Iron/Palladium Nanoparticle Functionalized Membrane for Chlorinated Contaminates Treatment

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血腫が流れ出る吹き出物
(訴訟資料より)
PCBs

- Polychlorinated biphenyls are a group of toxic chemicals, which were largely produced and used as insulating material and lubricants since 1920s. PCBs might be found in electrical equipment and plastic.

Toxicity

- Acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals (NIH). Have been classified as probably carcinogenic by EPA.

Current situation

- PCBs production was banned in US in 1979, was prohibited by 170 countries until 2014.

- The EPA requires < 0.5 ppb in drinking water. The FDA mandates < 0.2-3 ppm for all food.

- PCBs have been found in at least 500 of the 1,598 current or former NPL sites. (Agency for Toxic Substances and Disease Registry, ATSDR public health statement. Nov 2000)
Iron/Palladium Nanoparticle

Cons:
- Aggregation and leaching
- Stability and longevity
- Recycle and Reuse

Common methods:
- Incineration, Landfill disposal

PCBs Treatment

Fe⁰ + 2H₂O → Fe²⁺ + H₂ + 2OH⁻
H₂ → 2H⁺
PCBs + 2nH⁺ → Biphenyl + nH⁺ + nCl⁻
2Fe⁰ + O₂ + 4H⁺ → 2Fe²⁺ + 2H₂O

Extremely reactive
Membrane functionalization

- Membrane Hydrophilization
- Metal Ion Reduction
- Double Ion Exchange
- Fe nanoparticles
- Pd loading

Graphs:
(a) Permeability, LMH/bar vs. Time, day
- pH 3.1
- pH 11.2
(b) Permeability, LMH/bar vs. pH reversibility cycle
- Cycle 1
- Cycle 2
- Cycle 3

Graphs:
- Particle size, nm vs. Normalized depth
- Iron/Fluorine, atomic ratio vs. Normalized depth
Degradation performance

Membrane reusability

Regeneration

Reactivity
Comparisons to other technologies

- Particle size control, preventing leaching and aggregation, easy to regenerate and reuse
- Compare to incineration and landfill disposal, it destroys PCBs and control the yield of toxic byproducts
- This method can be used in heavy metal and other chlorinated organic treatment (TCE). It also shows the potential for functionalizing ceramic membrane polymer brushes

Current

- Ongoing cooperation with nutrition science department for toxicity analysis of degraded products on the macrophages
- Get access to the contaminated site, take the field samples for further testing

Challenges: pre-treatment needed, the longevity of iron nanoparticle, cost and scaling up issues
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