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Alternate materials for the capture and quantification of gaseous oxidized mercury compounds from the atmosphere

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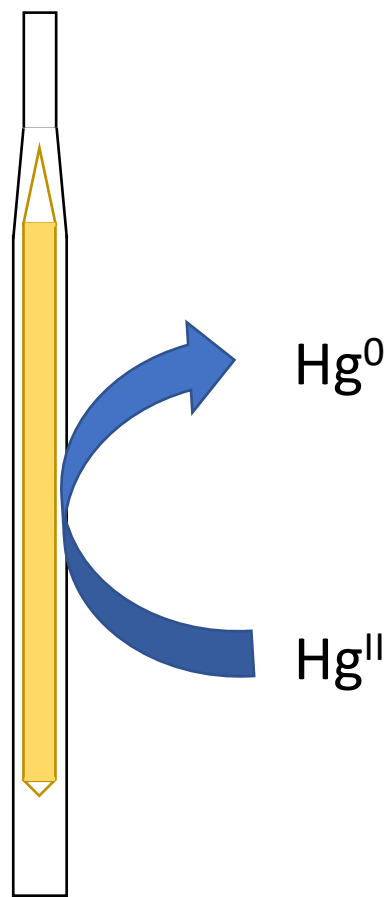
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Methods to observe chemistry are under development



New materials for Hg^{II} preconcentration are needed



McClure et al., 2013

Hg^{II} loss from KCl as Hg⁰ with atmospheric exposure

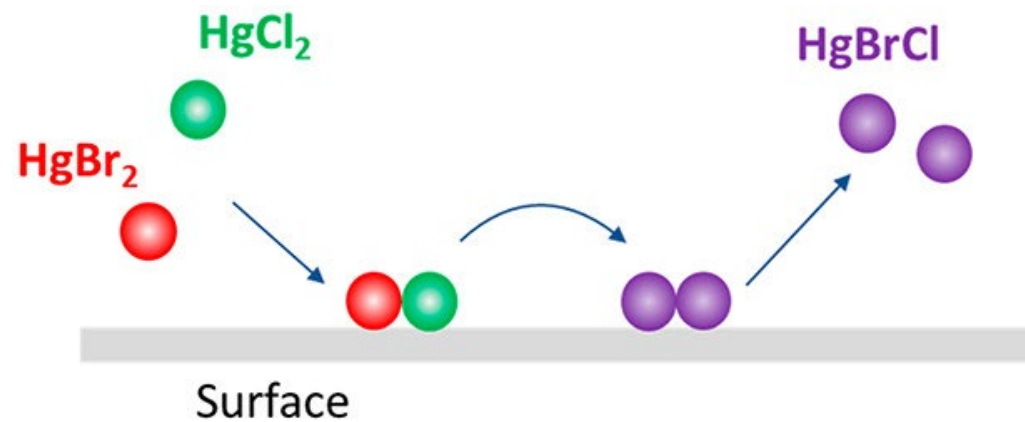
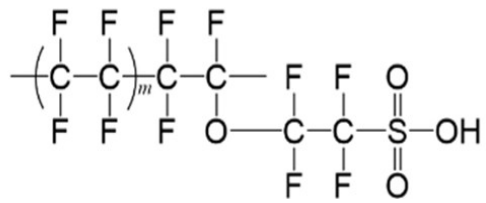


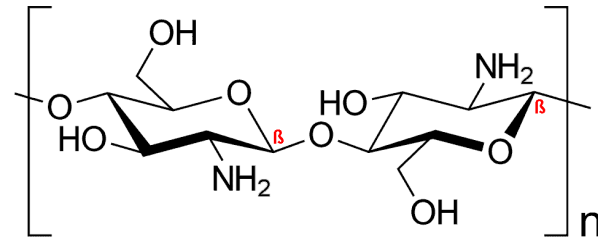
Figure: Mao and Khalizov, 2021

At high concentrations

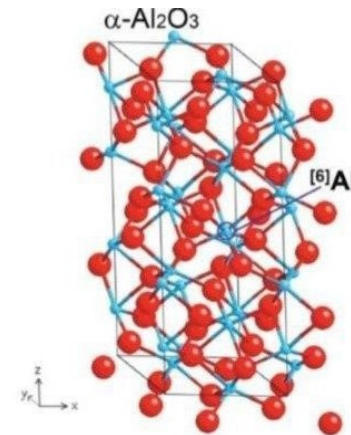
Ideal materials are selective and quantitative for sorption of Hg^{II} over Hg^0 and can be thermally desorbed



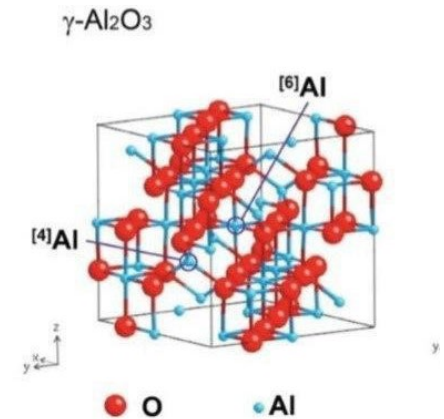
Perfluorosulfonic acid
(PFSA-M)



Chitosan



α -alumina



γ -alumina

Ideal materials are selective and quantitative for sorption of Hg^{II} over Hg^0 and can be thermally desorbed



Calcium aluminate
(CaAl)



Calcium Phosphate
(CaP)

