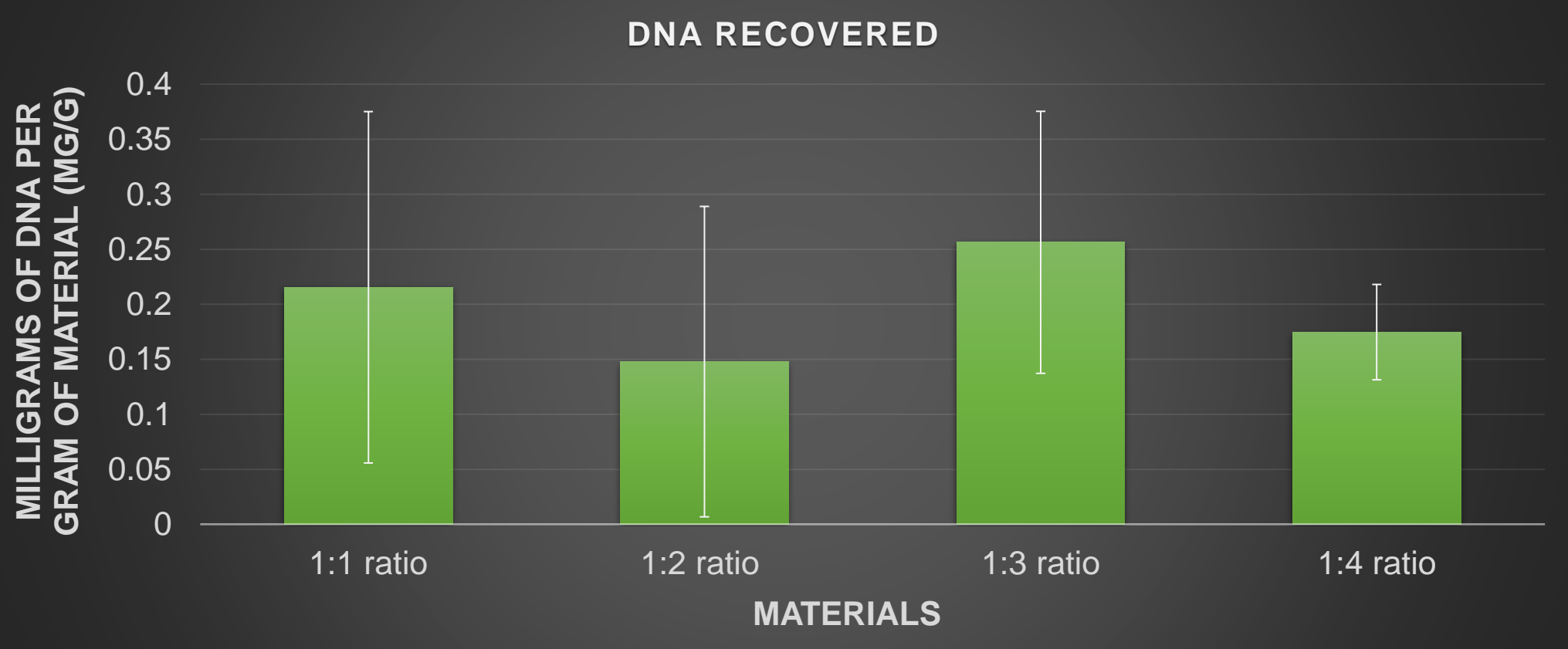
1:3

1:4

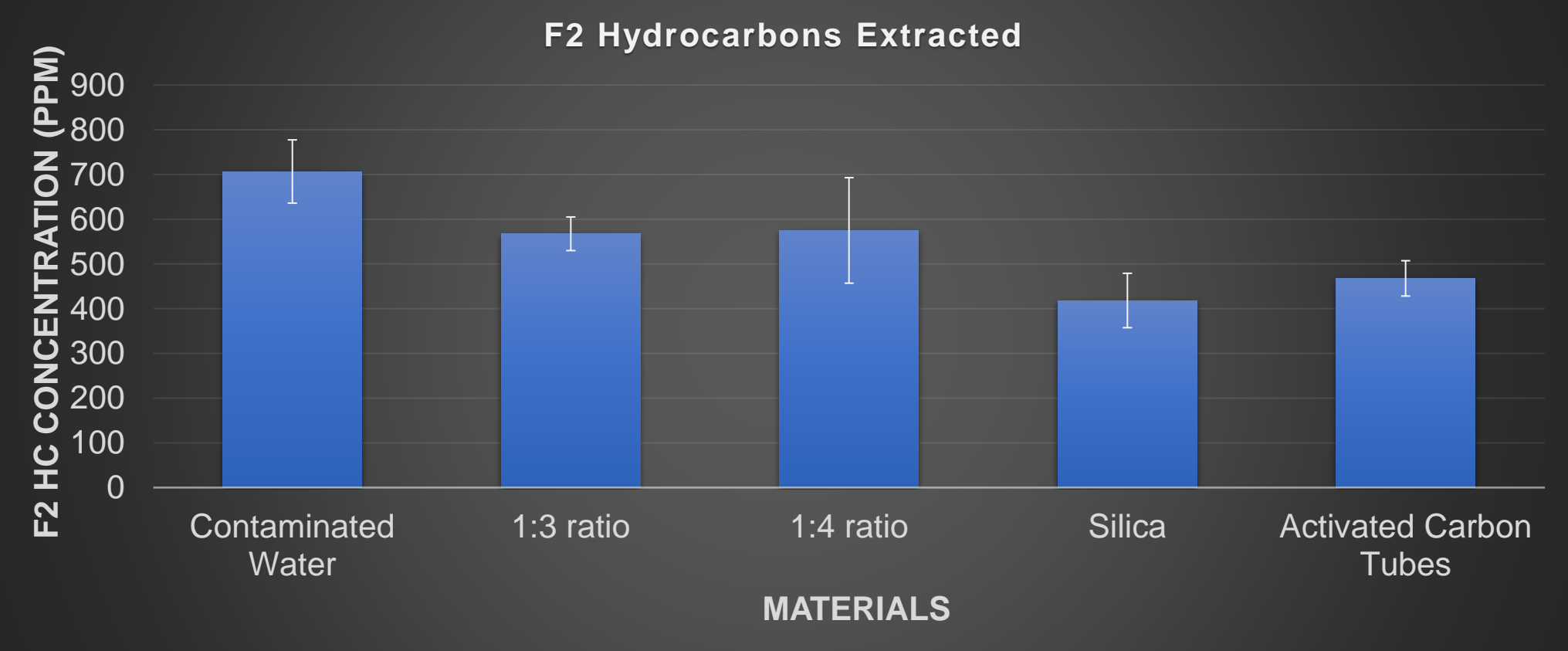
TOXICITY ASSESSMENT



DNA EXTRACTION

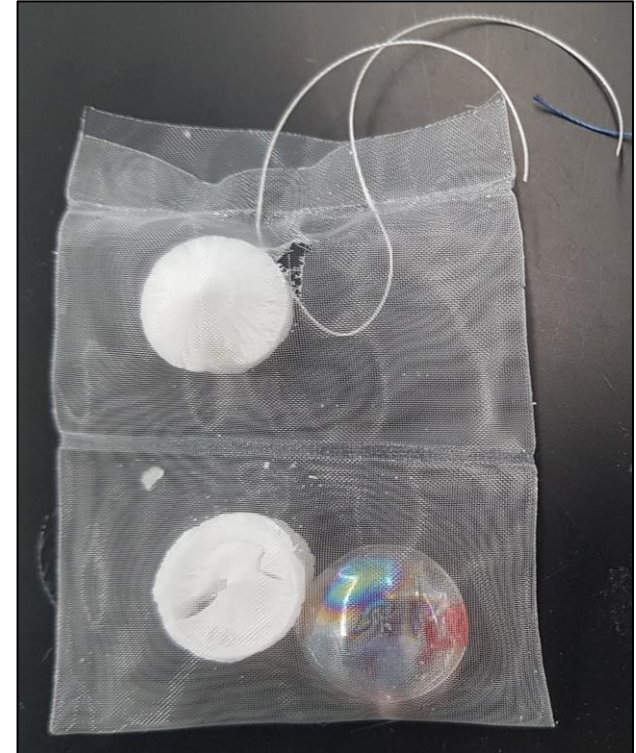


