



In-situ and on-site bioremediation of MTBE

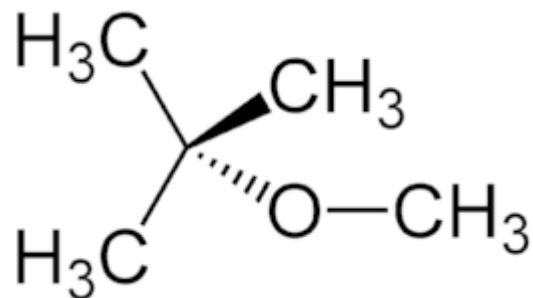
Dr. John Dijk

Battelle Conference April 16th, 2019



MTBE

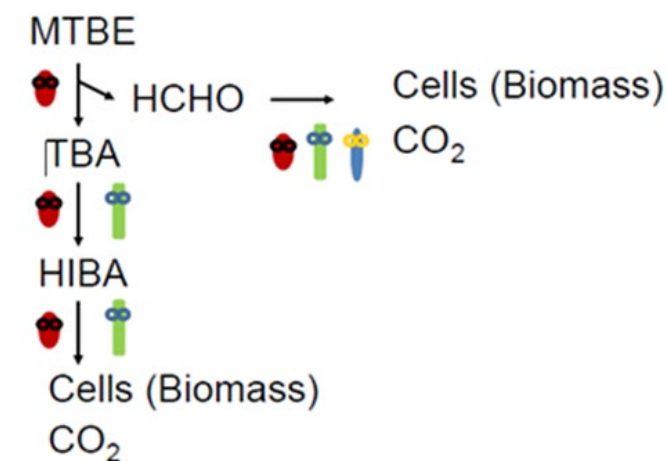
- Methyl-tertiar-butyl ether
 - Gasoline additive
 - Very mobile (low retardation)
 - Legislation Belgium (Flanders): 300 µg/l gw; discharge 100 µg/l,





MTBE - biodegradation

- Methyl-tertiar-butyl ether characteristics
 - Biodegradable, but not always straight forward (long HRT)
 - Often co-metabolism in presence of BTEX
 - 'Normal' bioreactor: 40-60% efficiency
- Special consortium (bioaugmentation)