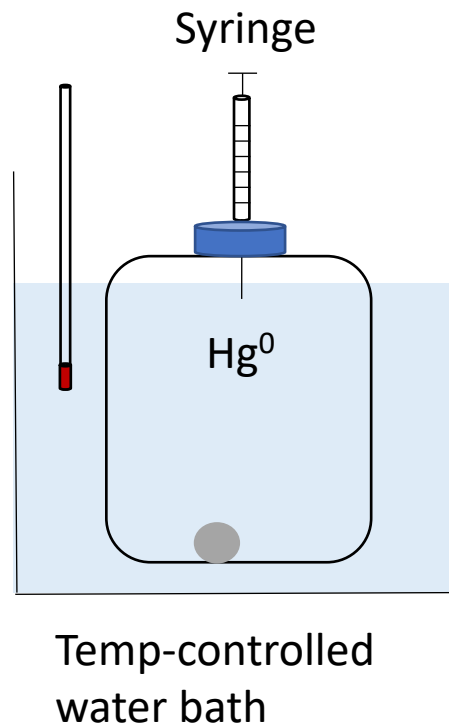


Iron Phosphate
(FeP)

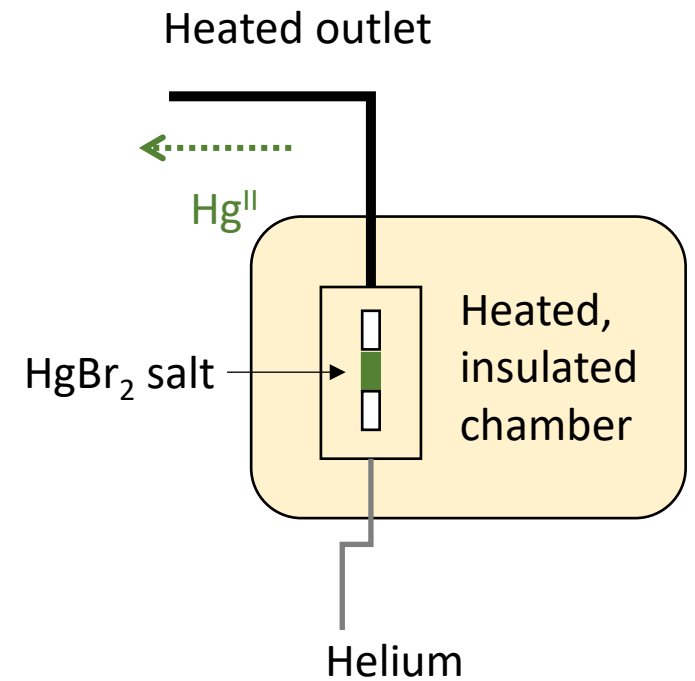
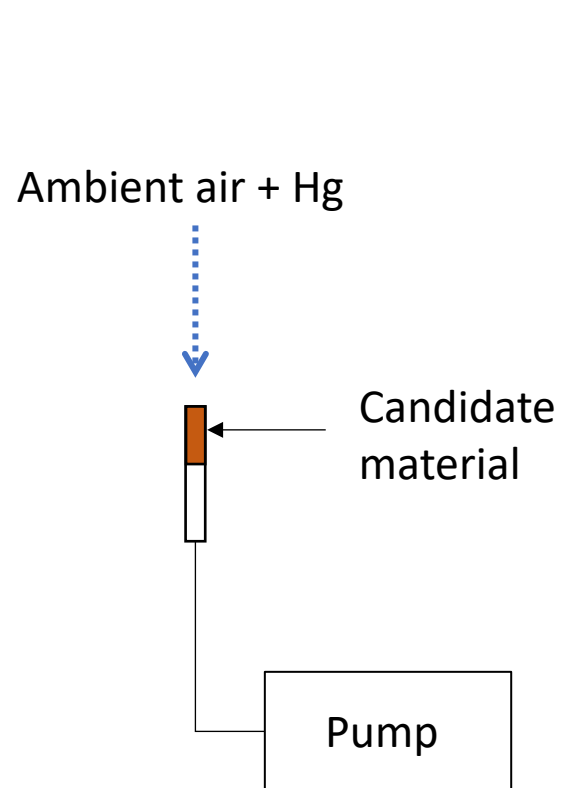
Research Questions

- Do these materials sorb Hg^{II} without sorbing Hg^0 ?
- How do these materials compare to CEM when deployed in the field?
- Is Hg^{II} lost from CEM or these materials during field deployment?
- Are there changes in Hg^{II} chemistry during field deployment on nylon?

Do these materials sorb Hg^{II} but not Hg^0 ?

