

# Implementation of Palladized Iron-Impregnated Reactive Activated Carbon (RAC) System for PCBs Cleanup: Effects of PCB Loading, Reaction pH, and Co-existing NOM and Ionic Species



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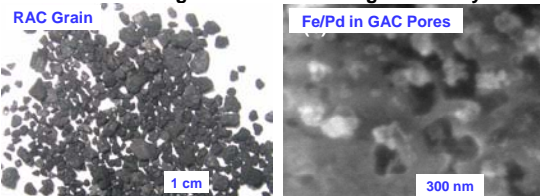


## PCBs Contamination

- Polychlorinated biphenyls (PCBs) used in electrical equipment
- Exist in sediments, bio-accumulate in fish, and reach humans
- Prevalent and toxic
- Hard to treat due to their persistent and hydrophobic nature

## PCBs Treatment Strategy on Reactive Activated Carbon (RAC) Impregnated with Fe/Pd Nanoparticles

- Adsorptive granular AC (GAC) incorporated with reactive Fe/Pd
- In situ nanoscaling of Fe and Pd for high reactivity



- Adsorption of PCBs to GAC
- Electrochemical reductive dechlorination of PCBs by Fe/Pd
- Applied as a “reactive” capping barrier

## Related Publications

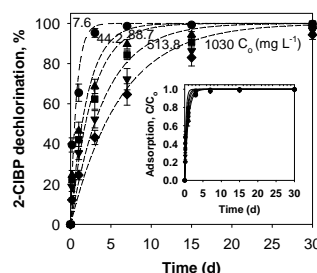
- Synthesis Route and Chemistry: Chem. Mater., 2008, 20, 3649
- Mechanistic Aspect: ES&T, 2009, 43, 488
- Treatment Capacity and Ageing : ES&T, 2009, 43, 4137
- Treatment of Various PCBs: ES&T, 2009, 43, 7510

## Objectives of the Current Study on RAC

- No study on the complexities of treating actual sites
- Need of examining practical reaction conditions relevant in natural systems
  - PCBs loading and reaction pH
  - Natural organic matter (NOM) and Ionic species

## 2-CIBP Loading Effect

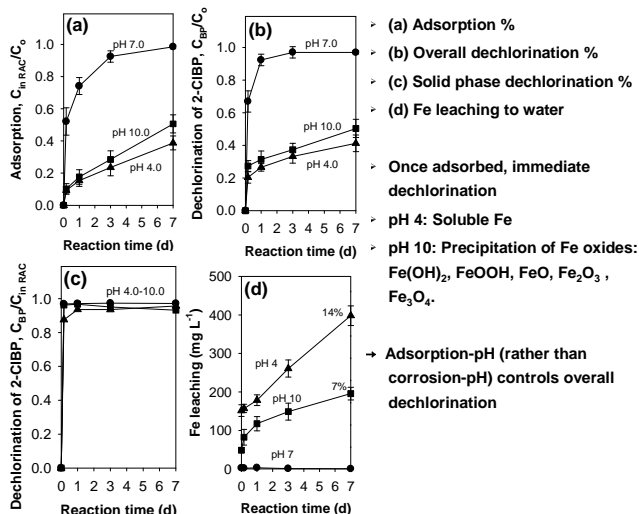
- Adsorption & dechlorination of 2-CIBP at concentration of 7.6–1030 mg L<sup>-1</sup> (mass ratio of 2-CIBP/RAC at 7.60×10<sup>-5</sup>–1.03×10<sup>-2</sup>).



- Immediate adsorption regardless of 2-CIBP loading
- Rate limiting step: adsorption (2-CIBP/RAC ratio < 1.0×10<sup>-4</sup>)
- Rate limiting step: dechlorination (2-CIBP/RAC ratio > 1.0×10<sup>-4</sup>)

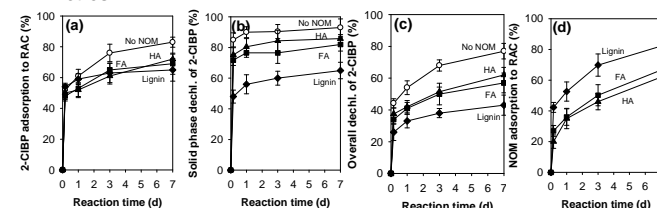
## Solution pH

- Treatment of 2-CIBP at different pHs



## Effect of NOM

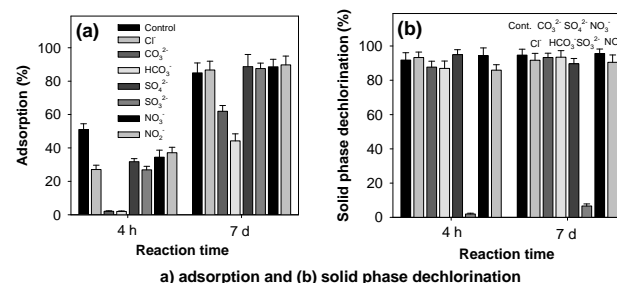
- Effect of humic acid, fulvic acid, and lignin on 2-CIBP reaction kinetics



- a) adsorption, (b) solid phase dechlorination, (c) overall dechlorination, and (d) adsorption of NOM onto RAC.
- Four locations of 2-CIBP: i) free 2-CIBP in the liquid phase, ii) 2-CIBP adsorbed into NOM in the liquid phase, iii) 2-CIBP absorbed into NOM which is adsorbed onto RAC, and iv) 2-CIBP directly adsorbed onto RAC

## Influence of Co-existing Ions

- Influence of co-existing anionic species 2-CIBP reaction kinetics



## Conclusions and Future Research Directions

- The results imply site-specific reactivity of RAC.
- A field test should be done prior to its application to actual contaminated sites.
- RAC strategy should be evaluated for in situ remediation of aquatic sediment contaminated with PCBs