F2 HYDROCARBON ADSORPTION



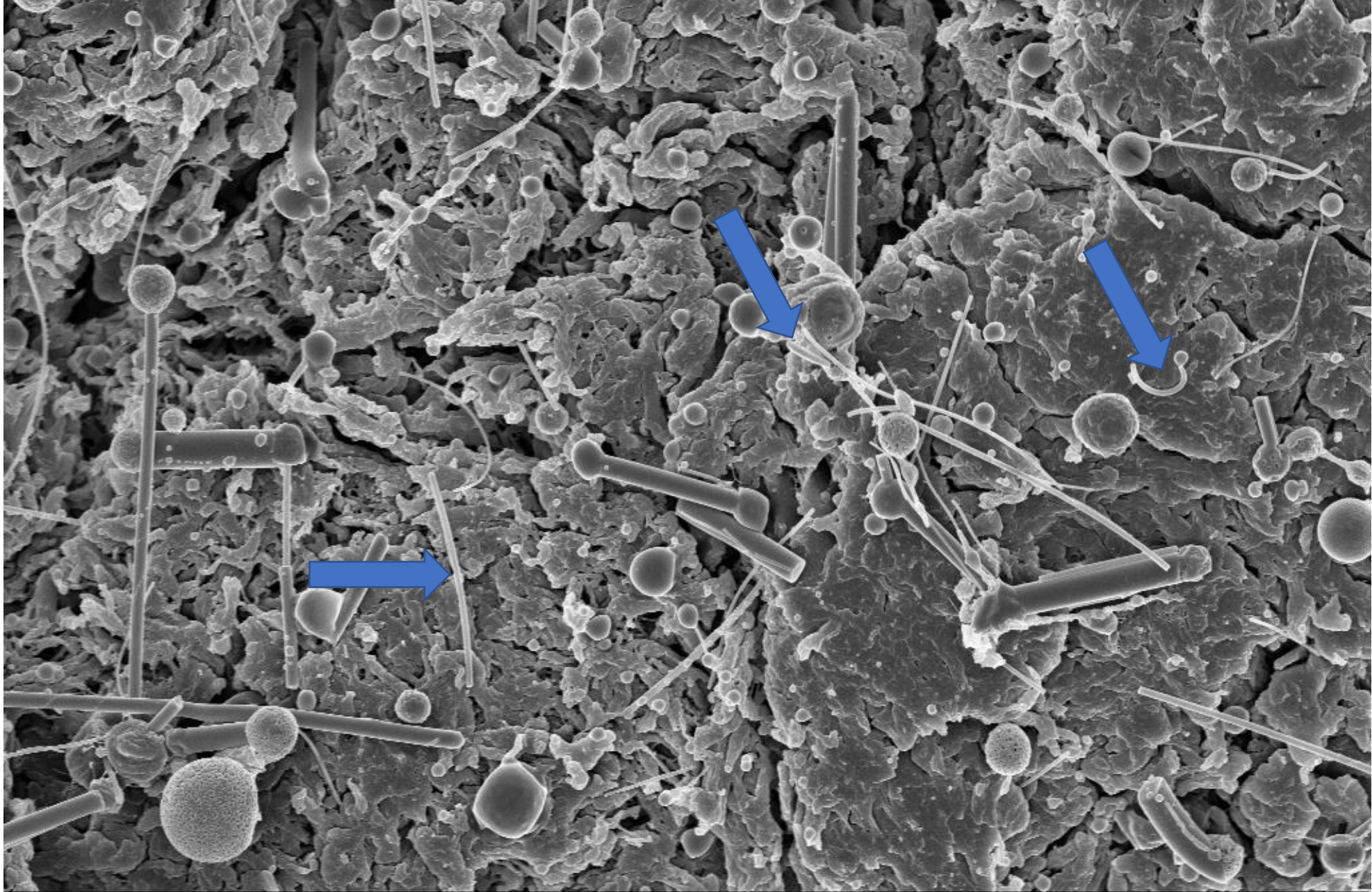
SUMMARY

- Can be heat sterilized
- Do not affect water chemistry
- 1:3 and 1:4 materials were more structurally resilient
- Non-toxic
- DNA can be recovered for sequencing
- Adsorbs fraction 2 (F2) hydrocarbons efficiently but not light fraction hydrocarbons
- 1:3 and 1:4 materials were selected for field trials



