

SYNTHESIS, CHARACTERIZATION, AND FIELD EVALUATION OF NOVEL CELLULOSE NANOCRYSTALS-BASED MATERIALS TO MONITOR HYDROCARBONS AND BACTERIA IN GROUNDWATER

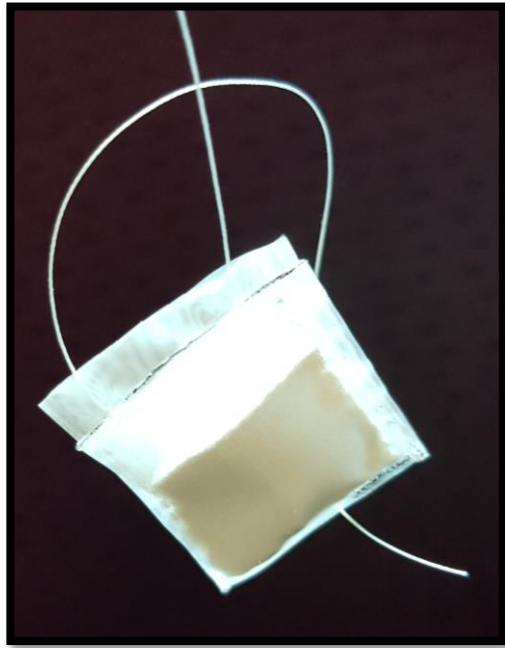
PRESENTER: DR. WEI-ZHENG (WENDI) SHEN



BACKGROUND



PREVIOUS WORK



~1.5 cm

HYDROCARBON TRAPS

- Tenax beads
- Silicone elastomer
- Silicone rubber cord
- Polyoxymethylene

BACTERIA SAMPLERS

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

SUITABLE CANDIDATES

- Non-toxic
- Water resistant
- High surface area and porosity
- Stable at temperatures required for heat sterilization
- Tunable physical and chemical properties
- Support biofilm growth and yield DNA for downstream analyses
- Will not alter the microbial community

CURRENT CNC APPLICATIONS

WATER REMEDIATION:

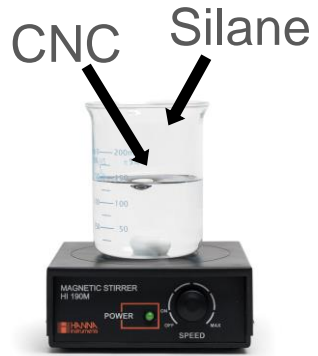
- Heavy metals
- Dyes
- Oil
- Pesticides
- Antibiotics
- Other organic pollutants