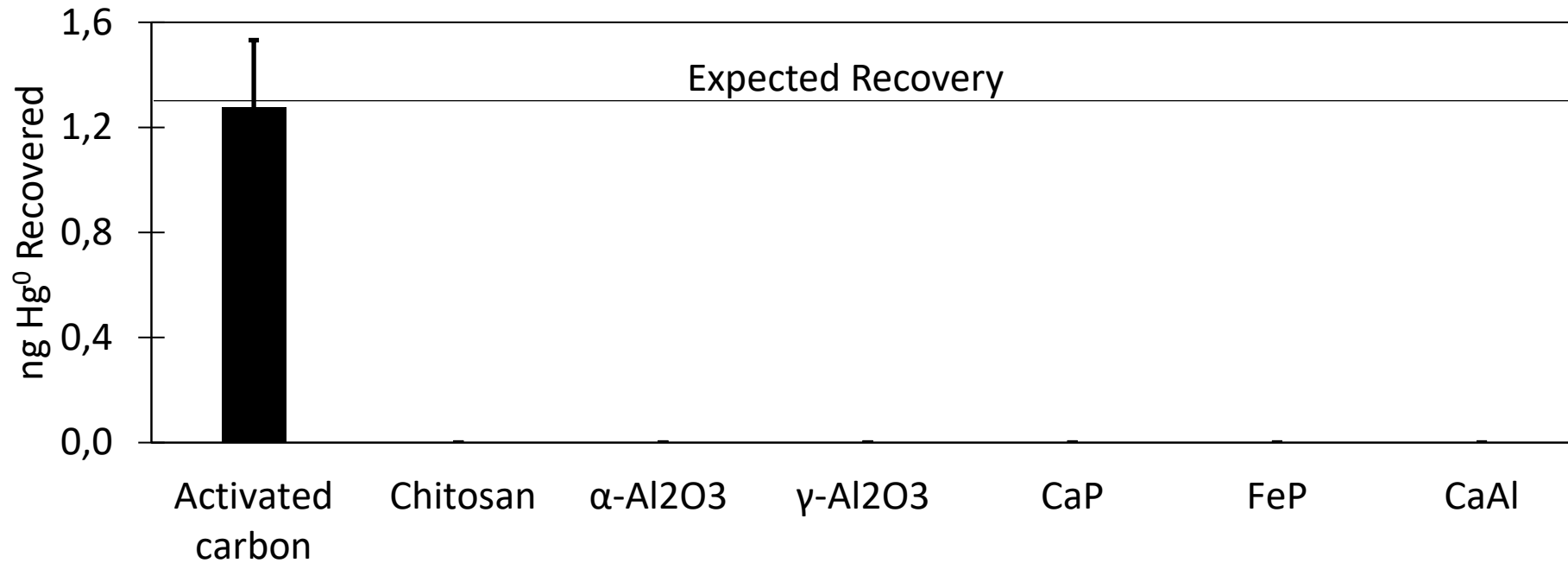


Analyzed by EPA 7473 (combustion)



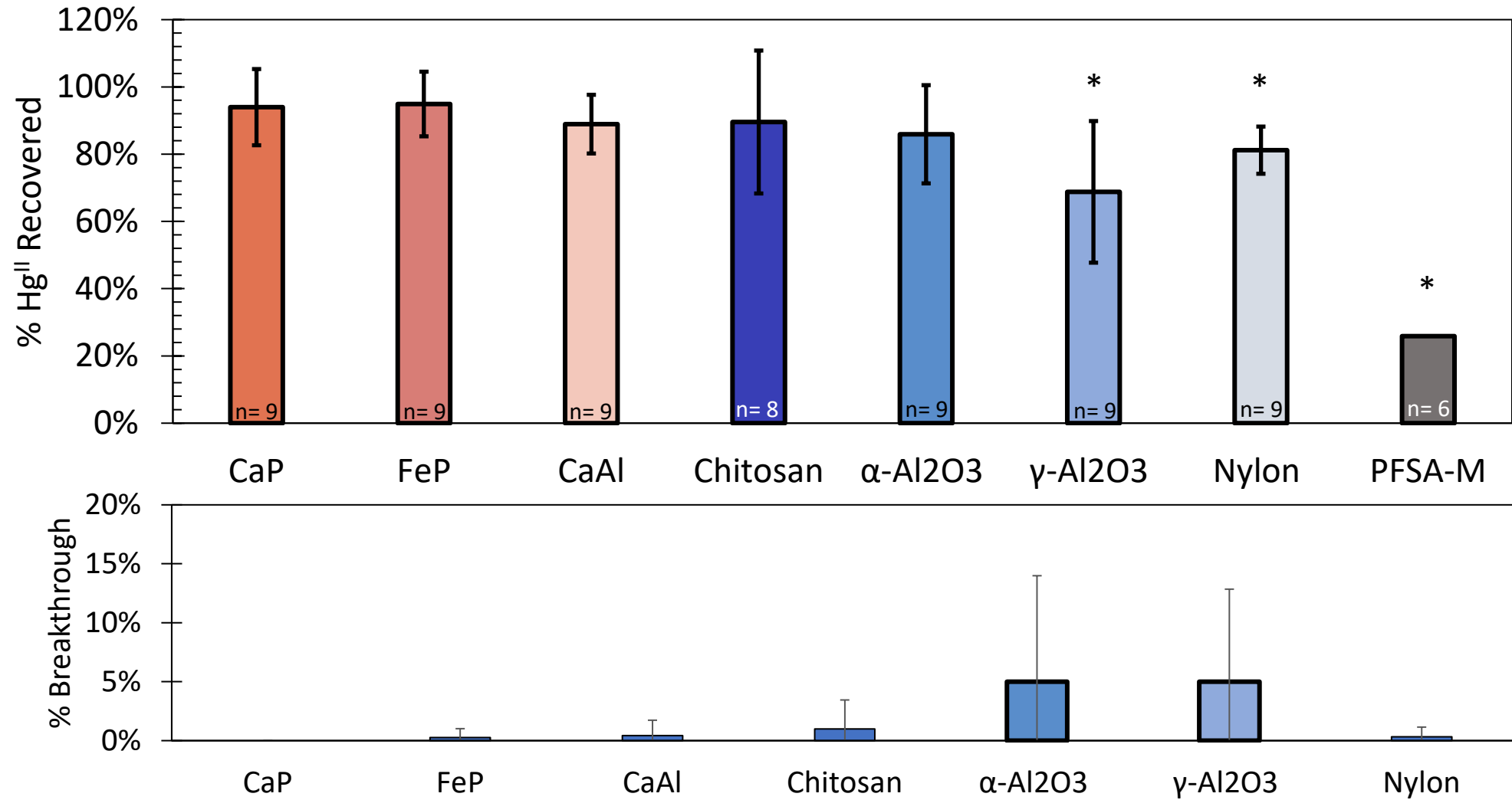
Analyzed by EPA 1631 (BrCl digestion)