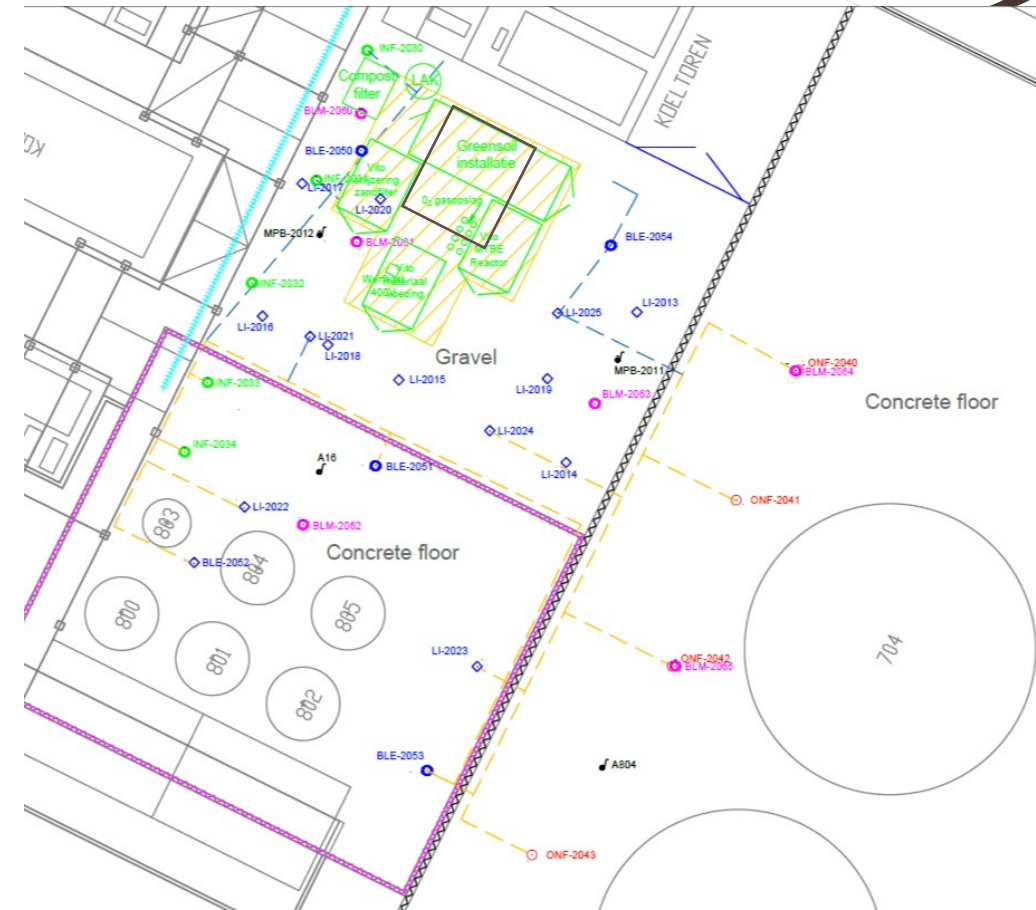
Site background

- Complex Industrial location
- Mixture of different contaminants
 - MTBE (up to 13,000 $\mu\text{g/l}$)
 - THP + BTEX (up to $\pm 10,000$ $\mu\text{g/l}$)
 - MCB (up to 3,000 $\mu\text{g/l}$)
- High COD (max 890 mg/l)
- Strongly reducing conditions (methanogenic)



Pilot scale field test

- In-situ bioremediation
 - Continuous groundwater circulation
 - Nutrient dosage
 - Biosparging
- MTBE bioreactor
 - P&T as possible containment measure
 - Test removal efficiency
 - Test influence of inoculation (bioaugmentation)

