

# SMART *Remediation*

*Don't Scrap that PRB – Optimizing Performance and Cost for Chlorinated Contaminant Destruction*



Jean Paré  
Chemco inc.  
SMART Toronto and Ottawa

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Optimizing Performance and Cost for  
Chlorinated Contaminant Destruction***

Smart Remediation 2024

Toronto, ON, Canada

Ottawa, ON, Canada

Presented by

Jean Paré, P. Eng., Chemco





# Presentation Agenda

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- **About us**
- **Enhancing PRB Performance**
  - Where are we now
  - ZVI Type
- **Case Study**
  - Schematic and economics
- **Q & A**



# Excellence & Science through proud Suppliers & Partners

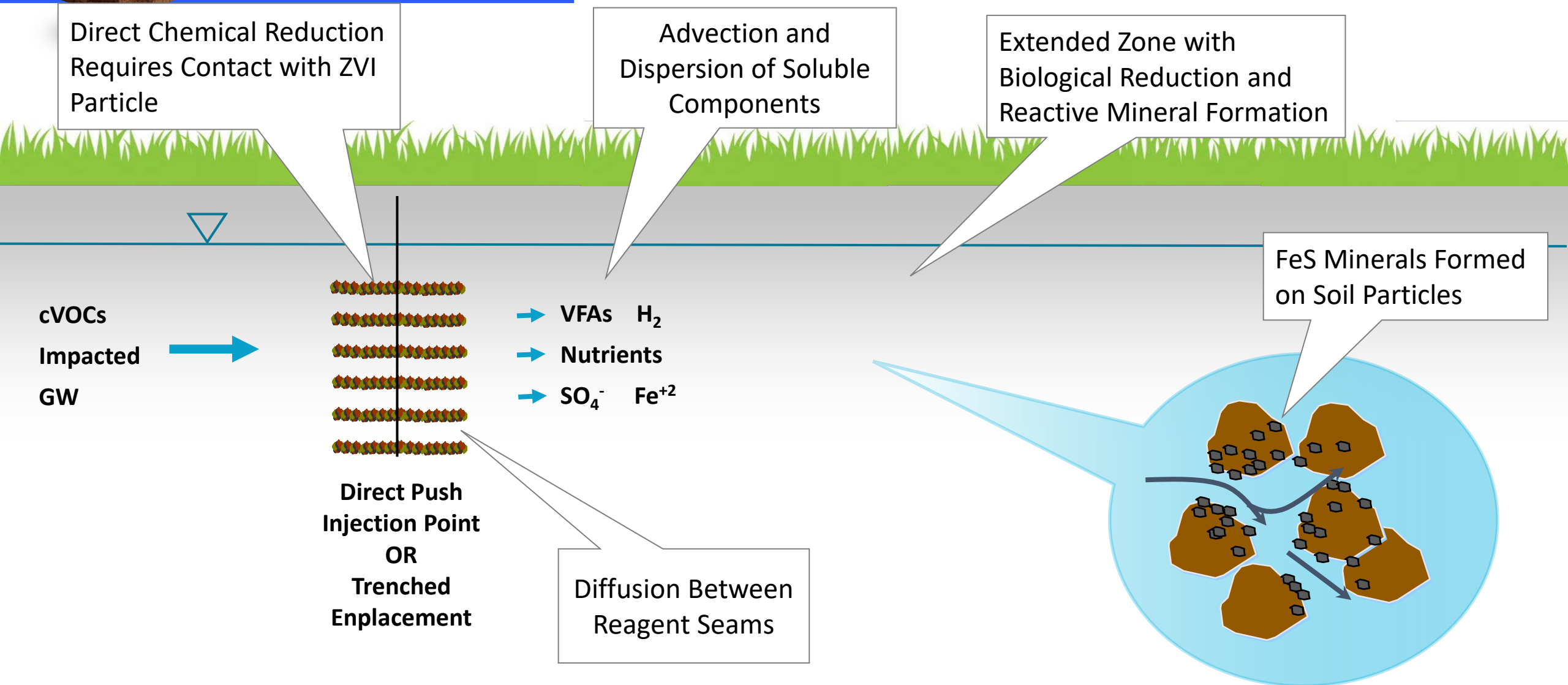


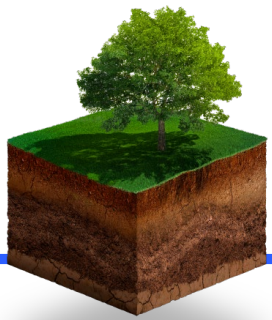
ADVANCED OXIDATION TECHNOLOGY (AOT) *Since 2005*