Particle diameter: 5-15nm
Particle length: 100-200nm

Nanomaterials, 2017, 7, 57; doi:10.3390/nano7030057

SYNTHESIS



Reaction



Addition to mold



Freeze with liquid nitrogen



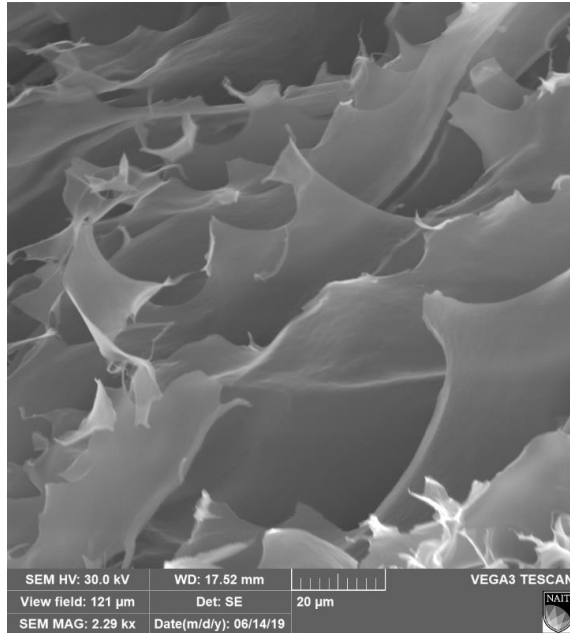
Freeze-dry



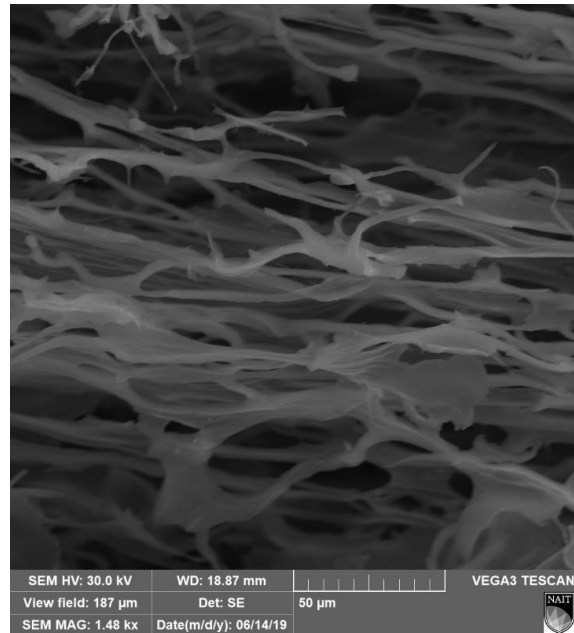
Nanocomposite

SEM