Hg⁰ Sorption to alternative materials



100% Breakthrough recovered on CaP, FeP, and CaAl

Hg^{II} sorption to alternative materials

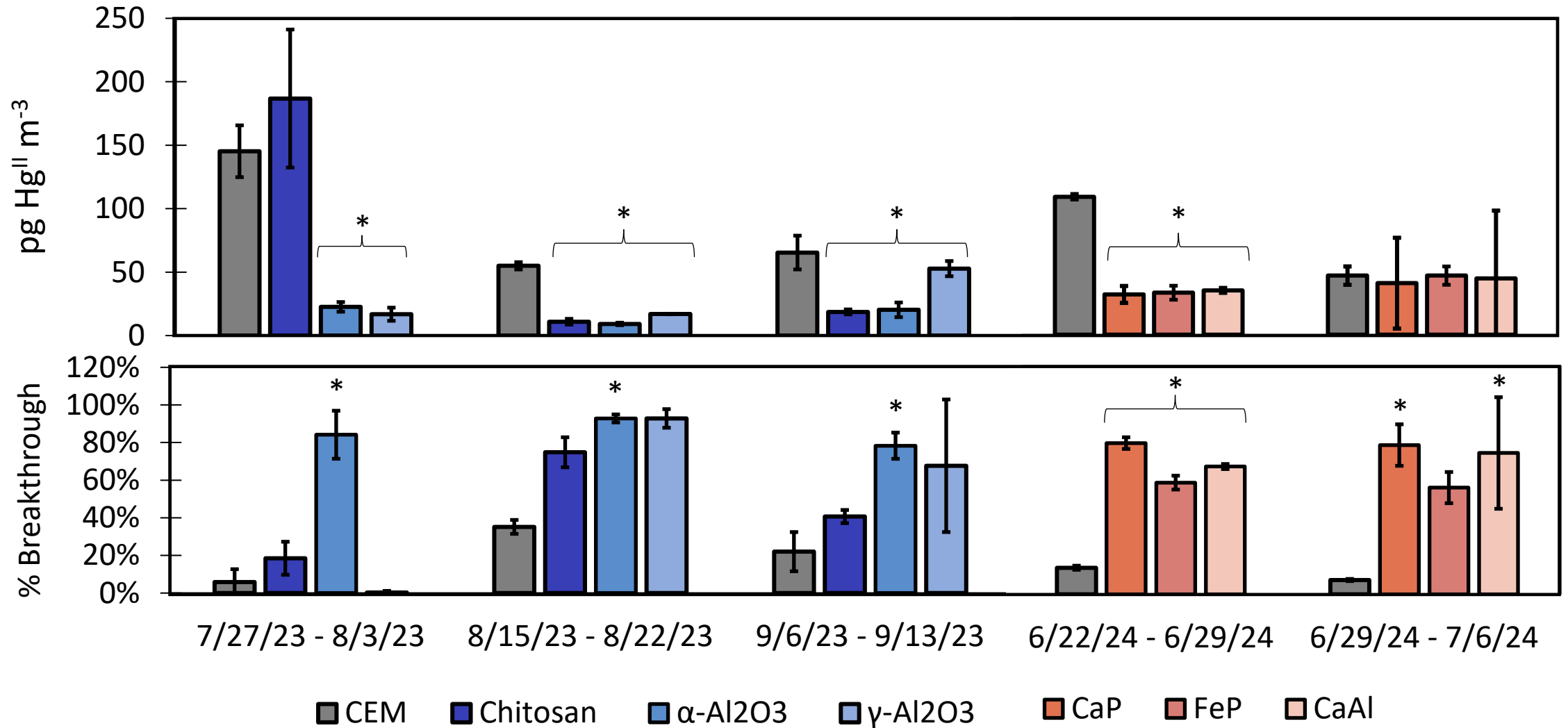


* Indicates statistical difference from CEM

Field deployment of alternative materials