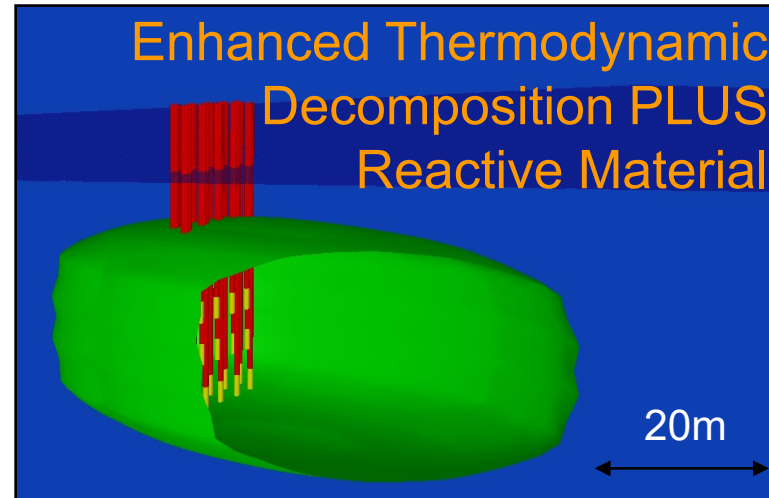
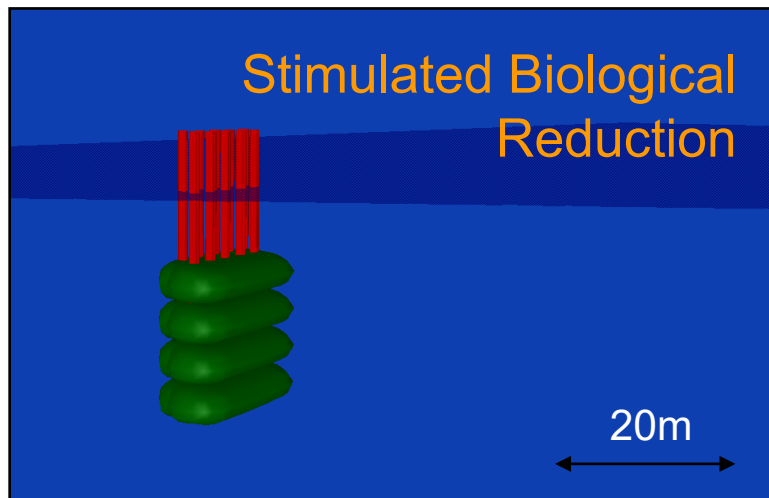
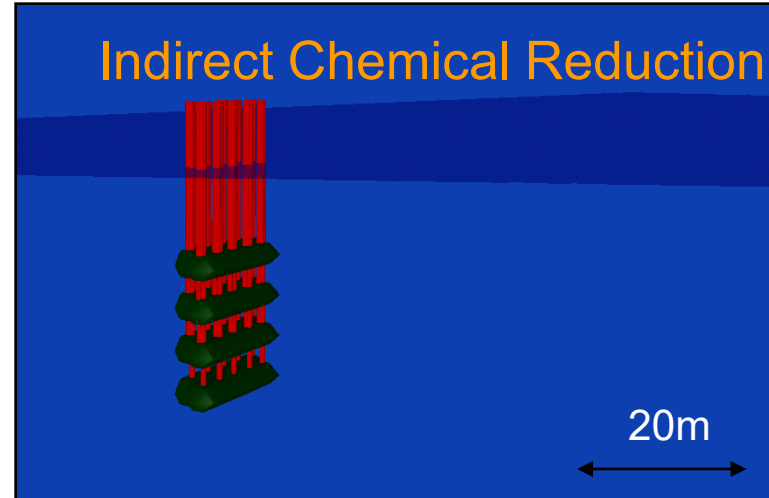
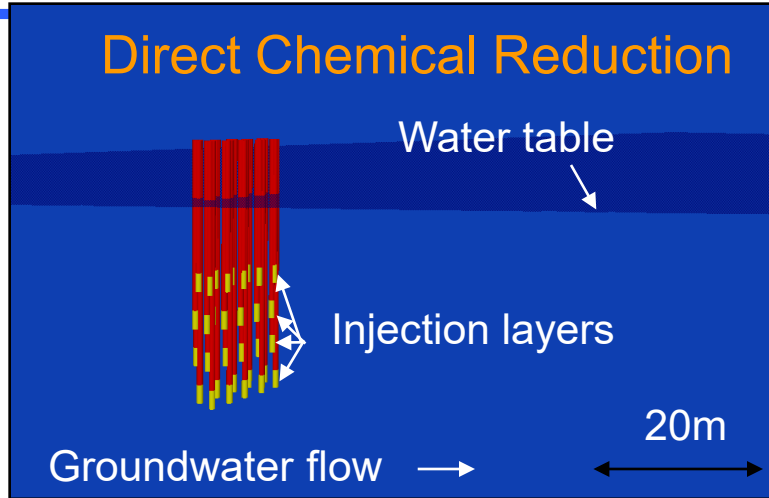