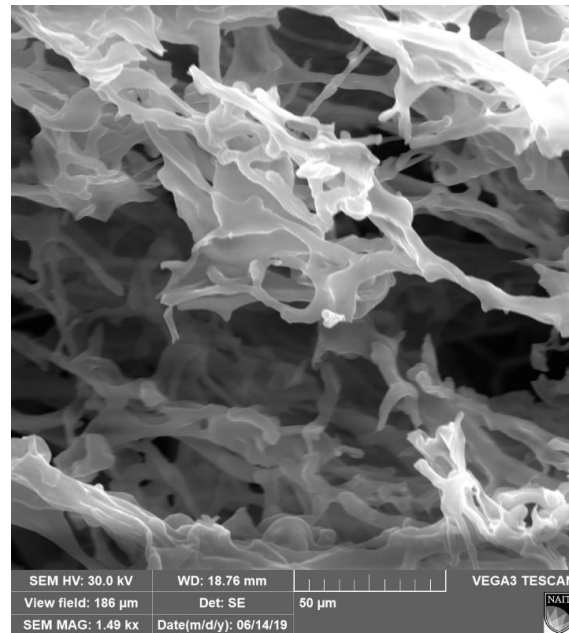
≤50um Magnification



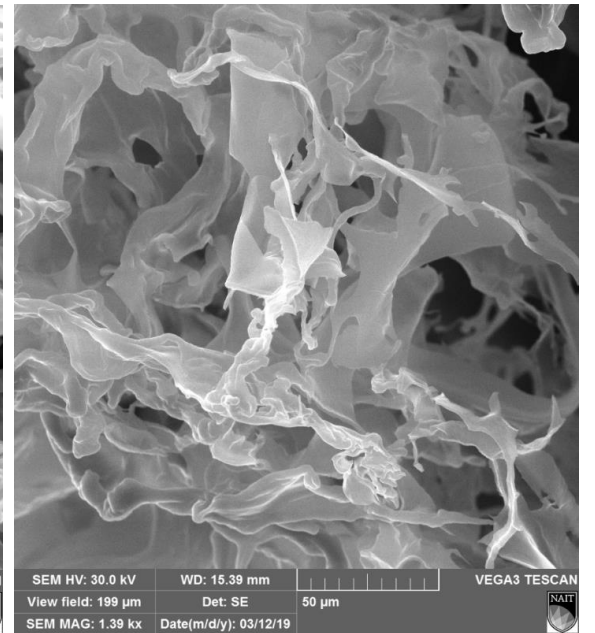
1:1



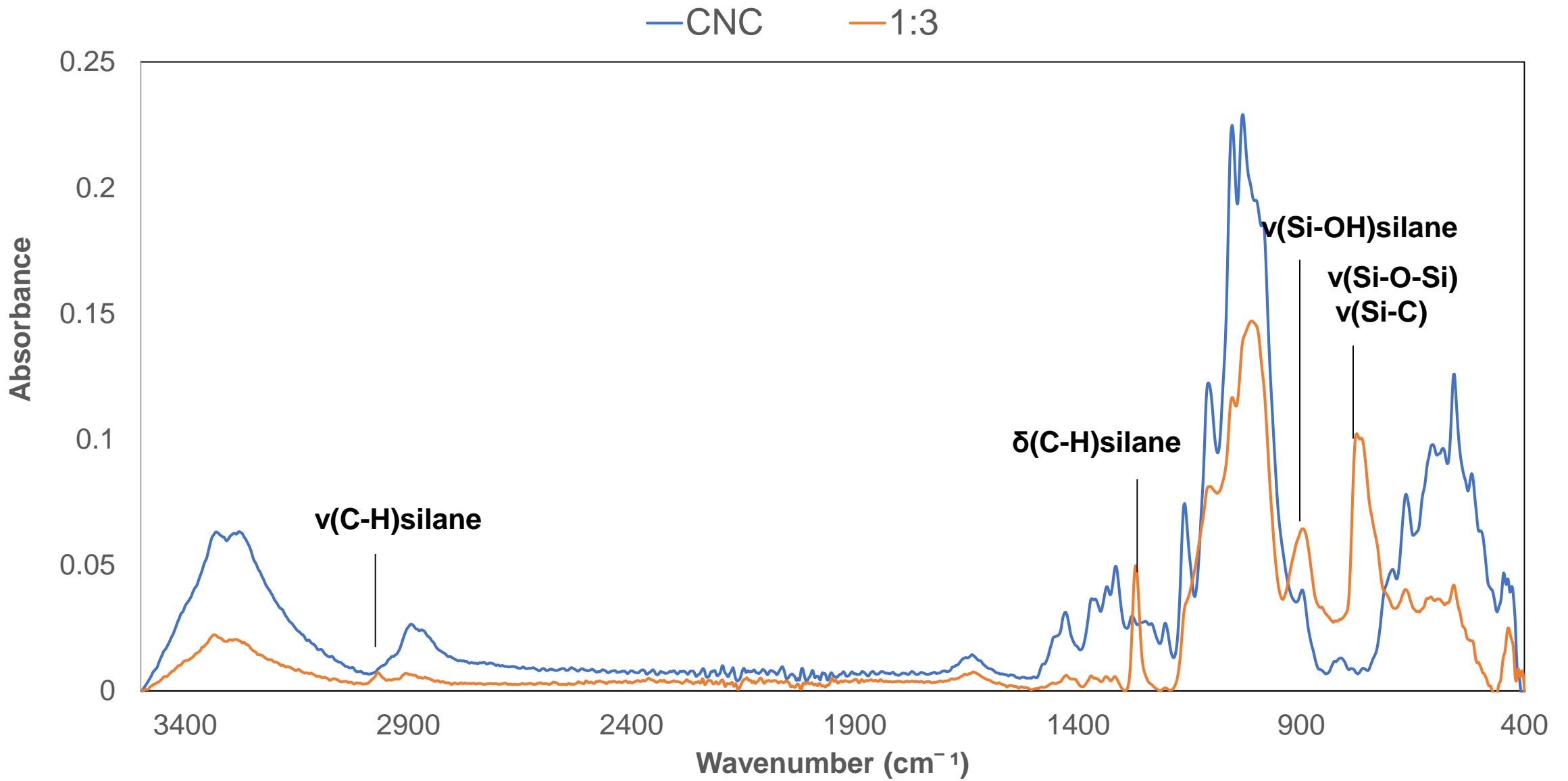
1:2



1:3

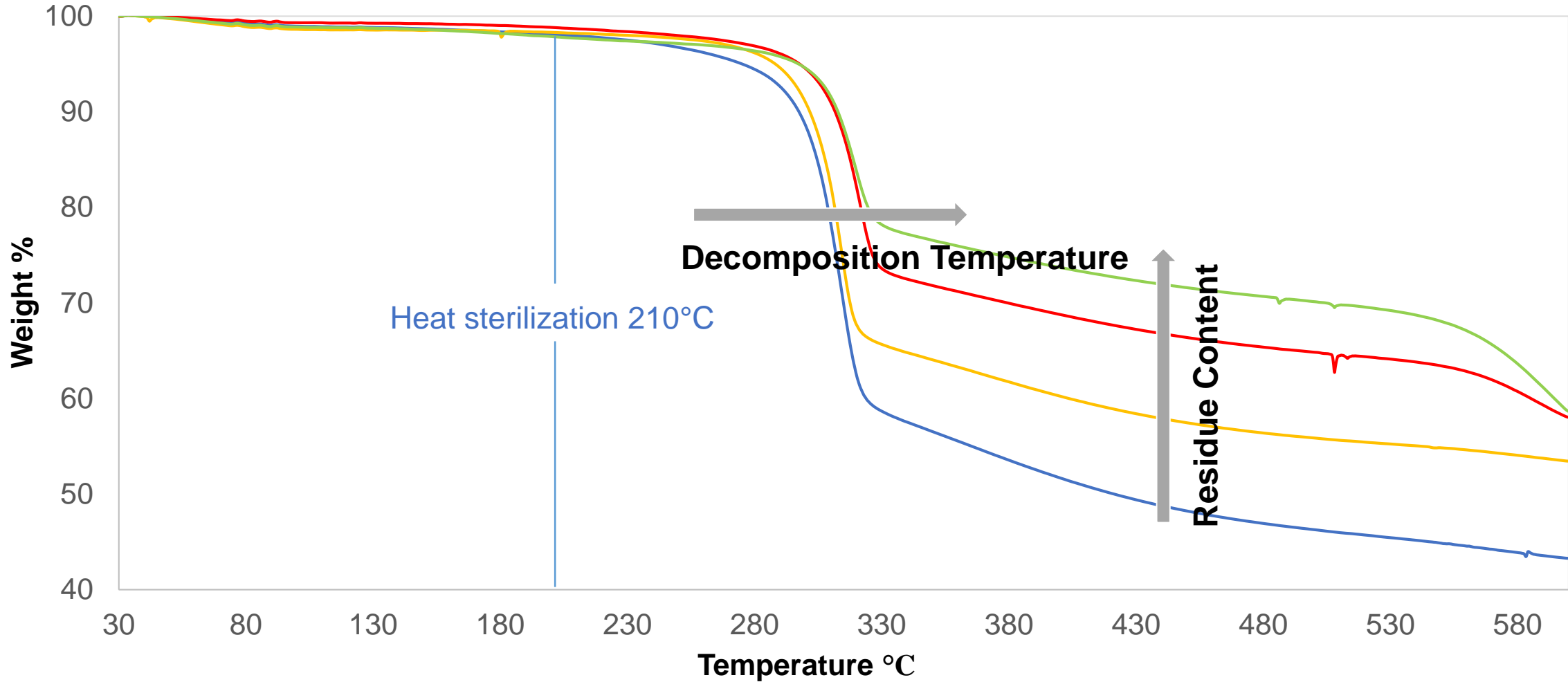


1:4

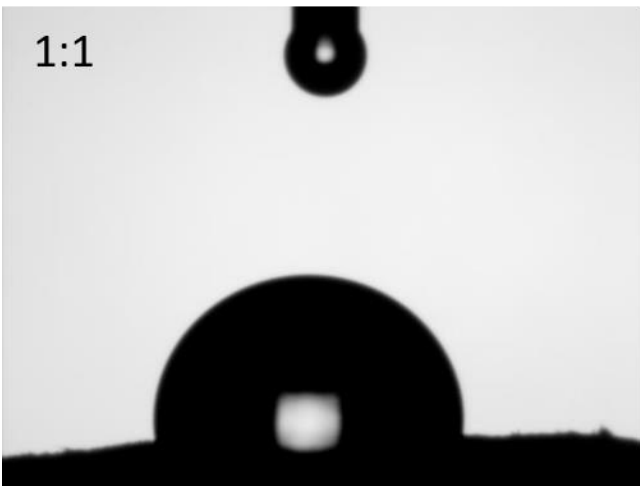


Thermal Stability

— 1:1 — 1:2 — 1:3 — 1:4



HYDROPHOBICITY