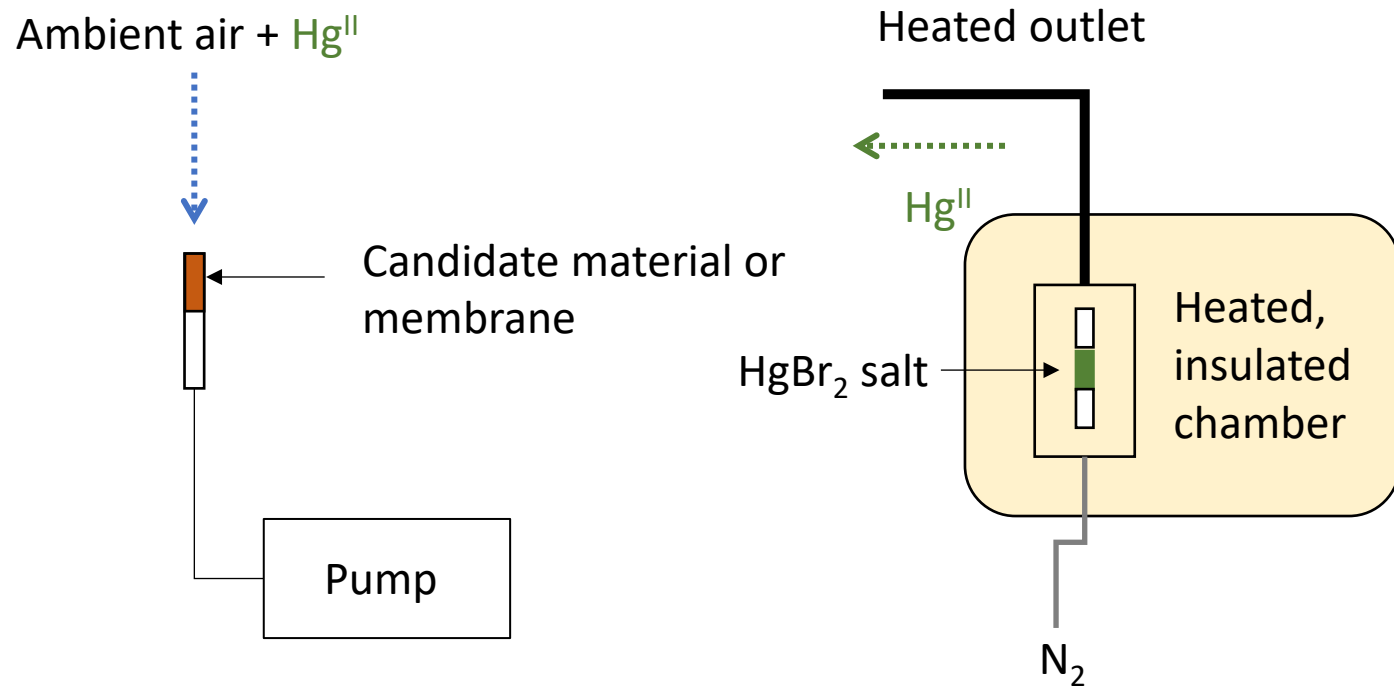


Field deployment of alternative materials

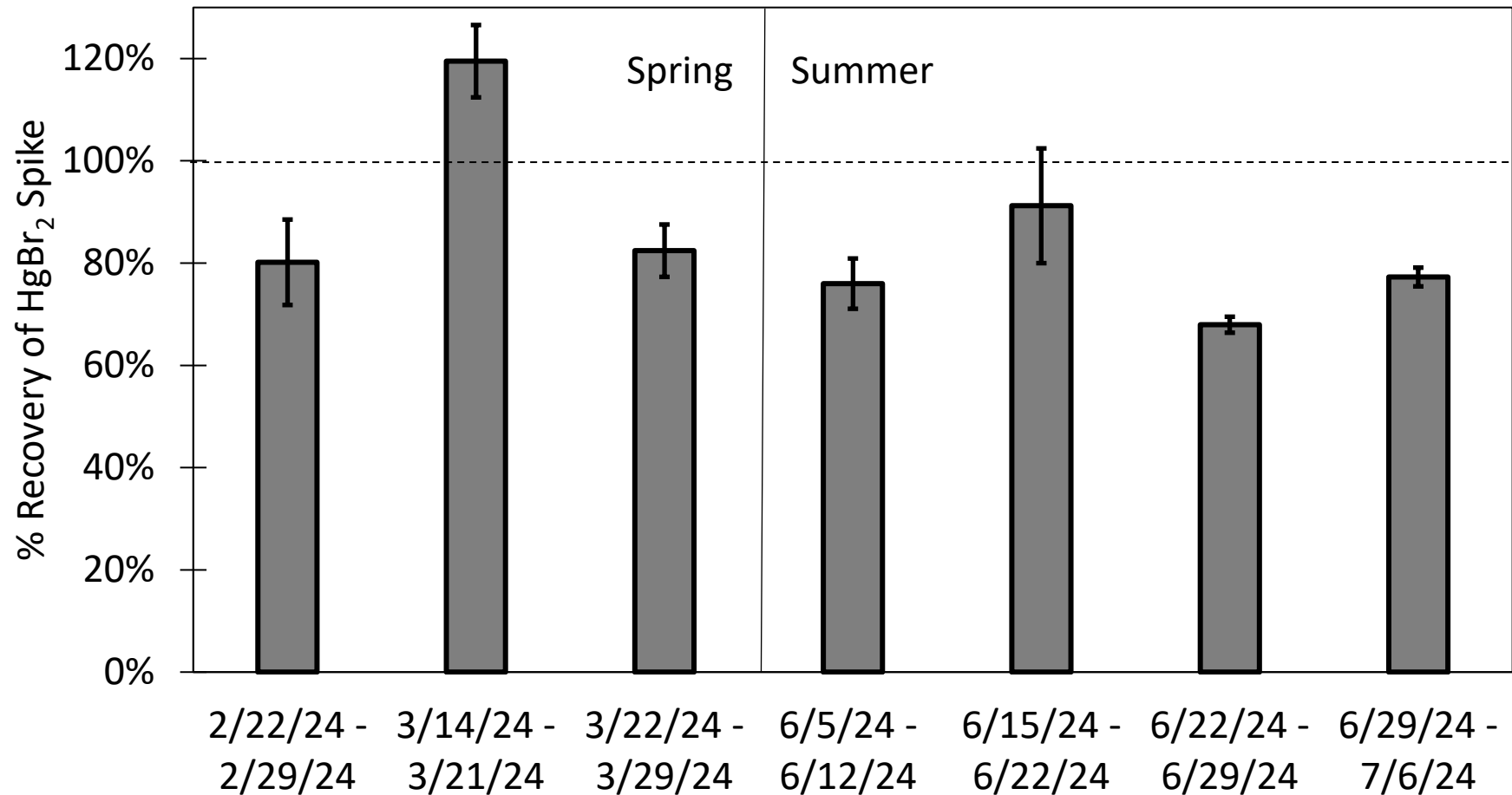


* Indicates statistical difference from CEM, n = 3

Are there sample losses or chemistry changes on Hg^{II} capture materials?