# Where we are now – Improved Distribution Properties and Barrier Lifetime





# ZVI + Carbone Synergies brings multiples dechloration mechanism

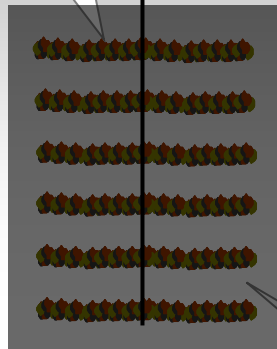




## Where we are now – Adding Activated Carbon to retard contamination in the reactive zone

Direct Chemical Reduction  
Requires Contact with ZVI  
Particle

cVOCs  
Impacted  
GW

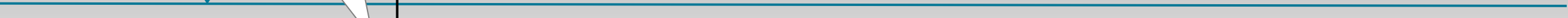


Direct Push  
Injection Point  
OR  
Trenched  
Emplacement



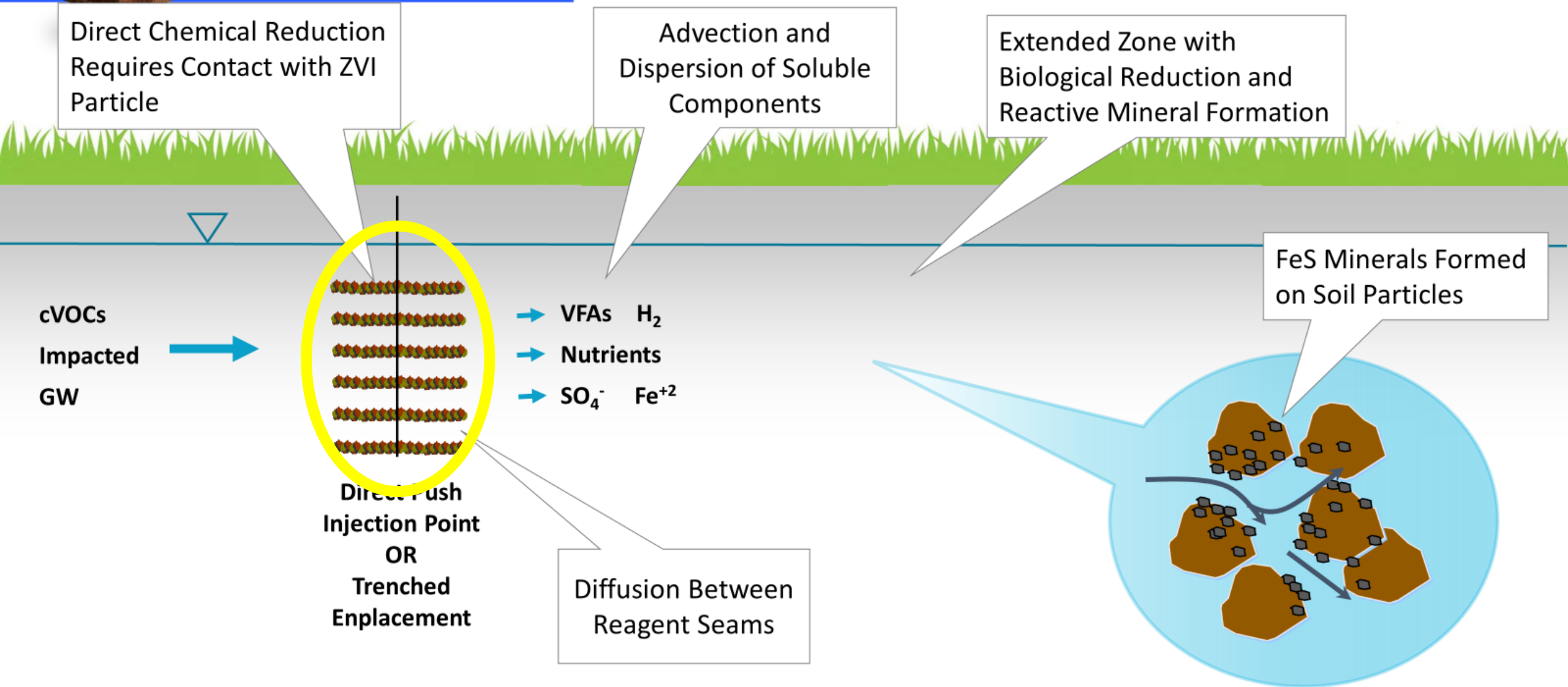
VFAs H<sub>2</sub>  
Nutrients Fe<sup>+2</sup>

Diffusion Between  
Reagent Seams





# Where we are now – Improved Distribution Properties and Barrier Lifetime

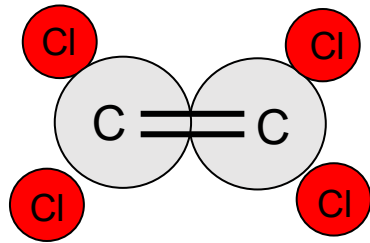




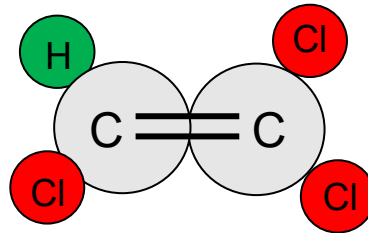
# Direct Dechlorination Reactions with ZVI