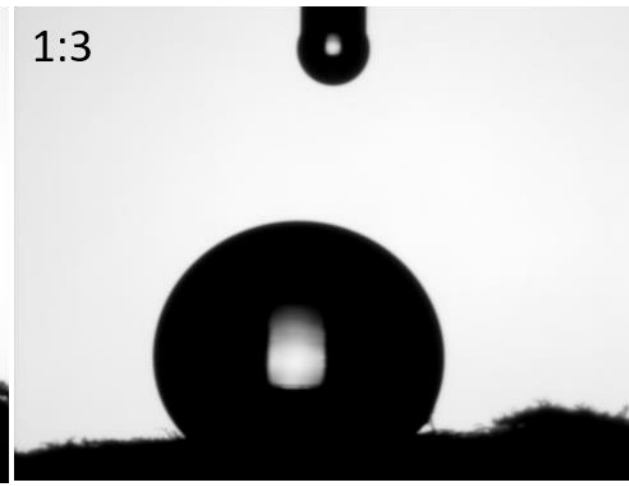
1:1

90°



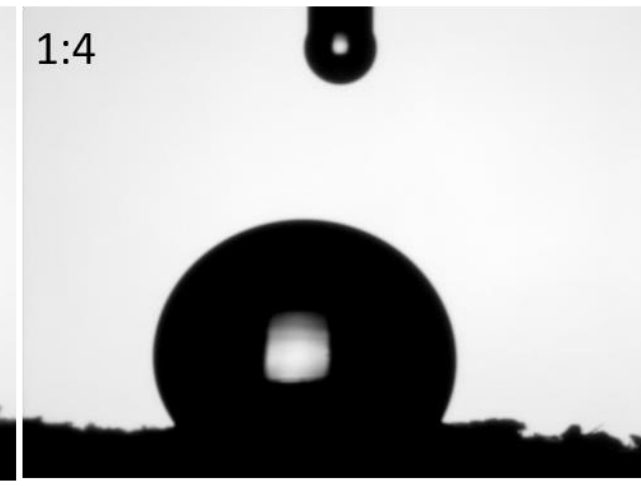
1:2

110°



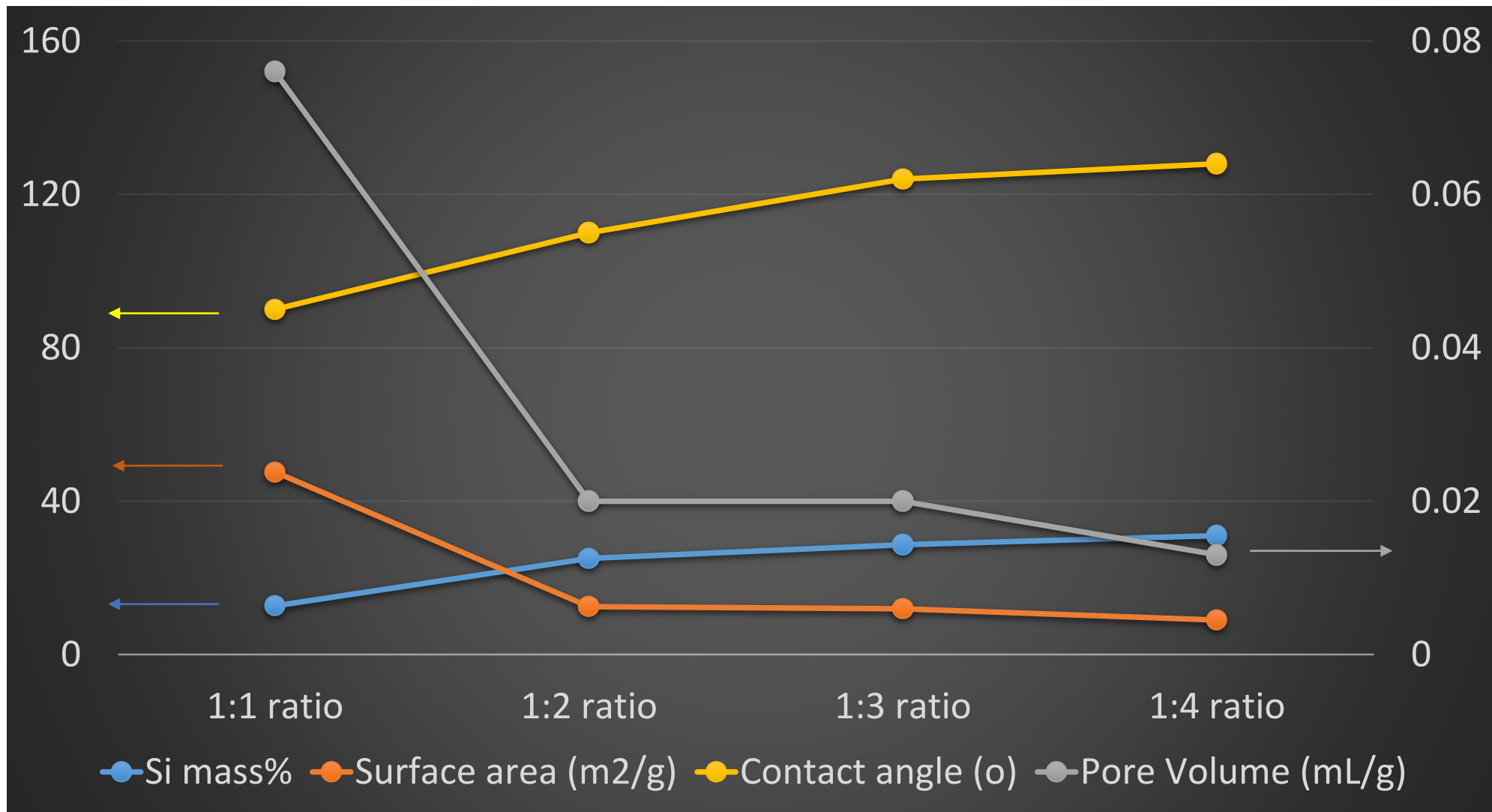
1:3

124°

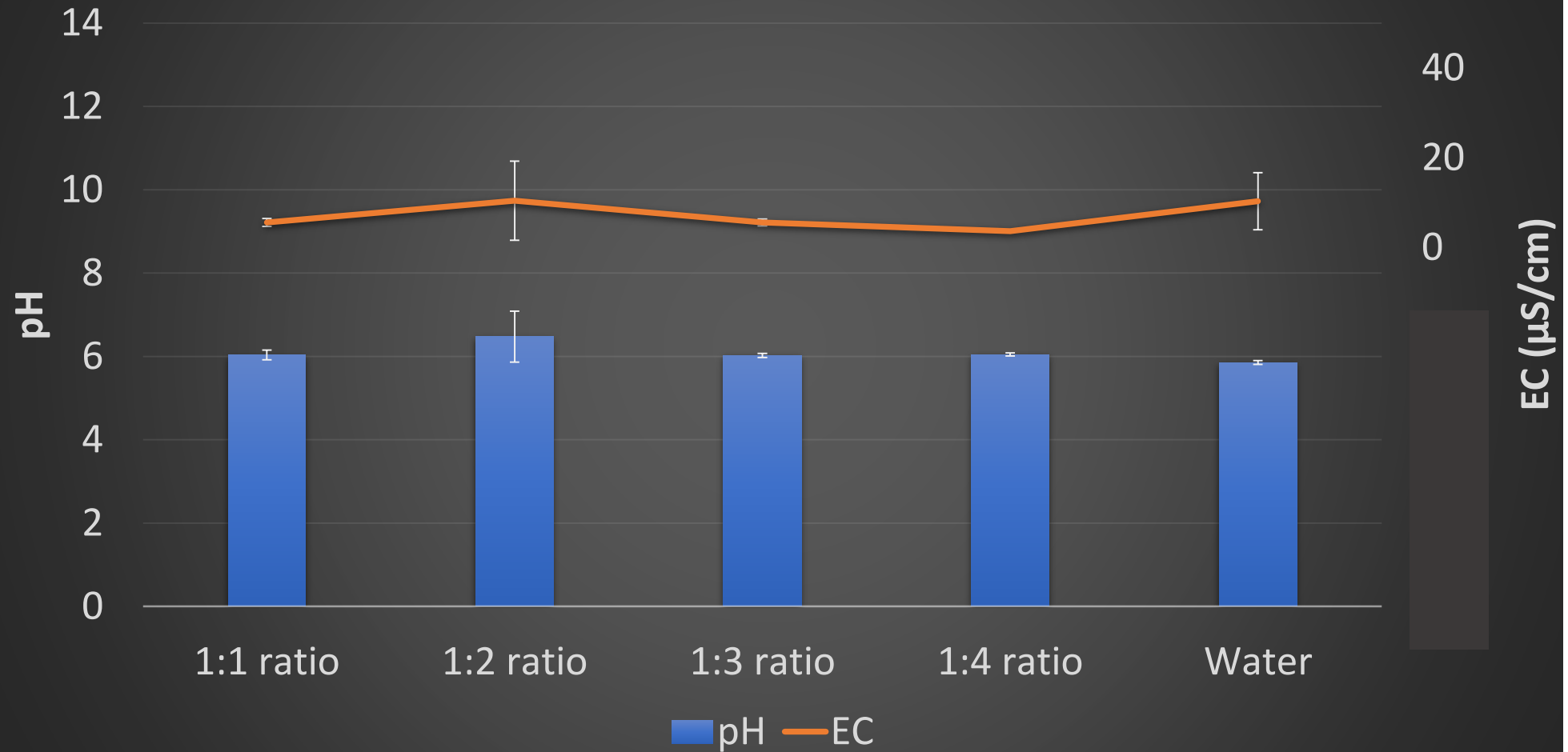


1:4

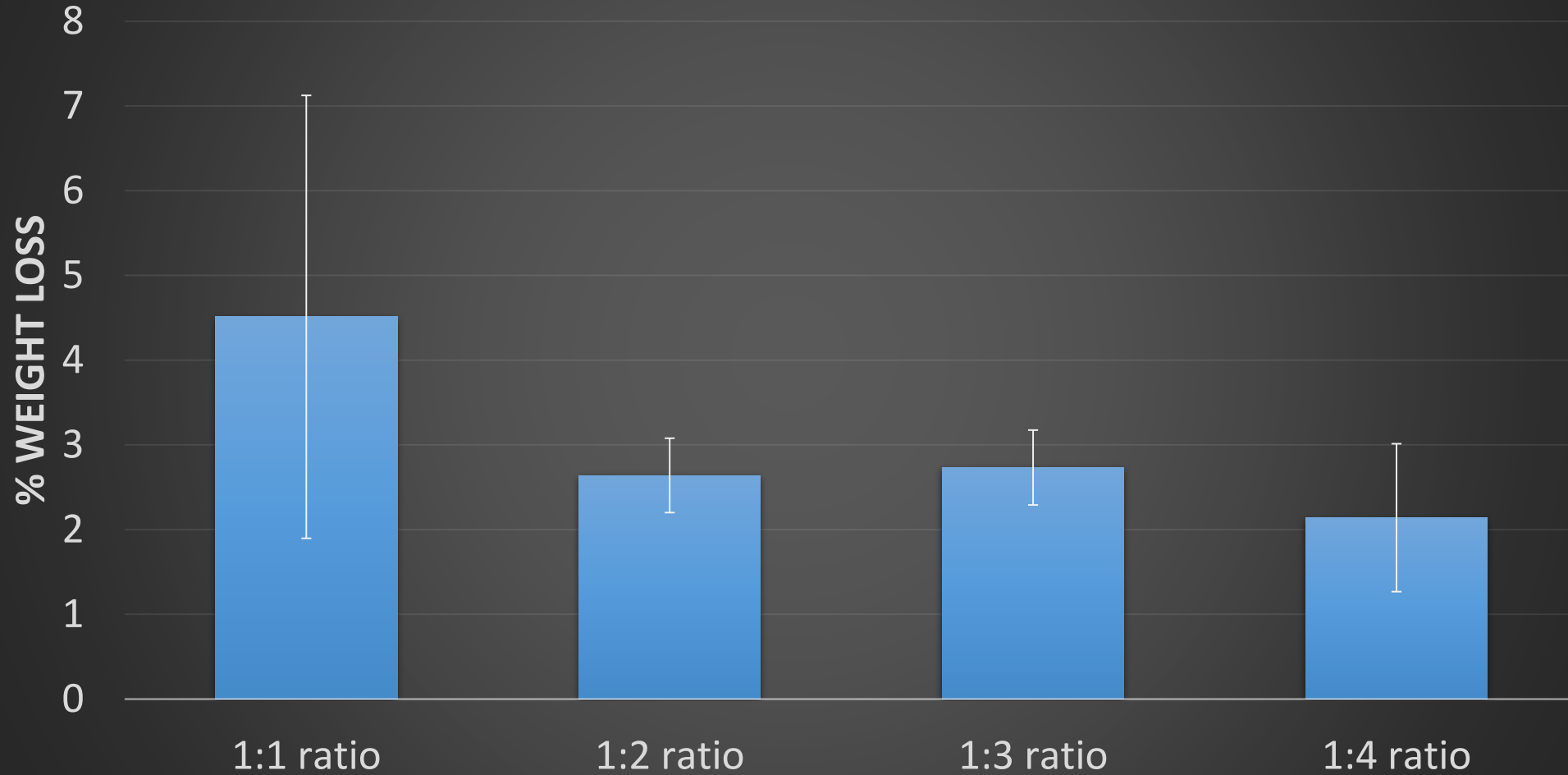
128°



pH and EC of Leachate