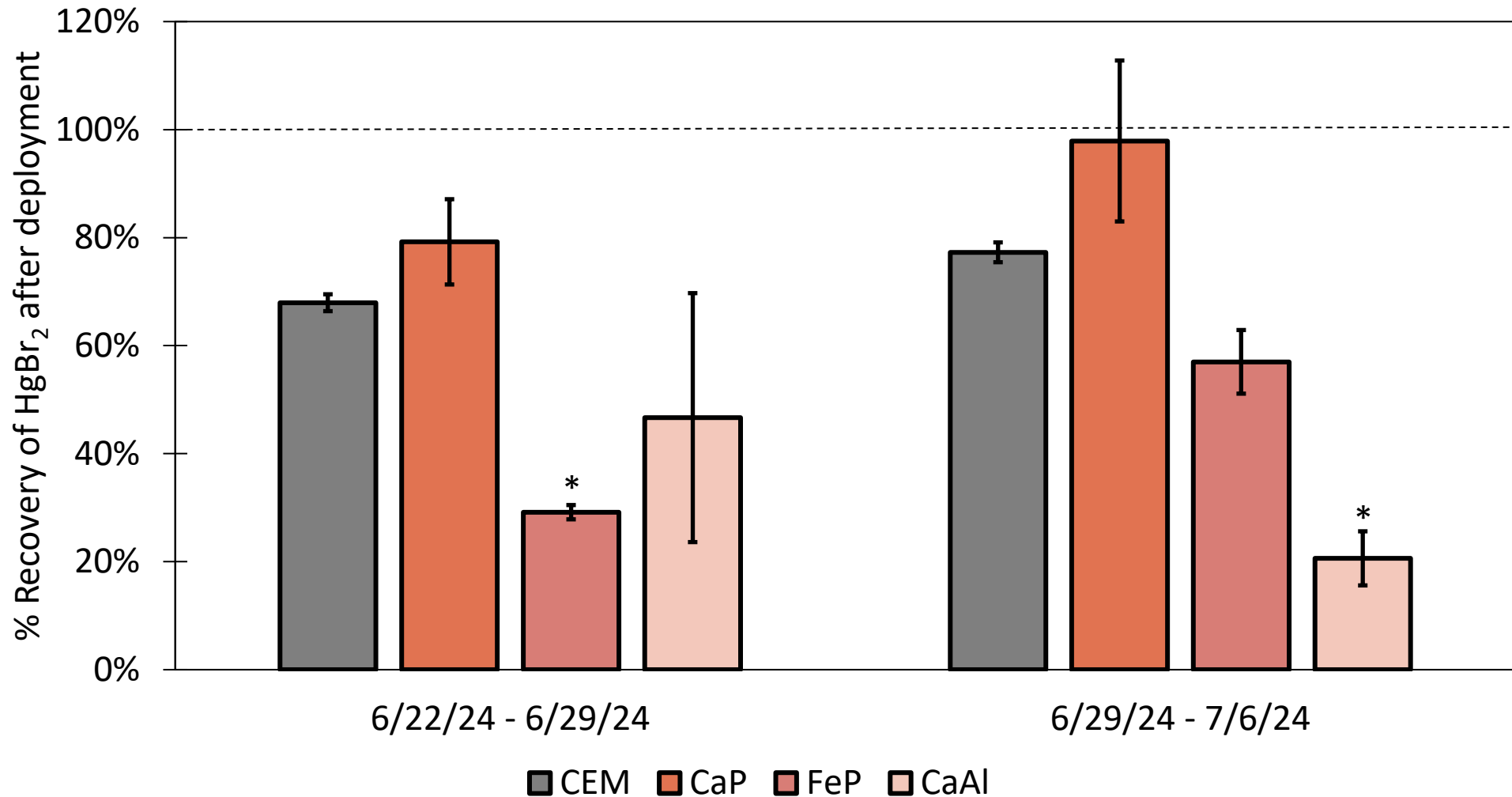


Are there sample losses on CEM?



$n = 3$

Are there sample losses on alternative materials?