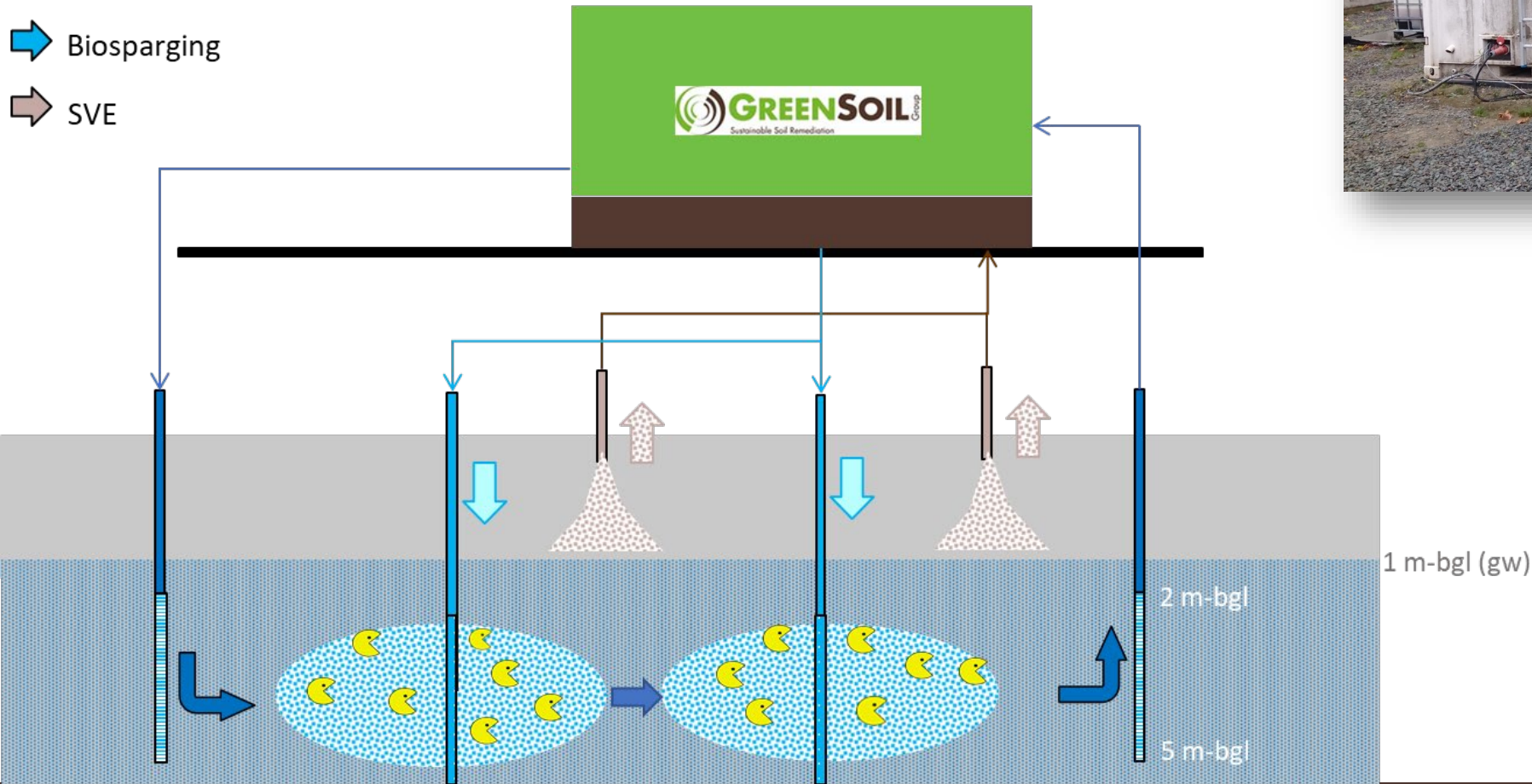


In-situ bioreactor

Water

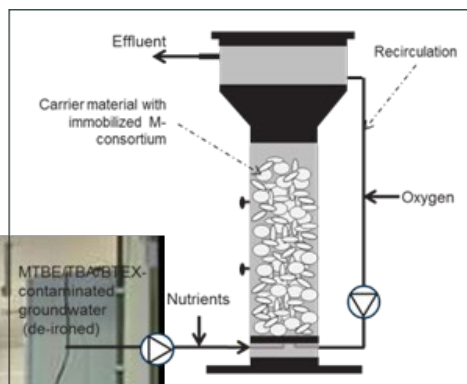
Biosparging

SVE