% Weight Loss After 3 Days





1:1

1:2

1:3

1:4



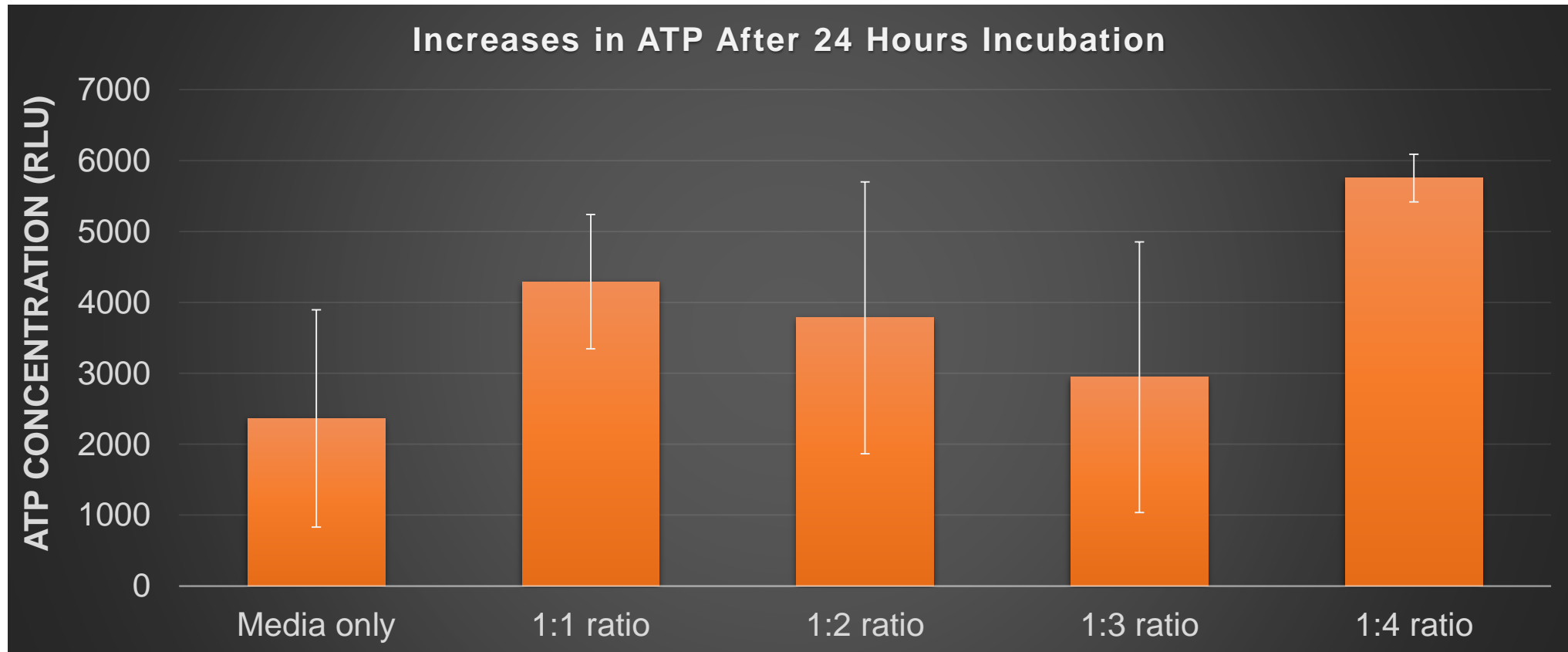
1:1

1:2

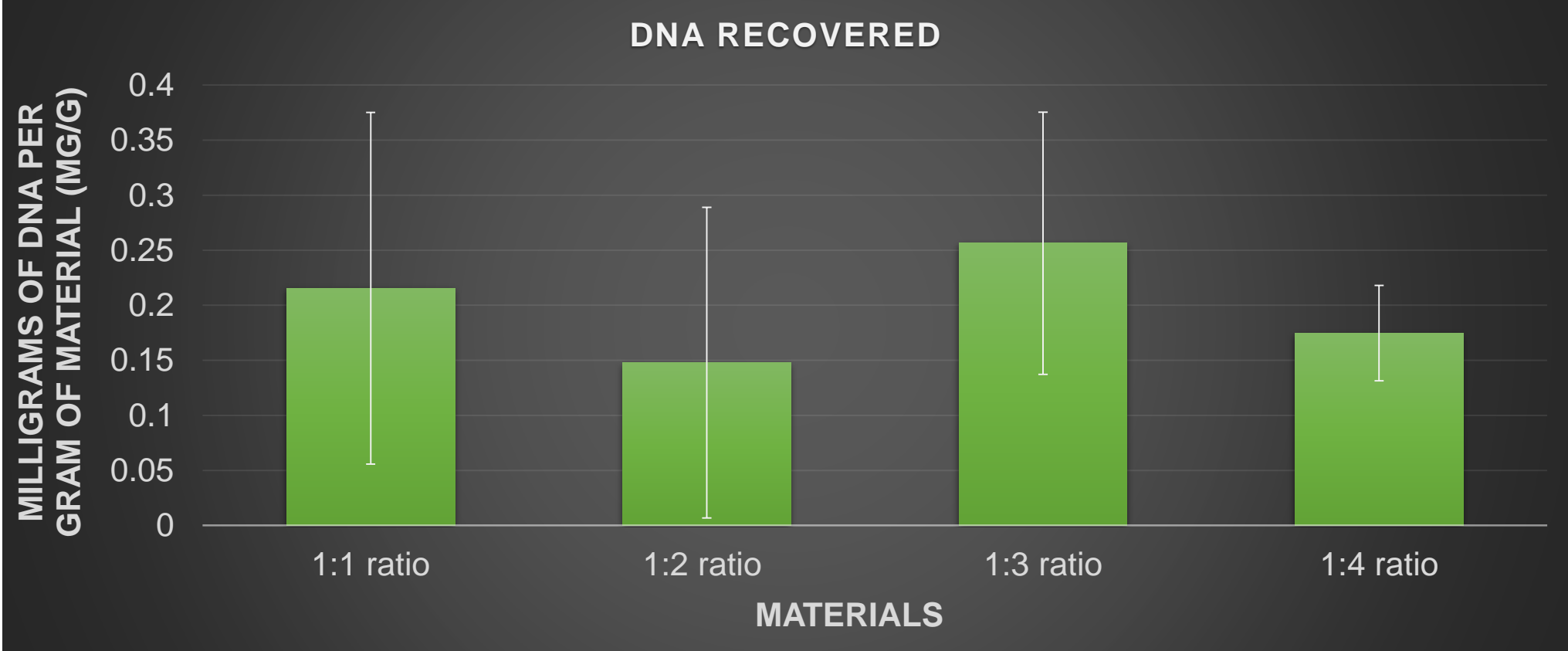
1:3

1:4

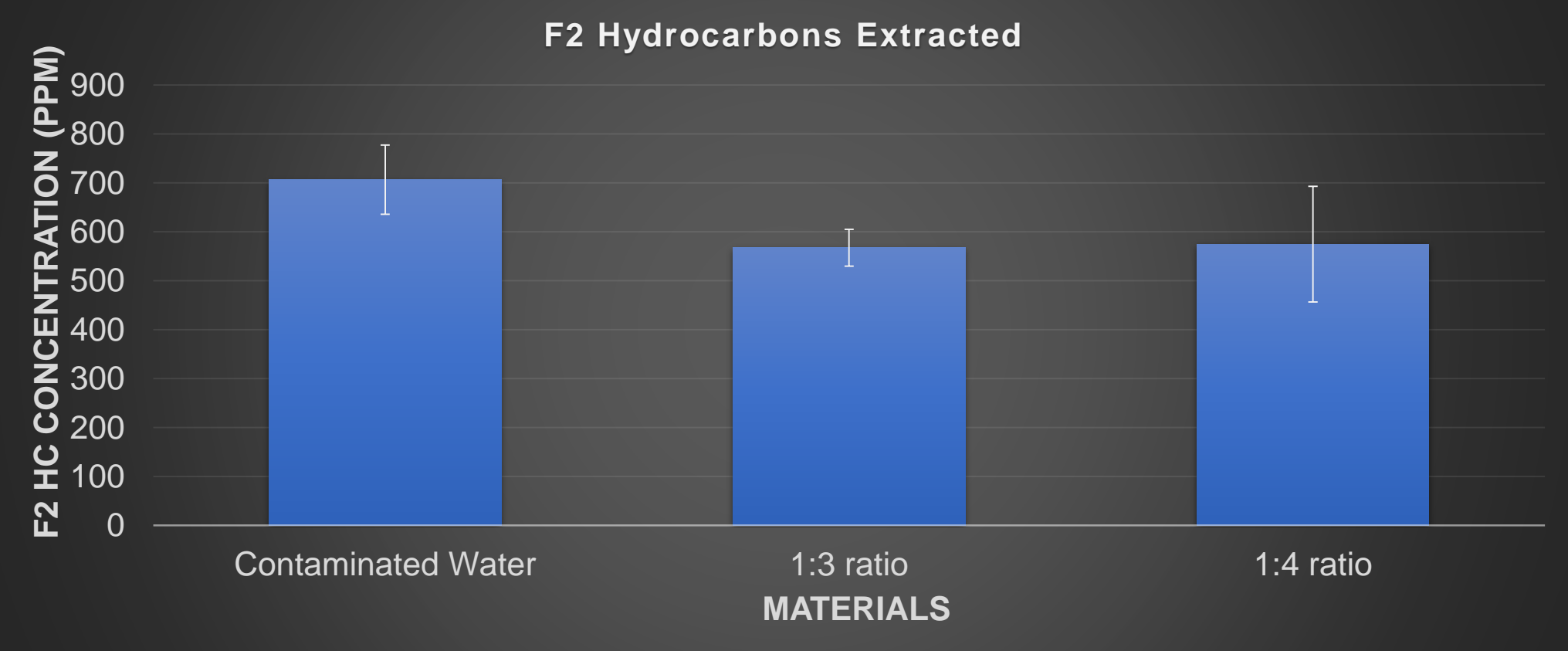
TOXICITY ASSESSMENT



DNA EXTRACTION

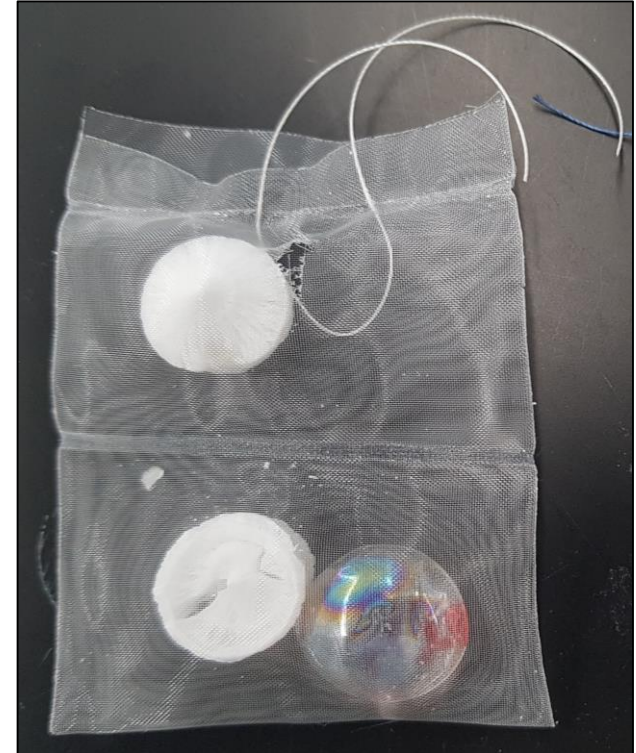


F2 HYDROCARBON ADSORPTION



SUMMARY