* Indicates statistical difference from CEM, n = 3

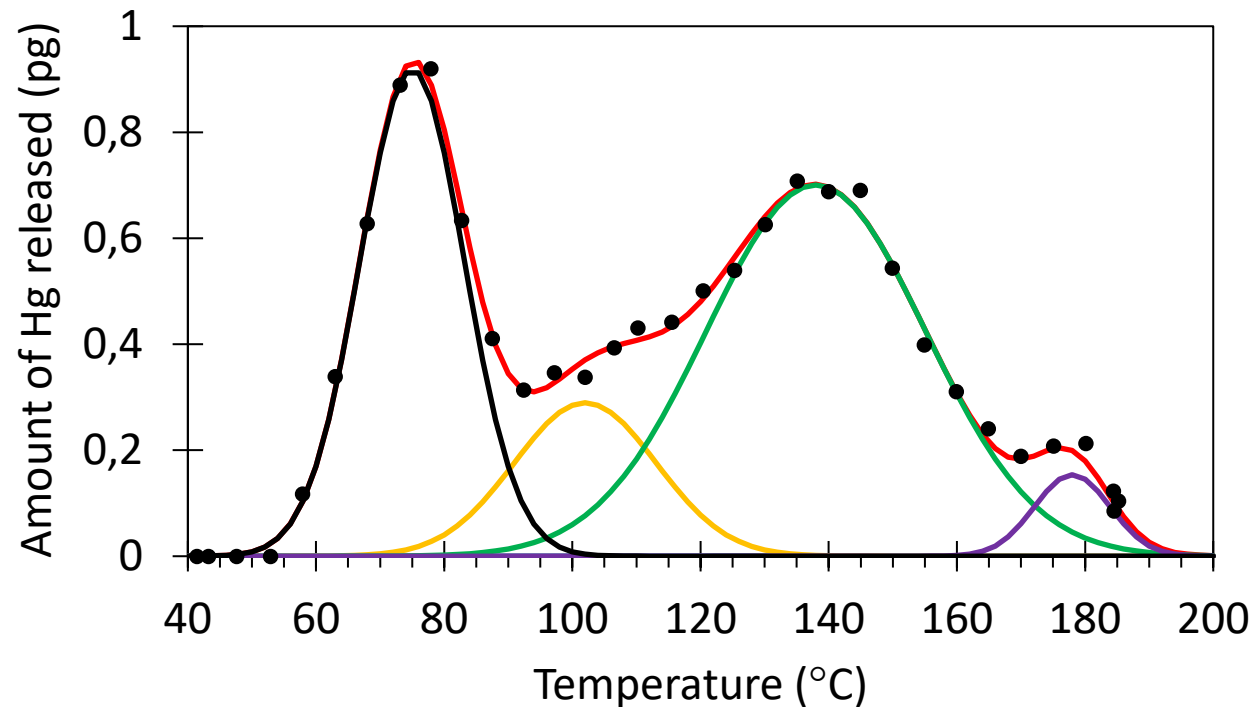
Are there chemistry changes on nylon?



Thermal
desorption
oven

Thermolyzer

Tekran 2537



- Experimental
- Overall Fit
- Br/Cl
- Organic
- O
- N
- S
- ?

Are there chemistry changes on nylon?

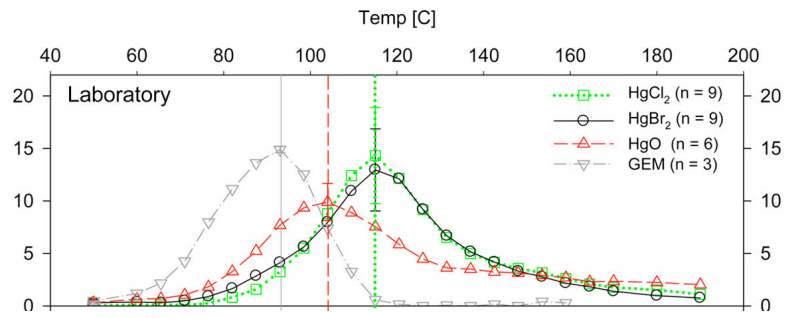
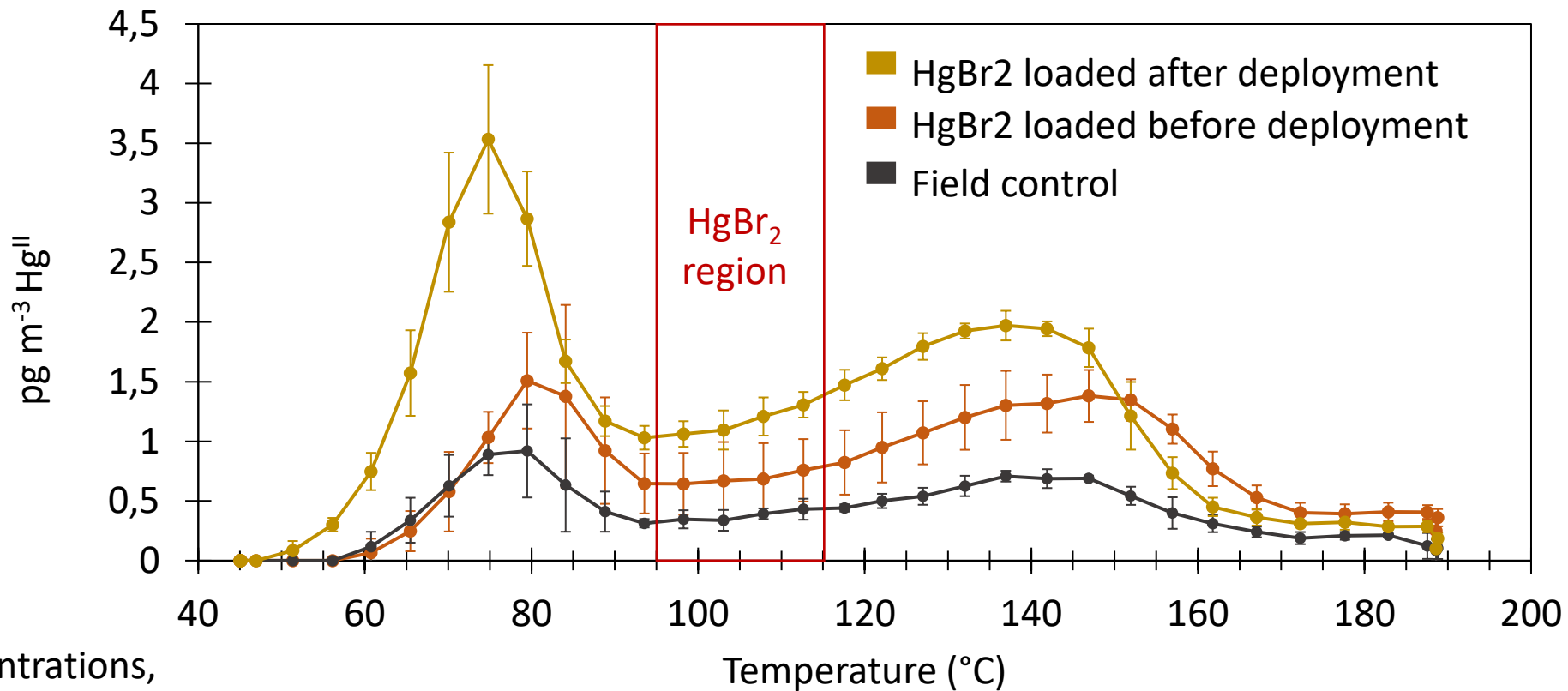