$\beta$  elimination (abiotic) pathway

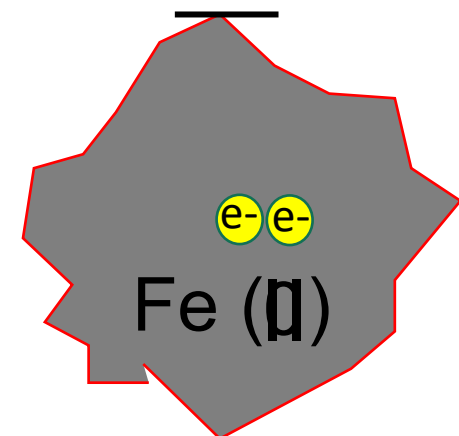
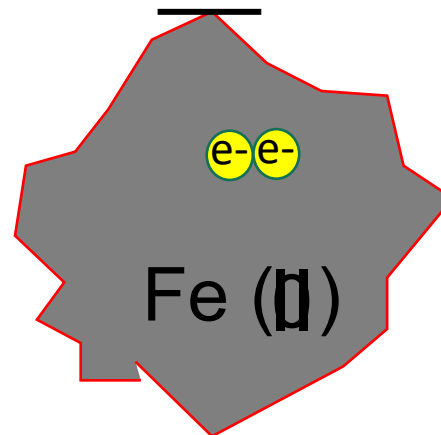
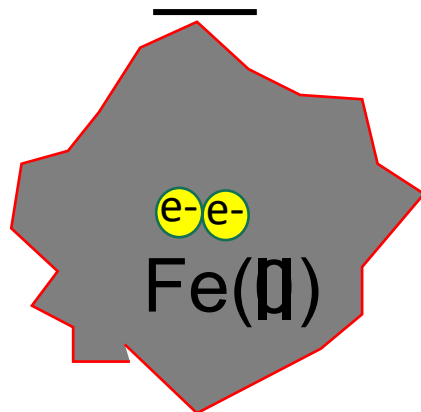
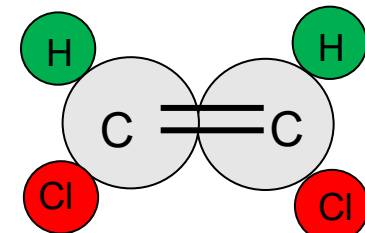
Tetrachloroethene



