**GROUNDWATER REMEDIATION**

**Reductive Technologies Based on Nanoscale Zero-Valent Iron**

**Highly Efficient in Removal Of**

- Inorganic compounds like Arsenic, Barium, Chromium, Selenium, Uranium, Copper, Lead, Cadmium, Mercury, Nickel (and many other heavy metals), sulphates, nitrates, perchlorates, etc.
- Organic compounds like polychlorinated methanes, ethanes, ethenes, benzenes, etc.

**Properties of Fe⁰ Nanoparticles**

- High redox potential (electron donor)
- High surface area (20-25 m²/g)
- Narrow particle size distribution (average of 50 nm) allowing the particles to migrate in groundwater conditions
- Pyrophoric or air-stable character (powder or aqueous dispersion)
- Magnetically separable
- High-reactivity and long-term performance
- Possibility to combine various properties in composite materials
- Ideal for remediation of large areas or for construction of permeable reactive barriers
- Environmentally friendly material
- Low cost comparing to conventional technologies

**APPLICATION EXAMPLE**

In field application of the reductive barrier at Mars Svratka (Czech Republic) in 2012-2014

**Concentration of CIE Day 0**

**Concentration of CIE Day 180**
SURFACE AND DRINKING WATER TREATMENT

OXIDATIVE TECHNOLOGIES BASED ON IRON IN HIGH VALENCE STATE (FERRATES IV,V,VI)

HIGHLY EFFICIENT IN REMOVAL OF

- Inorganic compounds such as Arsenic, Uranium, Zinc, Copper, Nickel (and many other heavy metals), metal cyanides, phosphates, sulfates, etc.
- Organic compounds such as hormones, pesticides, pharmaceutical compounds, etc.
- Biological pollutants such as Cyanobacteria

PROPERTIES OF FERRATE MATERIALS

- High oxidative potential (electron acceptor) due to Fe in high valence state
- Highly effective against wide spectrum of pollutants
- Disinfecting effect against various microorganisms (Cryptosporidium, Coliforms, Salmonella, etc.)
- Coagulation and flocculation capacity
- Increasing pH value
- High reactivity and low reagent consumption
- Reaction products are benign iron oxides with high surface area which is advantageously useful for additional sorption
- Environmentally friendly material
- Low cost comparing to conventional technologies
Available products

Nanofer 25P
- Fe⁰ nanoparticles (powder) without surface modification
- Highly reactive and pyrophoric Fe⁰ nanoparticles

Nanofer 25S
- Aqueous dispersion of Fe⁰ nanoparticles modified by biodegradable organic stabilizer
- Highly reactive with large scale of pollutants
- Excellent migration properties

Nanofer Star
- Surface-stabilized Fe⁰ nanoparticles (powder)
- Safe storage, transport, handling and applications compared to non-stabilized Fe⁰ nanoparticles
- When activated, the Fe⁰ nanoparticles are highly reactive with reducible pollutants
- Possibility to combine with biodegradable organic stabilizer for better migration performance

Fe⁰-based composites
- Micro-Fe⁰ & nano-Fe⁰ composite material combining long-term reactivity of microparticles with rapid effect of nanoparticles
- Nano-Fe⁰ & carbon composite material combining reductive/magnetic properties of Fe⁰ nanoparticles with sorption properties of carbon (active carbon, carbon black, nanotubes, biochar etc.)

Envifer
- Product based on Ferrate (IV, V or VI, or their combination) with outstanding oxidation capacity
- Oxidation/disinfection properties are accompanied with high sorption capacity of reaction products
- Soluble material stable in solutions at high pH
- Stable in solid form at dry conditions

And much more...
- We are able to offer custom modified Fe-based nanomaterials
- Any additional information on request

www.nanoiron.cz
APPLICATION REFERENCES


SCIENTIFIC REFERENCES

1 site in Austria
4 sites in Benelux
15 sites in Czech Republic
3 sites in Denmark
2 sites in France
1 site in Portugal
1 site in Slovakia
2 sites in Spain
and others, like USA, Canada, South Korea,...