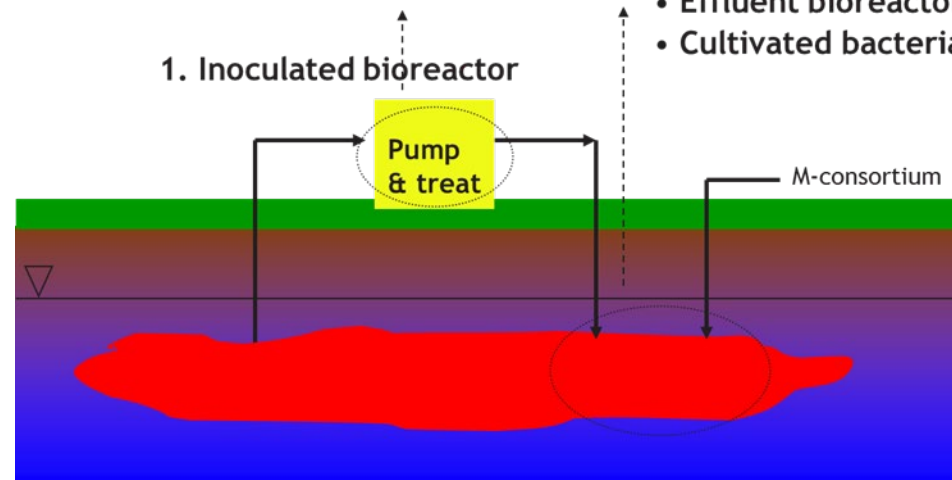




MTBE Bioreactor

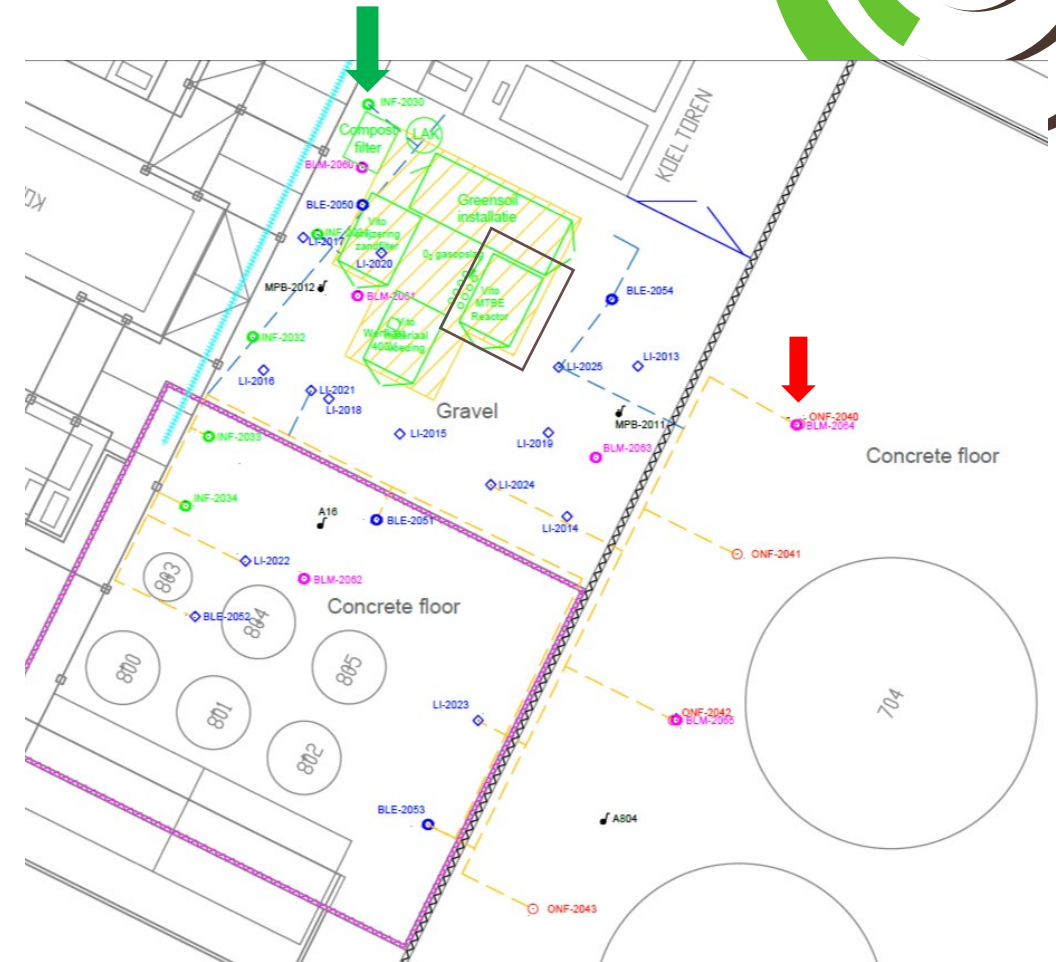


- 1. Inoculated bioreactor
- 2. In situ bio-augmentation