Trichloroethene



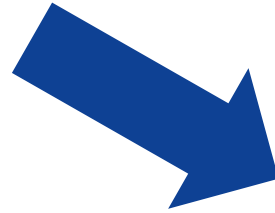
Dichloroethene



# Are all ZVI the Same?

## ZVI Production Options:

1. Conventional or Regrind Iron (RI)
2. Atomized Iron
3. Sponge Iron
4. Electrolytic Iron

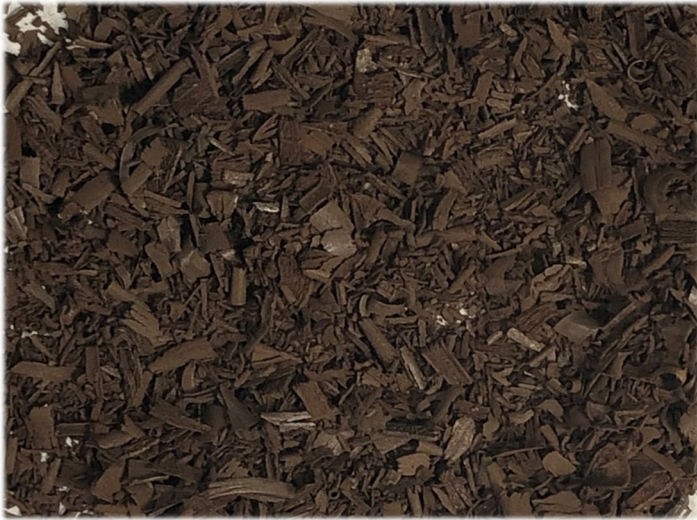


## Different:

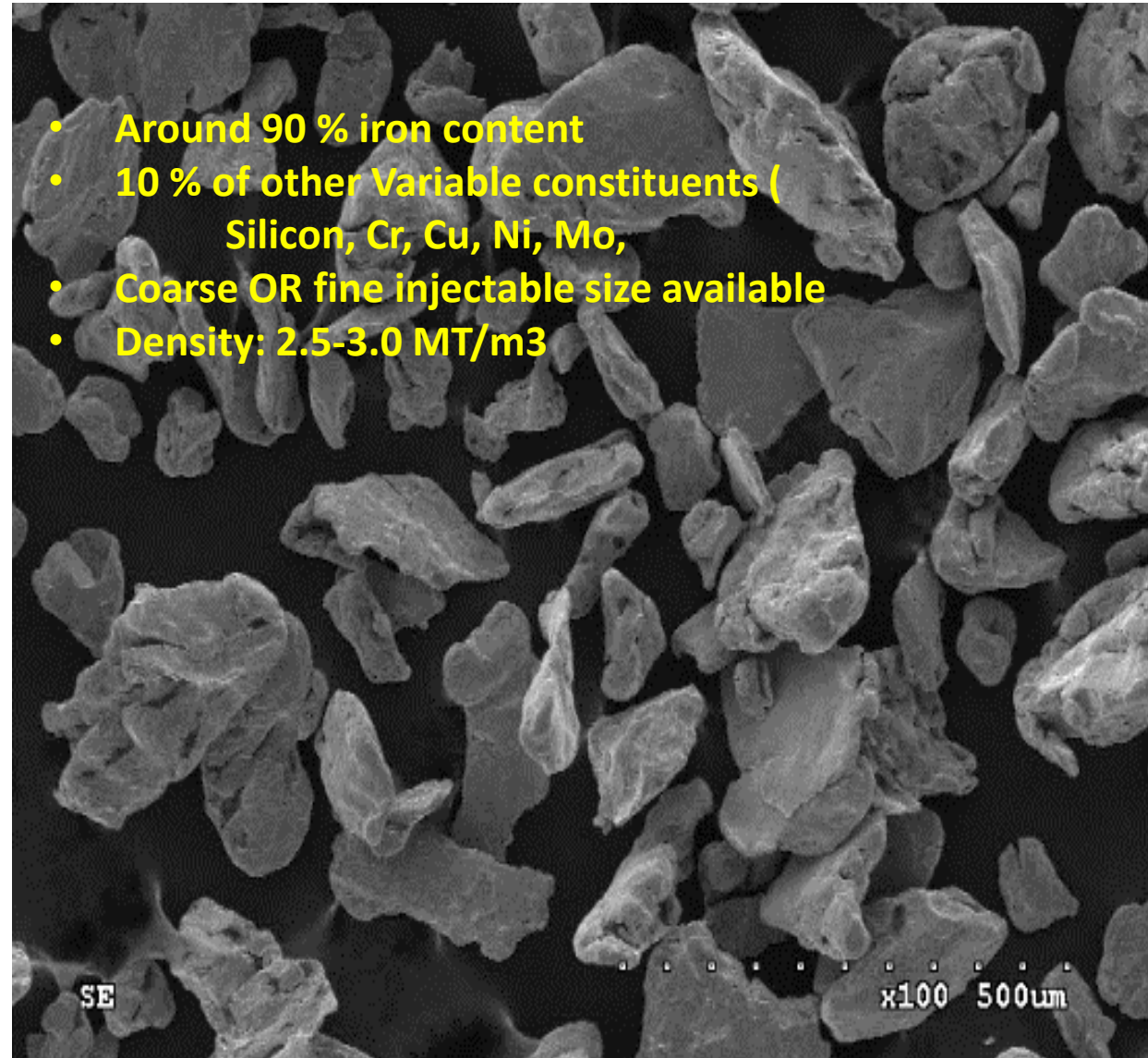
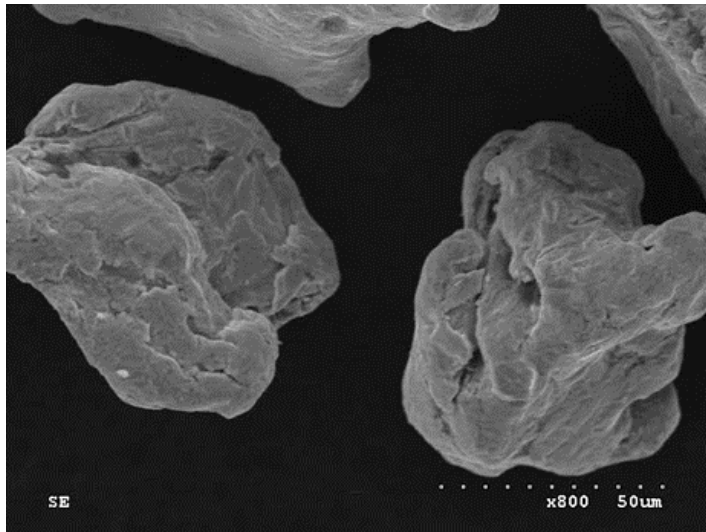
- Size and distribution
- Hydraulic conductivity and porosity
- Iron content and contamination
- Surface area and morphology
  - Reactivity
- Longevity
- Application