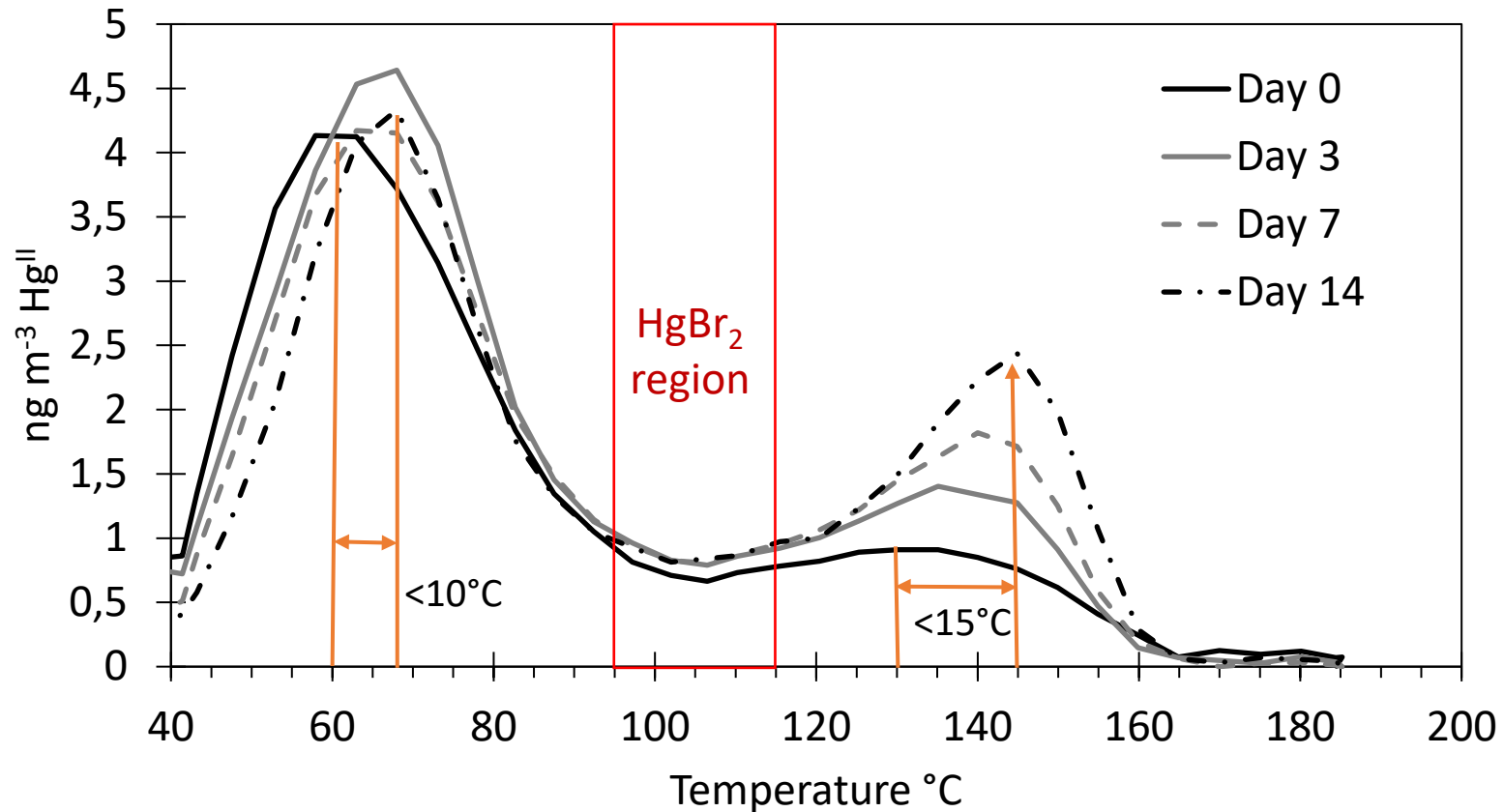
Fig 3, Huang et al., 2013

Loaded at high concentrations,
carbon-scrubbed air



Loaded at low concentrations,
ambient air

Changes in TD profile of Hg^{II} from HgBr₂ salt are minor



n = 6 per curve

Summary

- Materials tested were selective for Hg^{II} over Hg^0 , but did not perform as well as CEM
- HgBr_2 is lost from CEM and alternative materials during field deployment
- TD profile of HgBr_2 changes, with losses



Thank you! Questions?

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