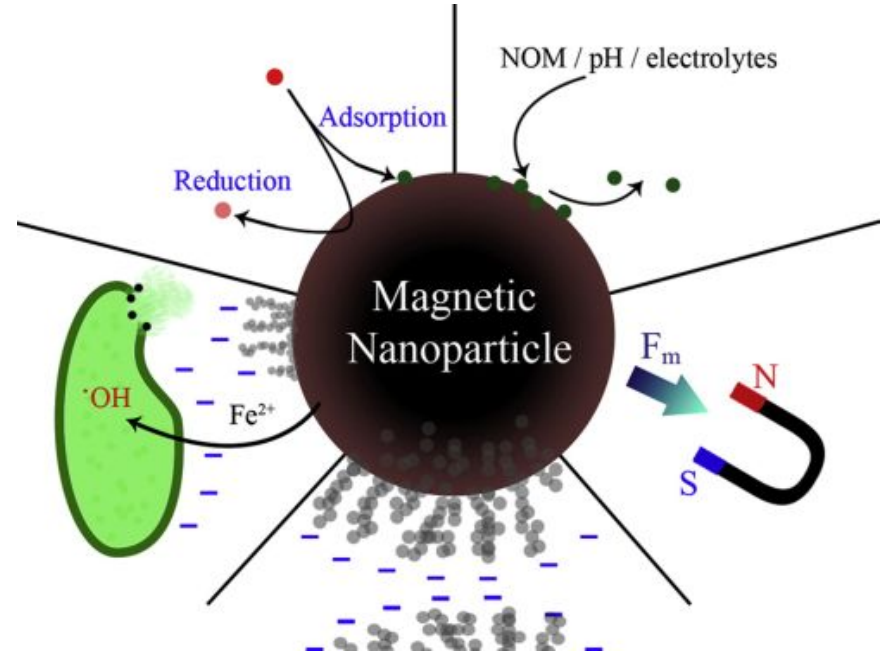


NANOPARTICLES IN SOIL CLEANING

**Team Mercury: Kayla Guarnieri, Madison Holdsworth,
Tyler Schmitz, Mitchell Wendt**

OVERVIEW

- Background
- Relevant History
- Significance
- Current State & Challenges
- The Future
- Other applications

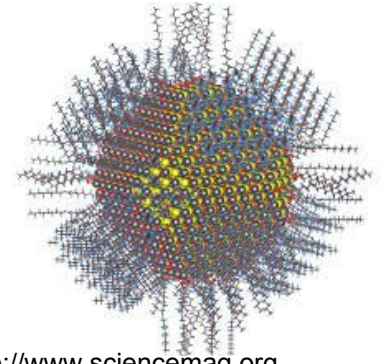


<http://workingwithwater.filtsep.com>

Review of Essential Factors for Sustainable Environmental Applications of Magnetic Nanoparticles

WHAT IS A NANOPARTICLE?

- A nanoparticle is a small object that behaves as a whole unit in terms of its transport and properties.
 - High surface area to volume



<http://www.sciencemag.org>
Semiconductor nanoparticle (quantum dot) of lead sulfide(size ~5nm)

WHY CLEAN SOIL?

- Supports several vital functions allowing several forms of life to develop
- Beginning stage of where most of the world's food supply comes from
- The relationship between soil, climate and trees
- Regulates the flow of water¹



companionplants.com
Ohio Medicinal
Medicinal Plant
Medicinal Herb Herb
Plants Seeds
Goldenseal Herb OH

¹"What Are Nanoparticles?" *News-Medical.net*. N.p., 17 May 2010. Web. 17 Nov. 2015.
<<http://www.news-medical.net/health/What-are-Nanoparticles.aspx>>."

FOR INSTANCE.....

- Abandoned Gold mines leaking mercury causing a chain reaction
 - Fe_3O_4 , TiO_2 , CeO_2 are common molecules used to clean Cr_6 , Pb_2 , phosphates, gold, mercury, etc
- Increasing cost of electromagnetic nanoparticles result in Ultra violet nanoparticles are being used.
 - Hydrophobic core and Hydrophilic shell¹



althouse.biz500
Abandoned Gold Mines Georgia HD Wallpaper

¹"Nanoparticles can clean up oil spills or remove contaminants from water or soils". N.p., 17 Oct. 2013. Web. <<http://carboninspired.com/blog/?p=610&lang=en>>

RELEVANT HISTORY – SOIL CLEANING/REMEDIATION



<http://www.marketplacelists.com>
Soil Remediation

- Original Purpose: to clean leaks and spills that result from industrial processes
- In 1980s strategy was “pump and treat”, contaminated soil was removed or destroyed
- Advancements in the 1990s resulted in vacuum blowers and vapor extraction, which extracted contaminated compounds directly from the soil

RELEVANT HISTORY - SOIL CLEANING/REMEDIATION

- Throughout the 2000s:
 - Air Sparging- enhance particles already in soil to help break down contamination
 - Air Blower- increase water pressure in contaminated areas and destroy/capture volatile compounds as they rise to the surface
 - Dual Phase Extraction- vacuum that removes both contaminated groundwater and soil vapor



<https://s3.amazonaws.com>
Contaminated Stream

¹CPEO Technologies." *Tech Tree*. CPEO, Sept. 2010. Web. 18 Oct. 2015. <<http://www.cpeo.org/techtree/ttdescript/>>.