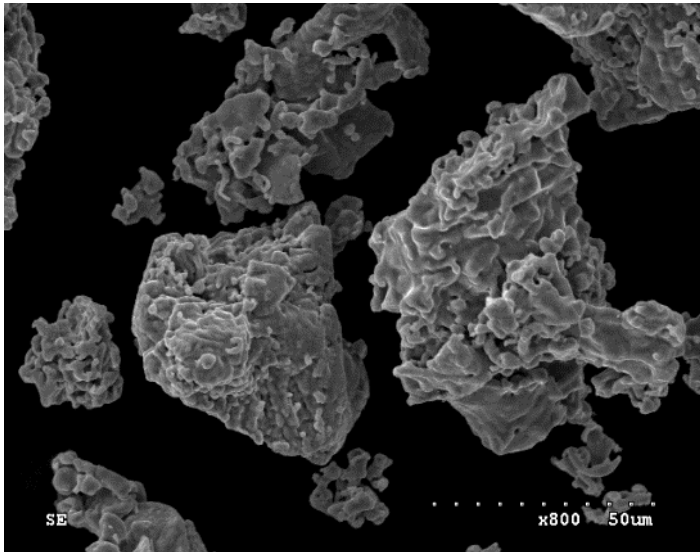
# Conventional ZVI (Regrind)



- Around 90 % iron content
- 10 % of other Variable constituents ( Silicon, Cr, Cu, Ni, Mo,
- Coarse OR fine injectable size available
- Density: 2.5-3.0 MT/m<sup>3</sup>



# Atomized Iron



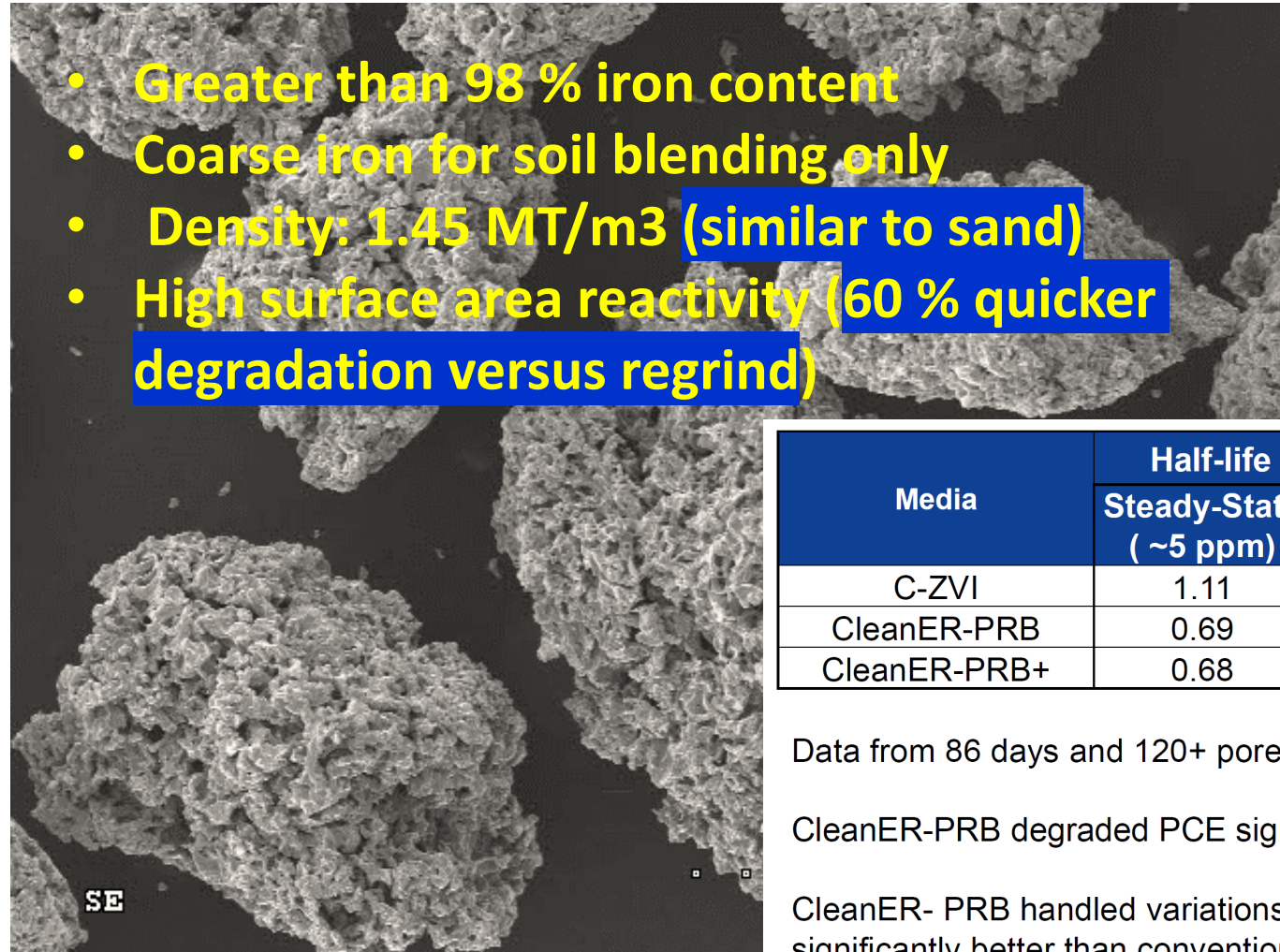
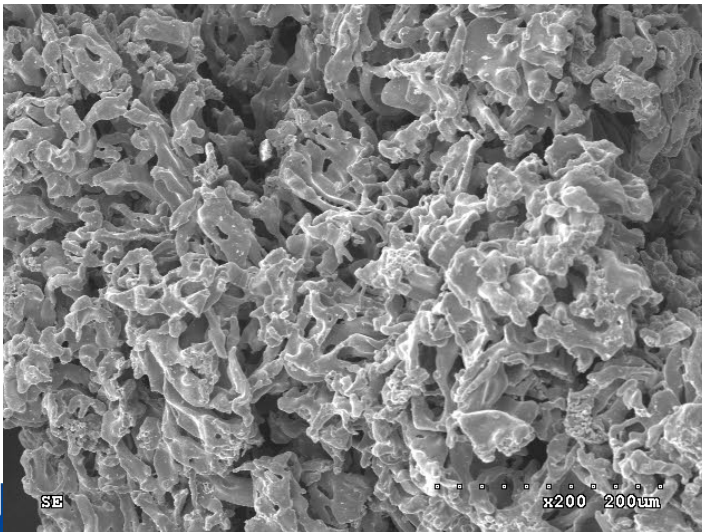
- Greater than 98 % iron content
- Coarse OR fine injectable size available
- Density: 3.0-3.5 MT/m<sup>3</sup>
- Can be micronized (1-10  $\mu\text{m}$ )