 - Effluent bioreactor
 - Cultivated bacteria



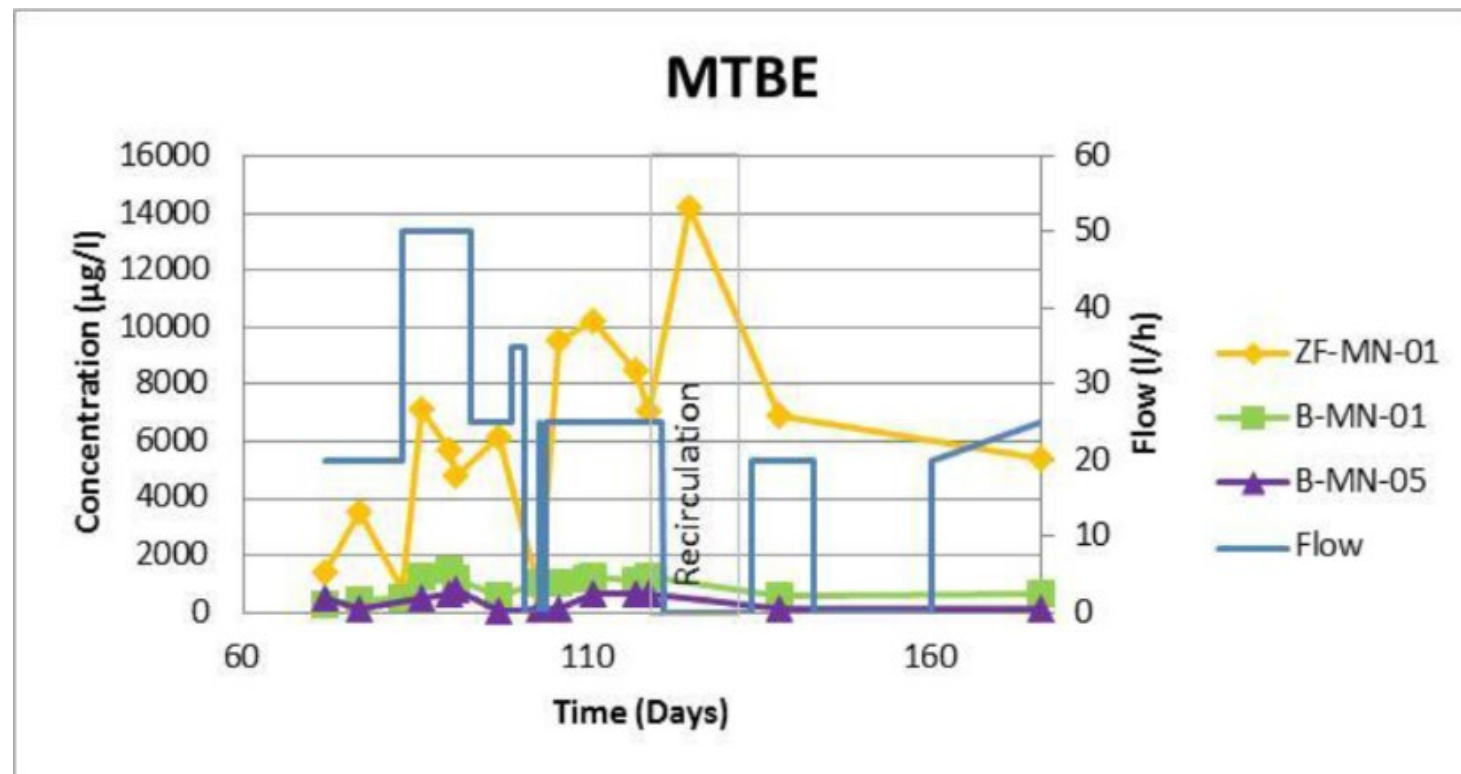
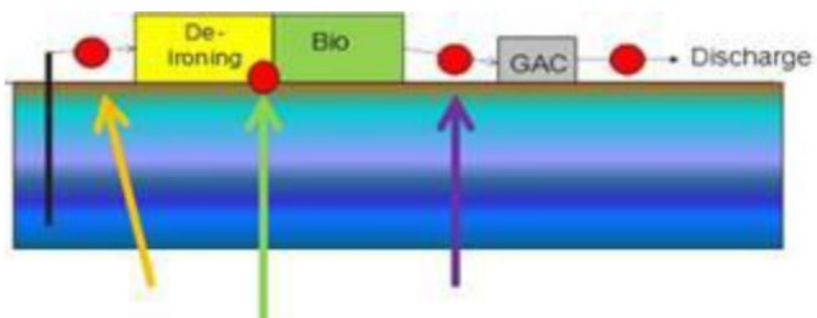
MTBE bioreactor

