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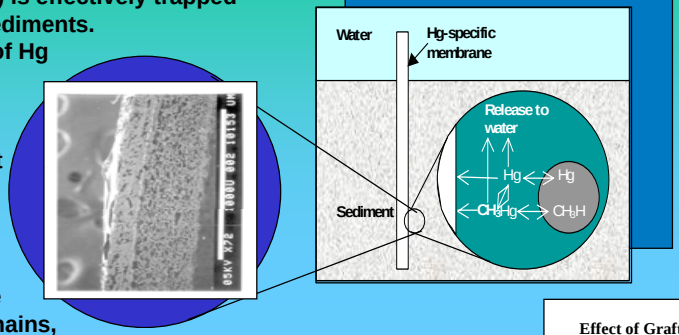
Monitoring Mercury Transport in Estuarine Sediments Using Novel Reactive Membranes

Background

Studies of contaminant transport in the coastal zone demonstrate that mercury (Hg) is effectively trapped and recycled within estuary sediments. Understanding the dynamics of Hg transport and bio-availability within estuarine sediments is important as porewater (i.e., water held within the sediment matrix) exposure may play a significant role in the Hg uptake potential of sediment-dwelling organisms. As these organisms often exist near the base of coastal marine food chains, Hg exposure within sediment porewater may facilitate Hg transfer throughout the food web.

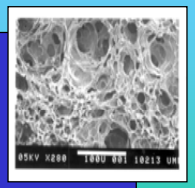
Proposed field deployment strategy. Total thickness of Teflon holder + chitosan membrane ~ 5 mm.



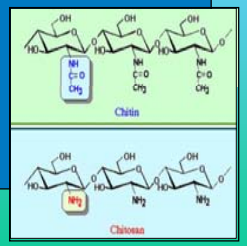
Cross-sectional view of scaffold reinforced chitosan membrane. Scale bar = 1 mm.

Objective

The creation of a macroporous, stabilized porewater sampling membrane based initially on chitosan, a derivative of crab shells that has been chemically and physically modified to enhance affinity and uptake capacity for Hg.



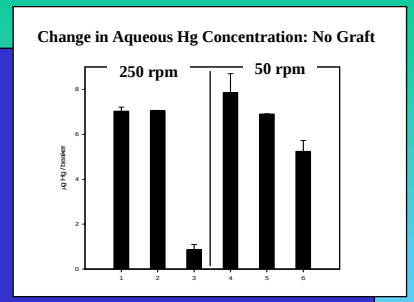
Plan view of macroporous chitosan. Scale bar = 100 µm



Deployment

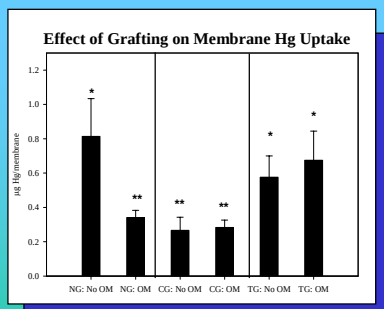
Chitosan membranes are deployed within estuary sediments to assess concentration and transport potential of Hg within sediment porewater. By matching tidal stage (rising or falling) to deployment time, the extent to which the resulting geochemical changes affect mobilization of porewater Hg species may be studied.

Reactive membranes may ultimately function as assessment tools for the remediation of contaminated sediments.



Treatments 1 & 4 = time 0; Treatments 2 & 5 = time 6 hrs for controls containing Teflon holders w/o membranes; Treatments 3 & 6 = time 6 hrs for Teflon holders w/ chitosan membranes.

Uptake at pH = 7.0; 0.01 M KNO_3; 0.1 µM Hg (as $Hg(NO_3)_2$); 6 hr exposure; data as mean ± 1 s.d. (n = 6).



NG = no graft; CG = cysteine graft; TG = thiourea graft; OM = organic matter (5 ppm humic acid); 6 hr exposure @ 50 rpm;

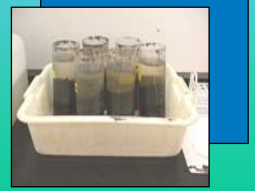
Results with matching stars (* or **) statistically equivalent at $p < 0.05$; data as mean ± 1 s.d. (n = 6).

Research

Initial research has focused on Hg uptake:

- By sulfur (-SH) and amino ($-NH_2$) grafted versus un-grafted chitosan membranes
- In the presence versus absence of dissolved organic matter
- Under varying agitation rate

We are currently testing membrane performance in sediments of known Hg contaminant level.



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