# Sponge Iron



- Greater than 98 % iron content
- Coarse iron for soil blending only
- Density: 1.45 MT/m<sup>3</sup> (similar to sand)
- High surface area reactivity (60 % quicker degradation versus regrind)



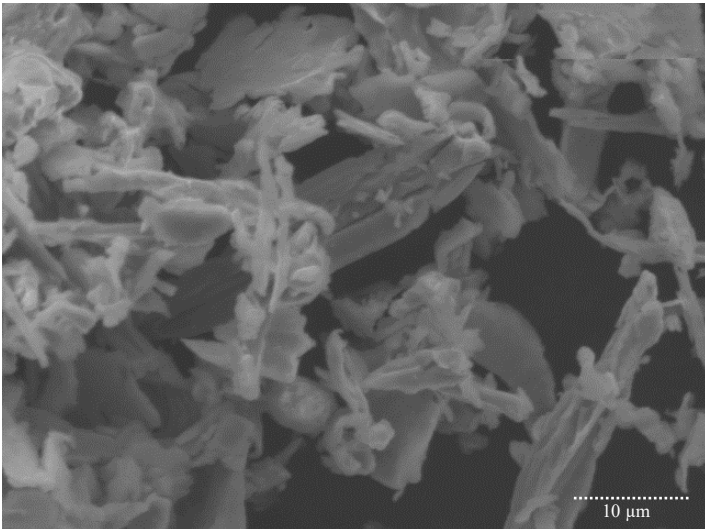
Media	Half-life T <sub>1/2</sub> (hr) PCE	
	Steady-State (~5 ppm)	High Dosing (~23 ppm)
C-ZVI	1.11	2.61
CleanER-PRB	0.69	1.14
CleanER-PRB+	0.68	1.04