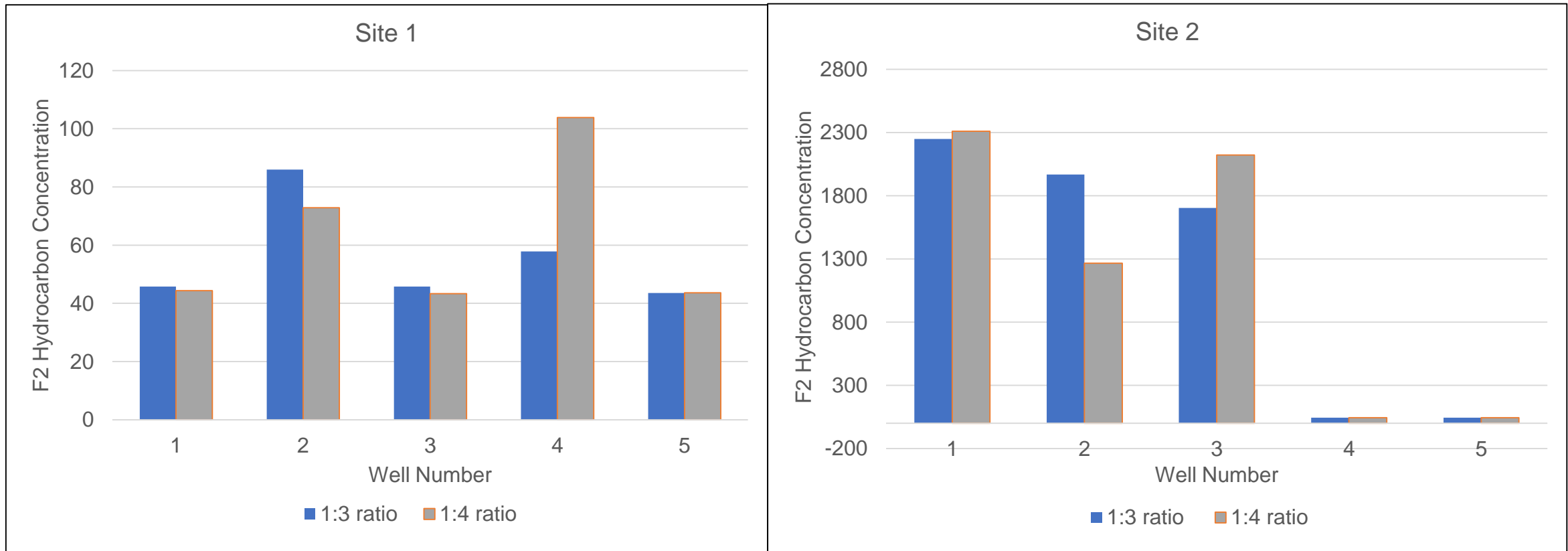
- Can be heat sterilized
- Do not affect water chemistry
- 1:3 and 1:4 materials were more structurally resilient
- Non-toxic
- DNA can be recovered for sequencing
- Adsorbs fraction 2 (F2) hydrocarbons efficiently but not light fraction hydrocarbons
- 1:3 and 1:4 materials were selected for field trials



SITE DEPLOYMENT



SITE SAMPLES



ONGOING WORK:

- Deployment and retrieval of samplers until Oct 23rd, 2019
- F2 hydrocarbon analysis
- DNA extraction and sequencing

SEEKING PARTNERS TO OPTIMIZE AND SCALE UP THE APPLICATION

CONTACT: pmussone@nait.ca



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NAIT team

- Dr. Paolo Mussone, *Applied Bio/Nano Industrial Research Chair*
- Ms. Victoria Collins MSc, *Microbiology Specialist*
- Ms. Kelsey Fleming and Louise Ramos, *Summer students*
- Mr. Jonathan Espiritu and Ms. Arantxa Pino Persico, *Technologists*