- Treatment system
 - Iron removal unit followed by bioreactor
 - Bioreactor is fed from 1 extraction well
 - Effluent infiltrated in another well
 - Flow 25-50 l/h



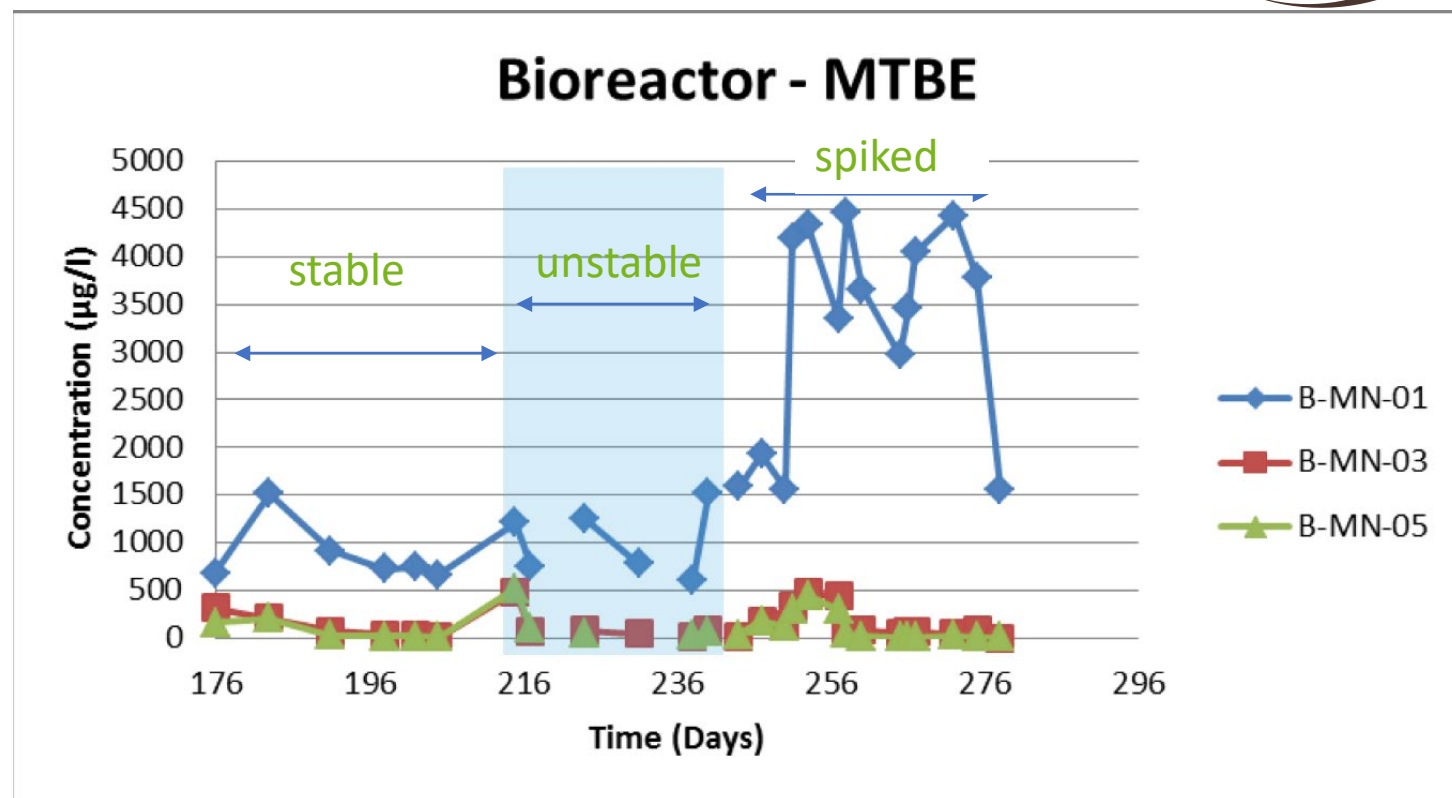
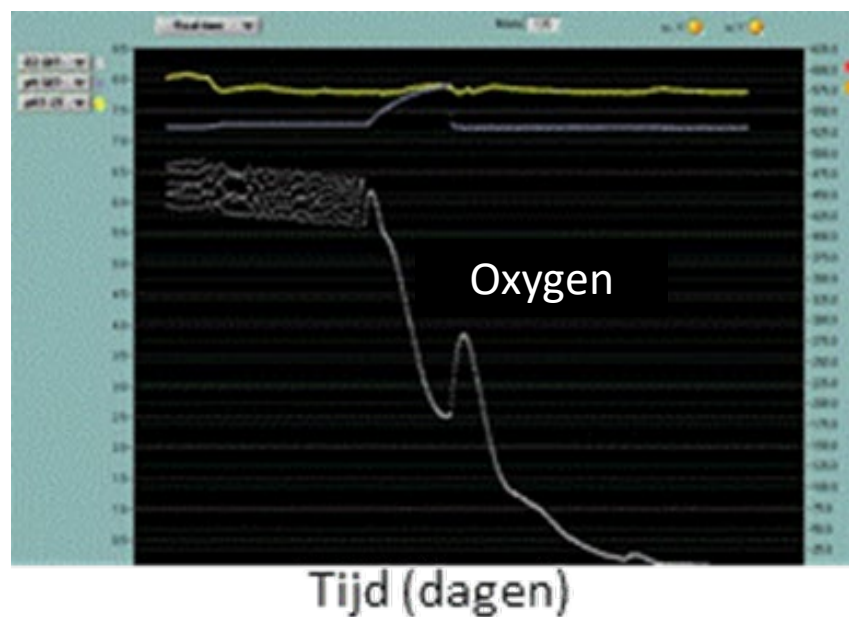