Data from 86 days and 120+ pore volumes

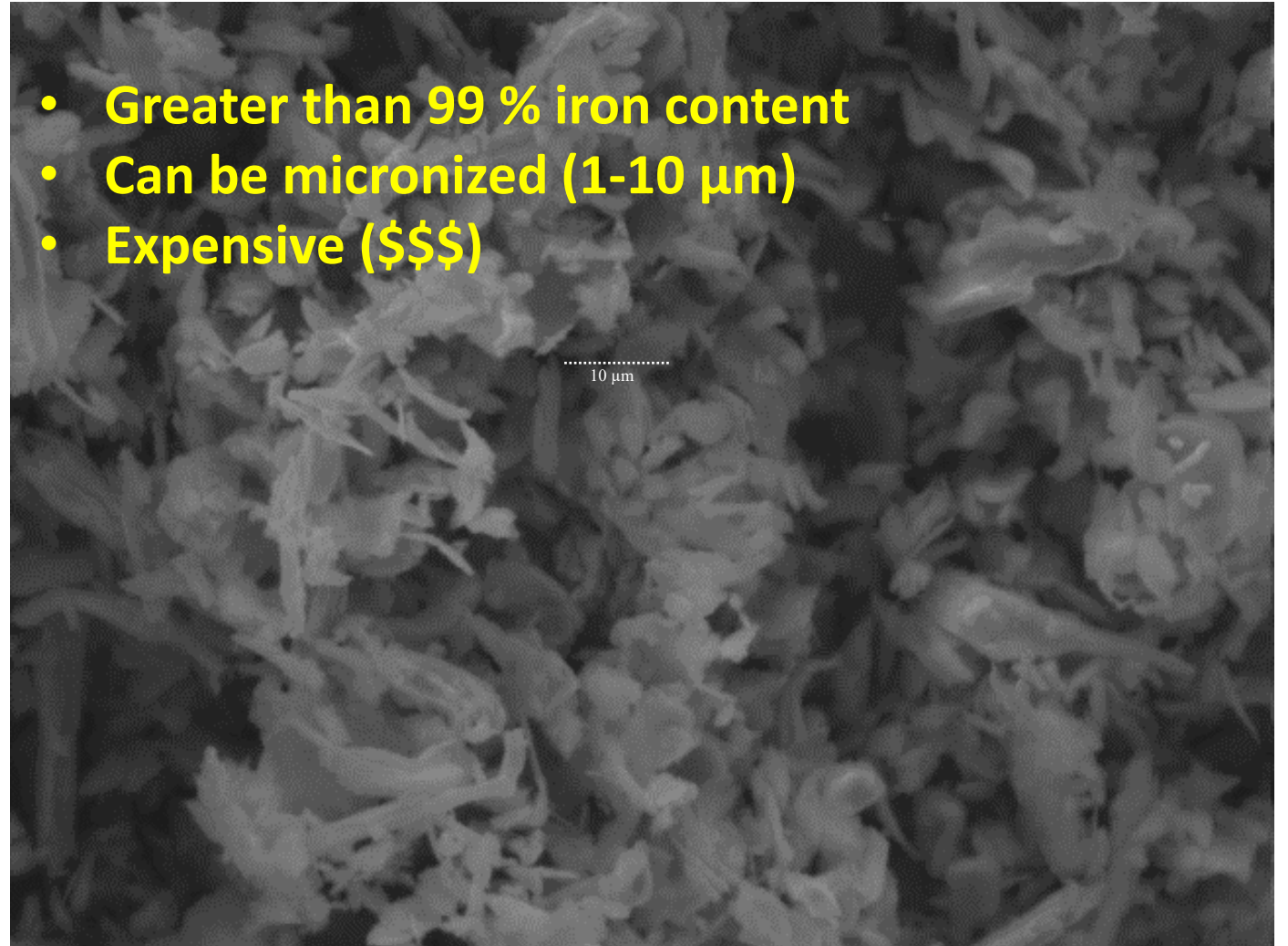
CleanER-PRB degraded PCE significantly faster

CleanER- PRB handled variations in load significantly better than conventional ZVI

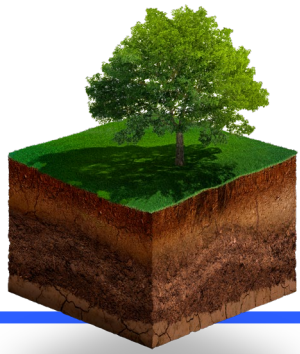
# Electrolytic Iron



- **Greater than 99 % iron content**
- **Can be micronized (1-10 μm)**
- **Expensive (\$\$\$)**



# Sponge iron Case study



# Regrind vs. Sponge Iron - Utilization Economic

## Improving Performance and Reducing ZVI cost for PRB – West Vancouver

### Project scope

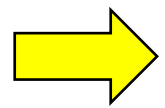
Large multi media PRB installed via trenching to cut off contaminant plume

### Design Parameter

4 % v/v ZVI loading rate over 1485 m<sup>3</sup> = 59.4 m<sup>3</sup> of ZVI

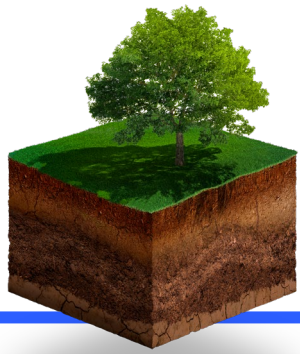
### ZVI required Mass using Regrind

59.4 m<sup>3</sup> x 2.8 kg/m<sup>3</sup> = 166 MT representing 149 MT of 100 % ZVI



**Regrind Bid Amount Estimate @ 1150 \$CAN\MT x 166 MT = 190 900 \$**





# Regrind vs. Sponge Iron - Utilization Economic

## Improving Performance and Reducing ZVI cost for PRB – West Vancouver

### Project scope

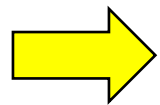
Large multi media PRB installed via trenching to cut off contaminant plume

### Design Parameter

4 % ZVI loading rate over 1485 m<sup>3</sup> = 59.4 m<sup>3</sup> of ZVI

### ZVI required Mass using Sponge Iron

59.4 m<sup>3</sup> x 1.45 kg/m<sup>3</sup> = 86.1 MT



**Sponge Bid Amount Estimate @ 2150 \$CAN\MT x 86.1 MT = 185 115 \$**



*Thank you for your attention !!  
Questions ?!?*

SMART Remediation  
January, February 2024

Contact info:

Jean Paré, P. ENG.

M: 418-953-3480 // [jean.pare@chemco-inc.com](mailto:jean.pare@chemco-inc.com)

T: 800-575-5422



Chemco-inc.com