SIGNIFICANCE

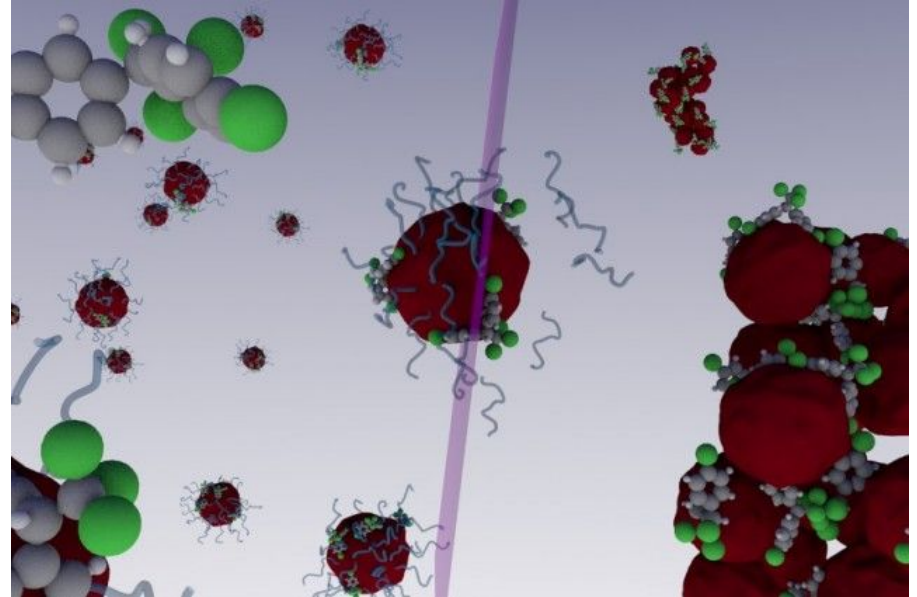
- **Most important to protect customer/consumer safety and health**
- Promotes uses of natural soil
- With the advancement of technology comes cheaper forms of soil cleansing and greater amounts of contamination destroyed
- Preserve the environment with natural uses of technology and eliminate aspects of pollution



www.extendonondaga.org
Soil Testing

CURRENT STATE

- In its infancy
- Examples:
 - Metal Immobilization
 - Pb, Zn
- Using UV Light
 - Previously used magnets¹



IFLScience

<http://www.iflscience.com/nanoparticles-used-remove-pollutants-could-lead-cleaner-drinking-water-and-soil>

¹Otto, Martha. "Remediation | Innovative Technologies." EPA. Environmental Protection Agency, Oct. 2008. Web. 25 Sept. 2015