SITE DEPLOYMENT





1 μm

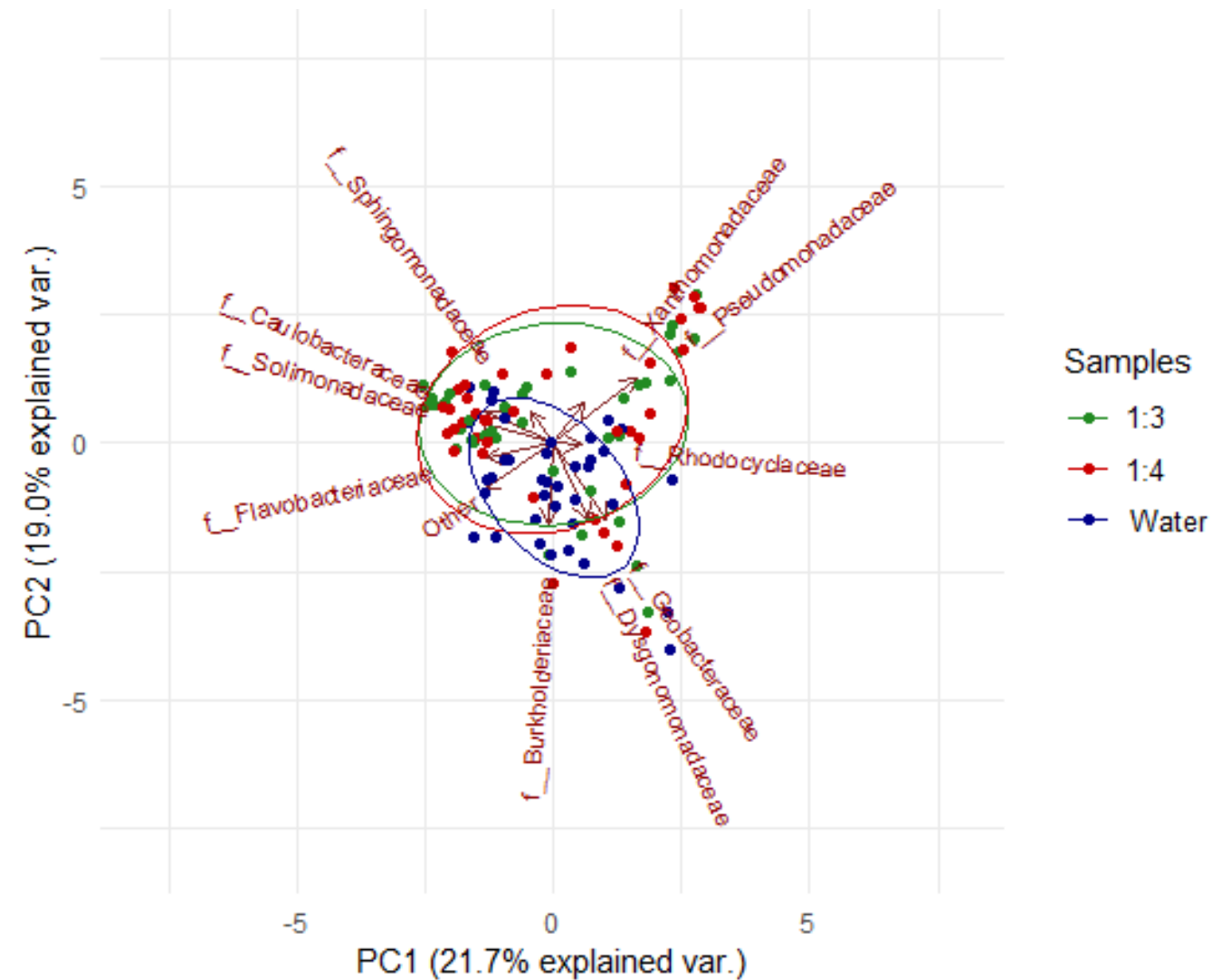

Mag = 3.42 K X
WD = 6.3 mm

EHT = 5.00 kV

Date :18 Feb 2020

File Name = 12_Sponge02.tif Signal A = InLens

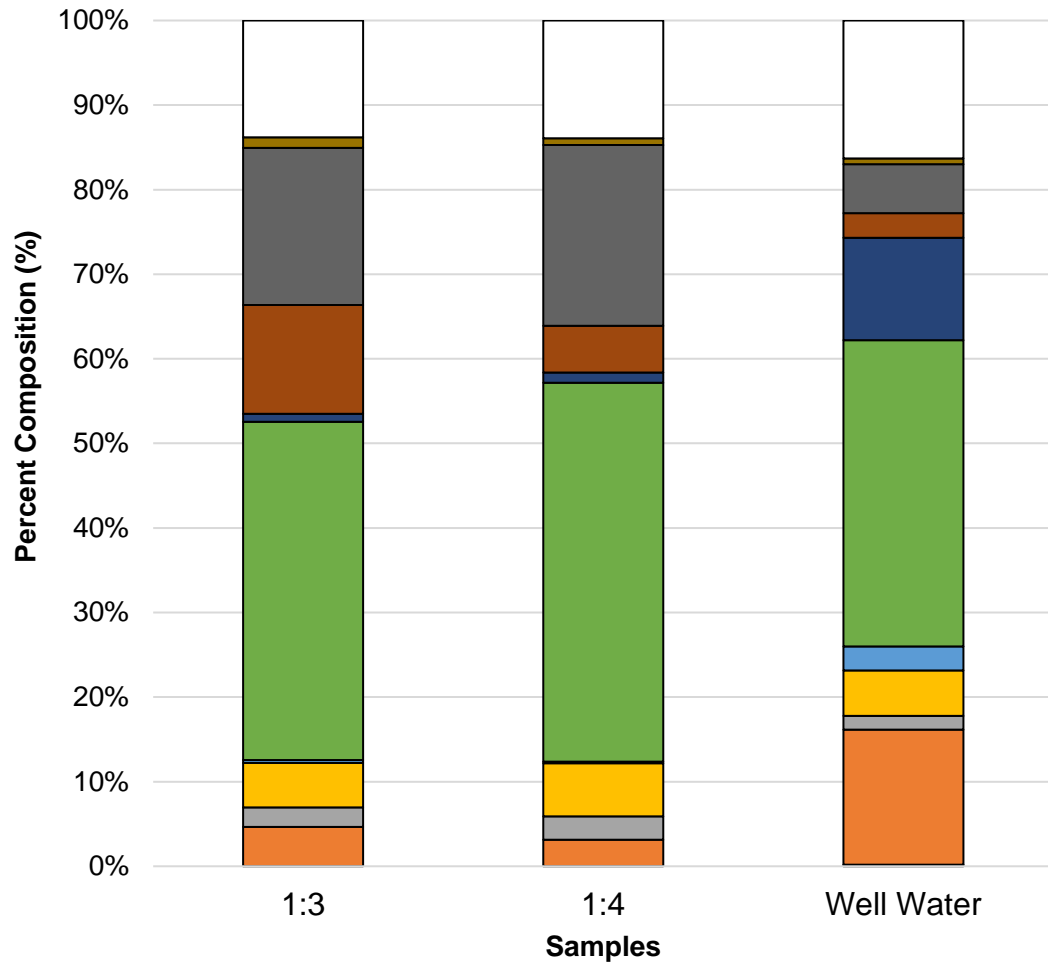




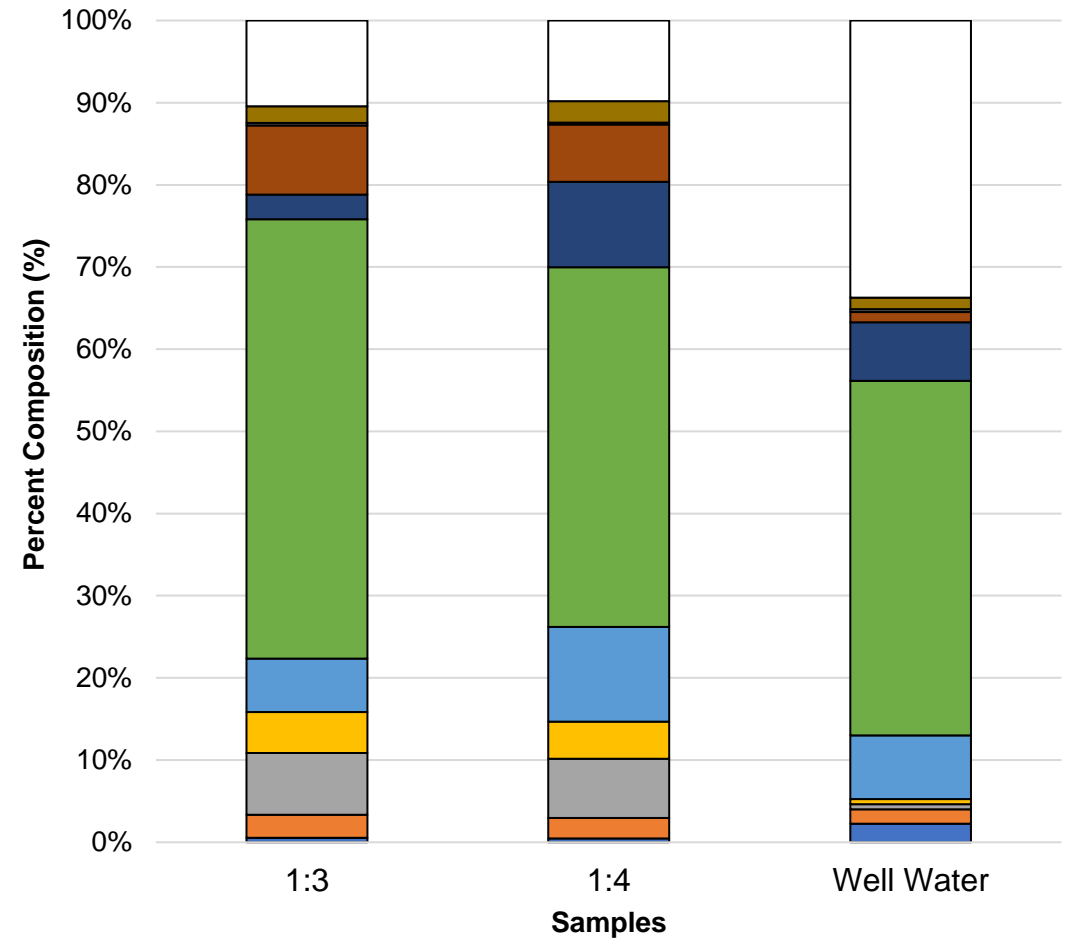
Principal component analysis (PCA)

- Silane concentrations did not have an effect on the microbial community
- Samplers did not substantially alter the microbial community

Site 1 Well 1 - August



Site 2 Well 5 - August



- Dysgonomonadaceae
- Sphingomonadaceae
- Rhodocyclaceae
- Xanthomonadaceae
- Flavobacteriaceae
- Geobacteraceae
- Pseudomonadaceae
- Solimonadaceae
- Caulobacteraceae
- Burkholderiaceae
- Other

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- Other

ONGOING WORK:

- F2 hydrocarbon analysis
- Mapping changes in the microbial community over time

SEEKING PARTNERS TO OPTIMIZE AND SCALE UP THE APPLICATION



- **NAIT Industry solutions**
- **Dedicated researchers to address industry's research and technical needs**
- **Industry retains the intellectual property**
- **Capable of leveraging industry capital with grant funding agencies**

ACKNOWLEDGEMENTS

Industry partners

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Mark Tse, Theresa Keenan

Government partners

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Natural Sciences and Engineering Research Council of Canada

NAIT team

- Dr. Paolo Mussone, *Applied Bio/Nano Industrial Research Chair* (pmussone@nait.ca)
- Dr. Weizheng (Wendi) Shen, *Materials Chemist*
- Ms. Kelsey Fleming and Louise Ramos, *Summer students*
- Mr. Jonathan Espiritu and Ms. Arantxa Pino Persico, *Technologists*



Ongoing Hydrocarbon Analysis