MTBE bioreactor - results



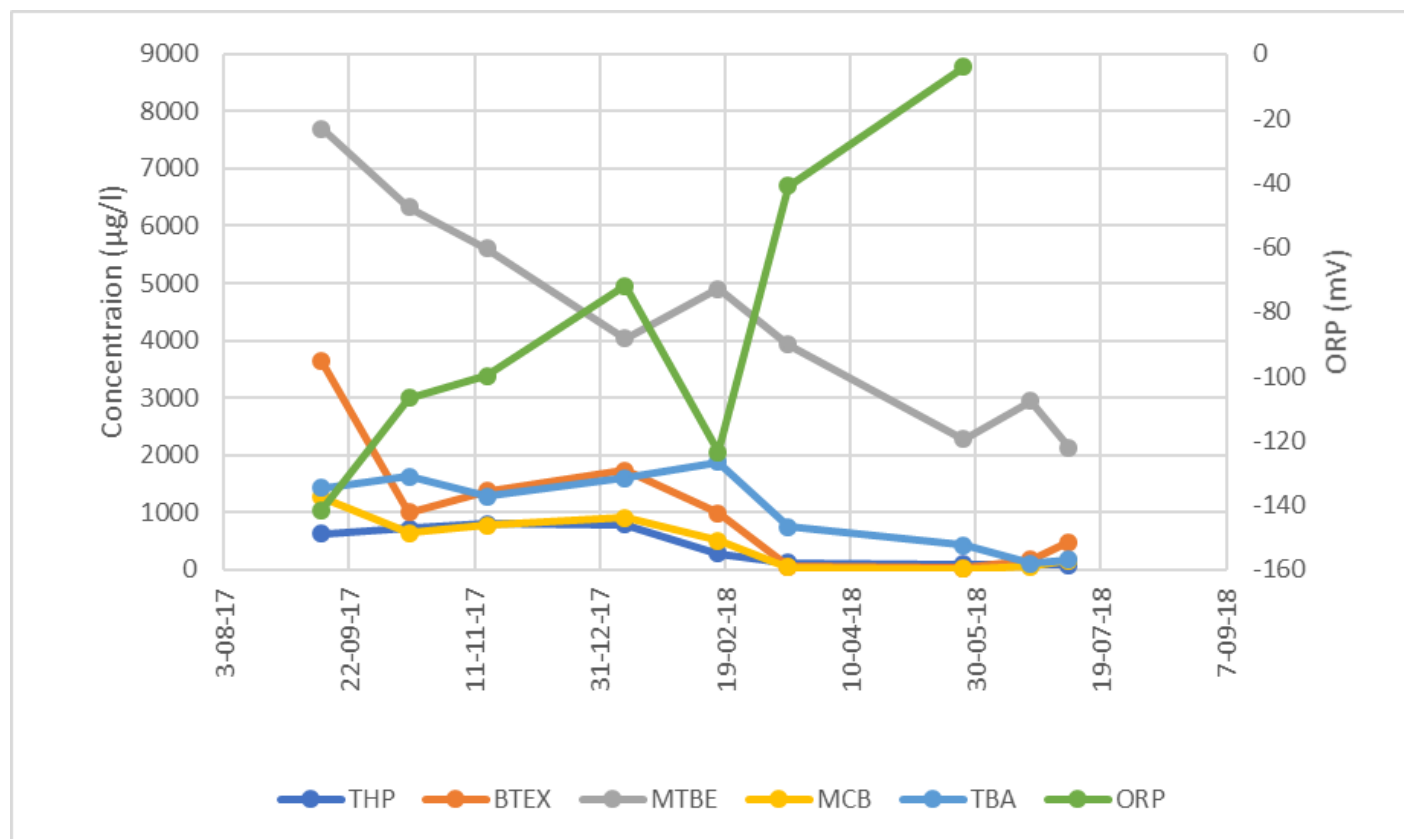


MTBE bioreactor - results





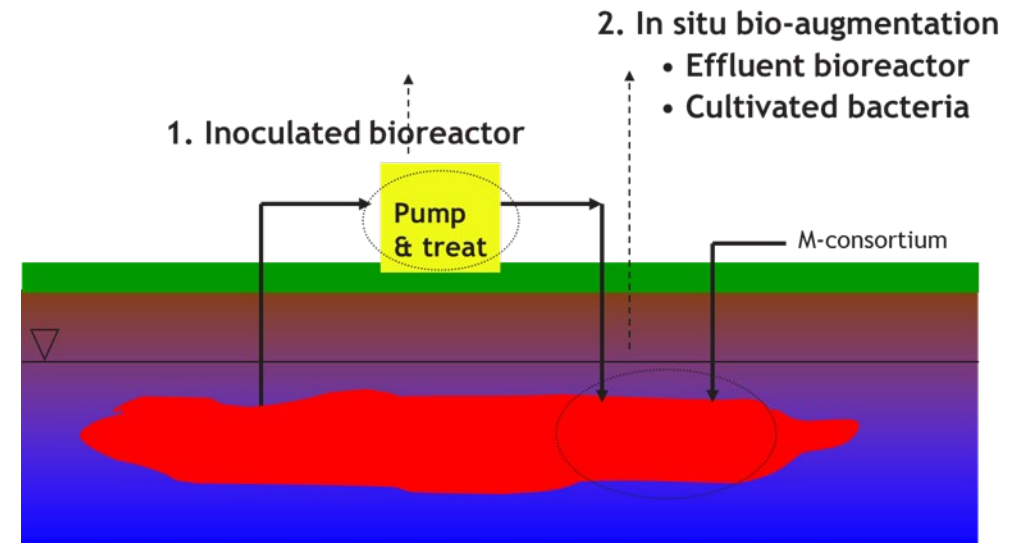
MTBE in-situ



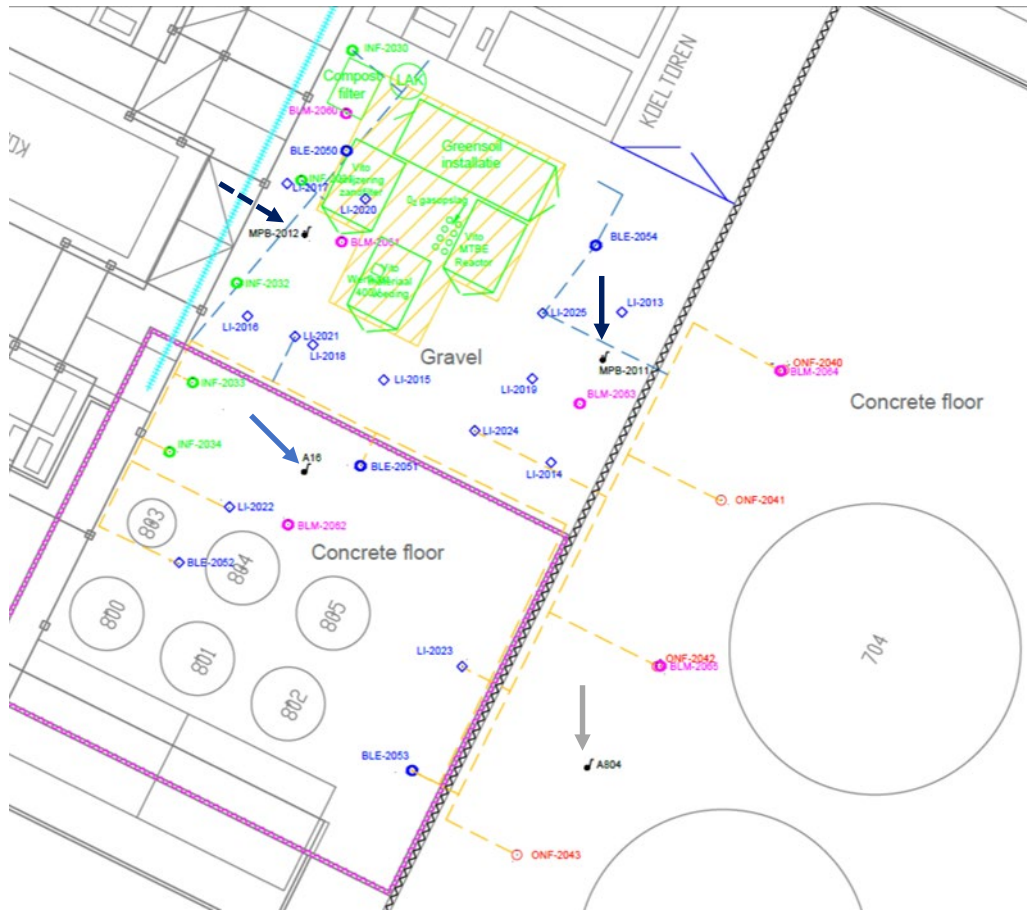


MTBE in-situ

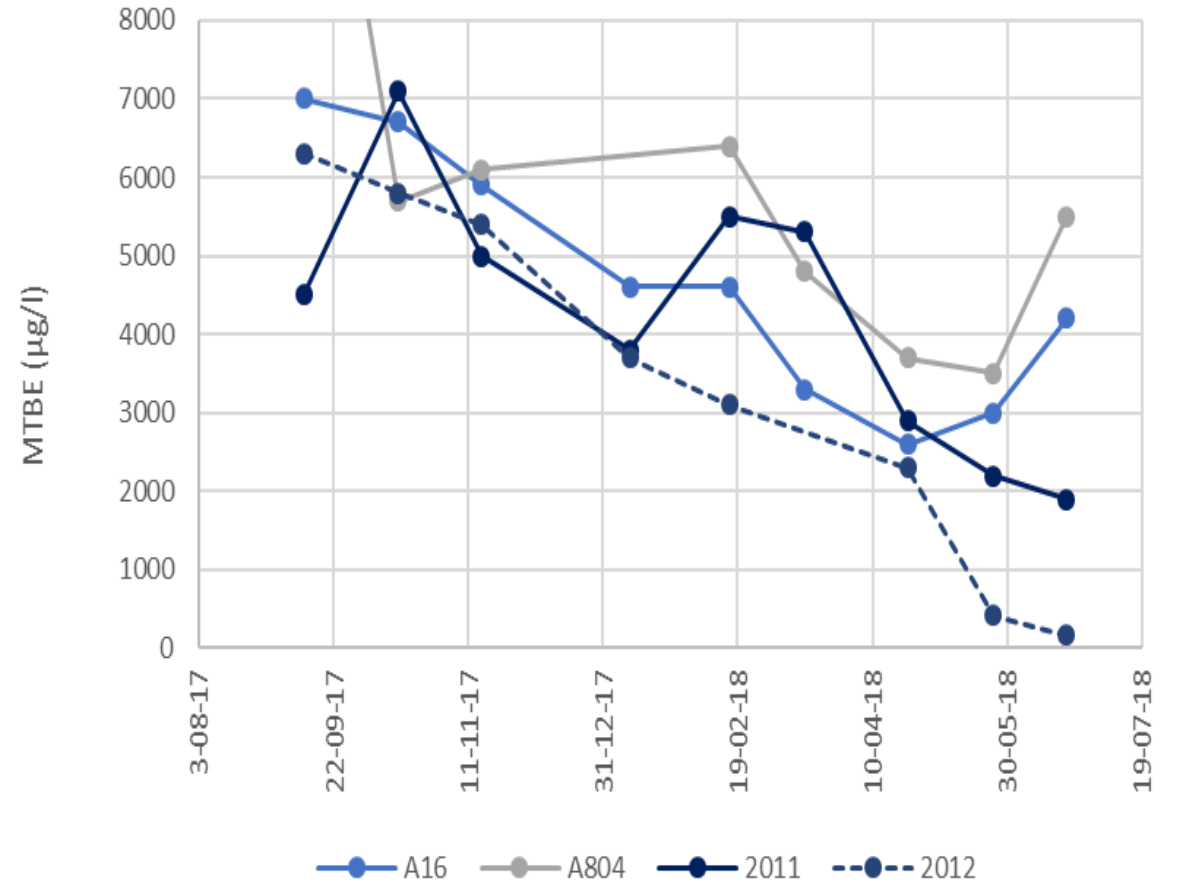
- No complete removal of MTBE in-situ thus far
 - Degradation 56-73 % (co-metabolic? BTEX/THP depleted)
- Innoculation with consortium?
 - Monitoring well closest to infiltration effluent: 93%!



MTBE in-situ



MTBE concentration in monitoring wells





MTBE bioreactor conclusions

- Complete degradation of MTBE/TBA
- Degradation efficiency > 99% (effluent < DL)
- Oxygen crucial! (4 mg/l minimum, 6 mg/l optimum)
- High (unexpected) oxygen demand: low flow rate



MTBE in-situ conclusions

- Removal of a complex mixture of contaminants
- “Natural” stimulated MTBE removal 56-73%
- Indications for in-situ bioaugmentation (up to 93% in-situ removal)
- Combination of inoculated bioreactor and in-situ bioremediation promising
- Upscaling and integrating for full-scale application

Thank you for your attention!