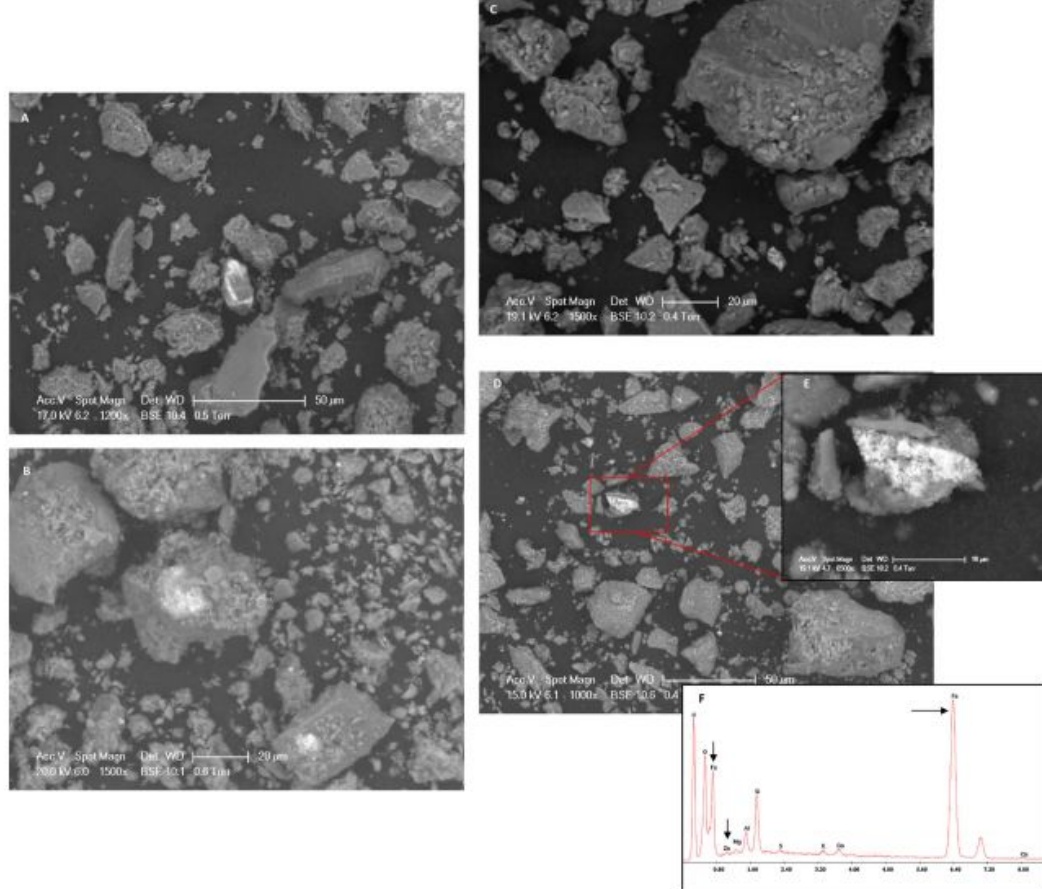


Figure 6. SEM images of (A) calcareous soil polluted with Pb, (B) calcareous soil polluted with Pb and treated with nZVI, (C) calcareous soil polluted with Zn, (D) calcareous soil polluted with Zn treated with nZVI where the red square indicates a magnification of the area shown in (E); (F) SEM-EDS spectra of image (E).

CHALLENGES

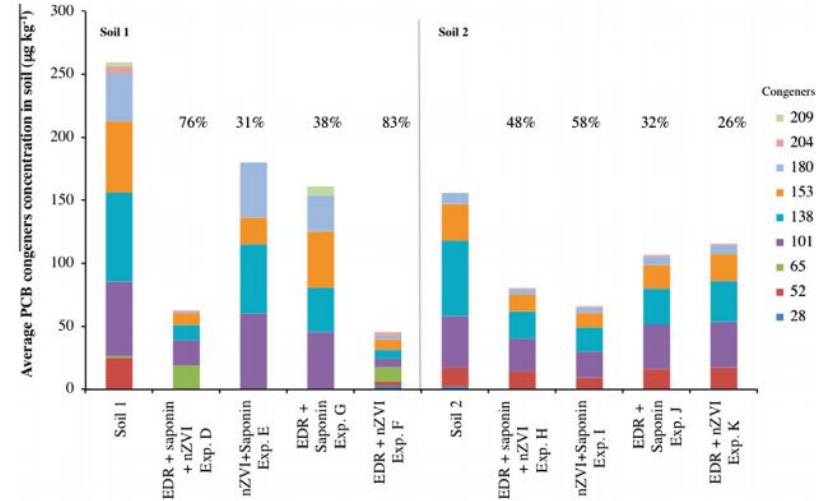
- Site specific
- Depends on geologic conditions
- Concentration/ types of contaminants affect effectiveness
- limitations for toxicity and safety²
- “Radius of influence” ; agglomeration¹

¹"Remediation | Innovative Technologies." EPA. Environmental Protection Agency, Oct. 2008. Web. 25 Sept. 2015.

²O'Callaghan, Jonathan. "Nanoparticles Used To Remove Pollutants Could Lead To Cleaner Drinking Water And Soil." *IFLScience*. N.p., 21 July 2015. Web. 16 Nov. 2015.

FUTURE

- Main goal: develop current methods to have consistent results in various conditions
- Results of using nanoparticles (esp. nZVI) largely rely on:
 - soil textures
 - chemical composition of soil
 - accompanying remediation methods
 - accompanying chemicals (ie. surfactants)¹



[http://ac.els-cdn.com.proxy.lib.ohio-state.edu/](http://ac.els-cdn.com.proxy.lib.ohio-state.edu)
Average concentration of PCB congeners in Soils 1 and 2 after using the two-compartment cell.

¹Gomes, HI, C Dias-Ferreira, LM Ottosen, and AB Ribeiro. "Electroremediation of Pcb Contaminated Soil Combined with Iron Nanoparticles: Effect of the Soil Type." *Chemosphere*. 131 (2015): 157-63. Print.

OTHER APPLICATION: FERTILIZATION

- Nanoparticles can also act as a fertilizer
- nano TiO_2 particles make more of the phosphorus in soil available to *Lactuca sativa* plants (aka: Iceberg Lettuce)
- Leads to healthier (higher) phosphorus levels and growth of roots and body¹



Lactuca sativa (Garden lettuce)
linnaeus.nrm.se

¹Hanif, Hina Umber, et al. "PHYTO-AVAILABILITY OF PHOSPHORUS TO *Lactuca Sativa* IN RESPONSE TO SOIL APPLIED TiO_2 NANOPARTICLES." Pakistan Journal Of Agricultural Sciences 52.1 (2015): 177-182. Academic Search Premier. Web. 25 Sept.2015

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