

# Is Biotreatment of Crude Oil easy?

*Presented by:*  
*Marie-Claude Drouin*  
*&*  
*Guillaume Bedard*  
*Biogenie S.R.D.C. Inc.*

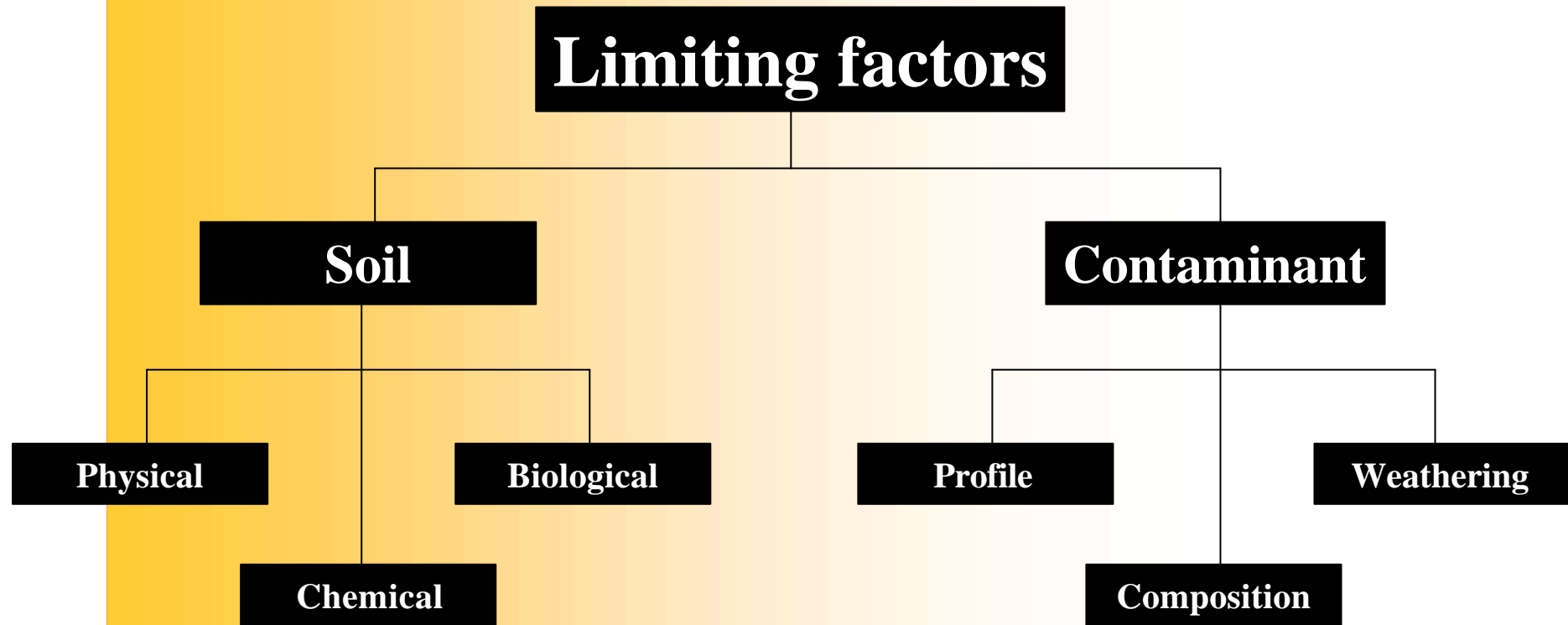


# Summary

- **Is biotreatment of crude oil easy?**
- **Bioremediation fundamentals**
- **Common technologies**
- **Innovative technologies**



# Limiting factors



# Limiting factors

- **Particle Size Distribution**

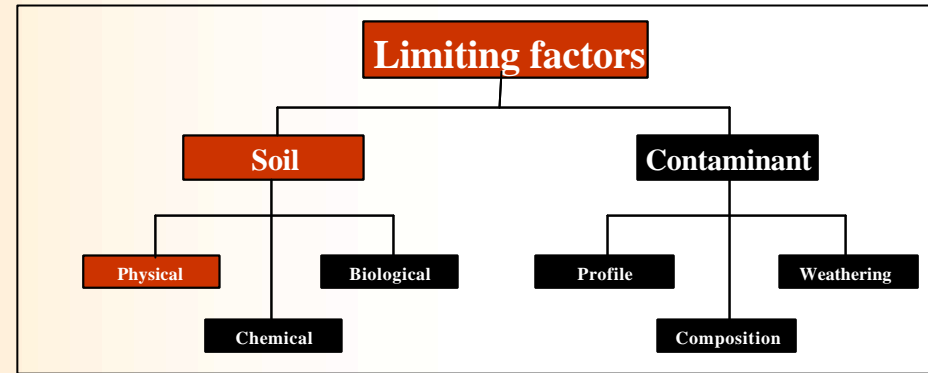
- Air Distribution
- Sorption

- **Temperature**

- Acceptable range : 5-55°C
- Optimal : 30-35 °C

- **Moisture Content**

- 30-80 % Field Capacity



# Limiting factors

- **pH**

- Acceptable range : 5-9
- Optimal range : 6-8

- **Nutrient Level**

- C:N:P = 100-300:10:1

- **Metal Concentration**

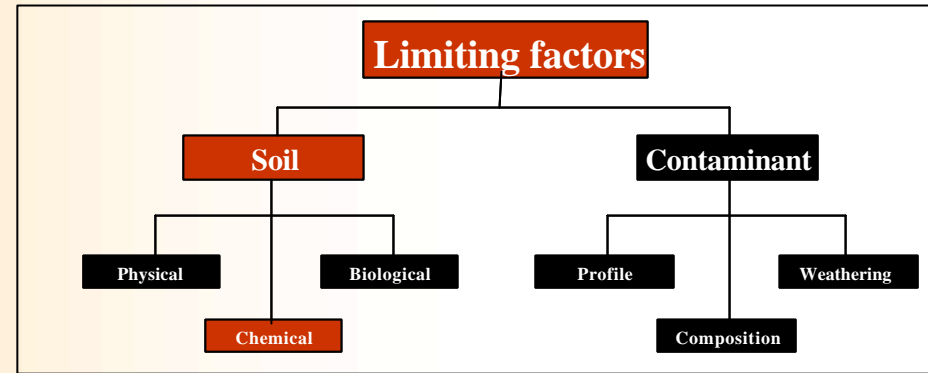
- Cd, Cu, Hg, As, etc

- **Salinity Level**

- $EC_{1:2} > 10$  dS/m : Potential inhibition

- **Total Organic Carbon**

- Increases Contaminant Sorption



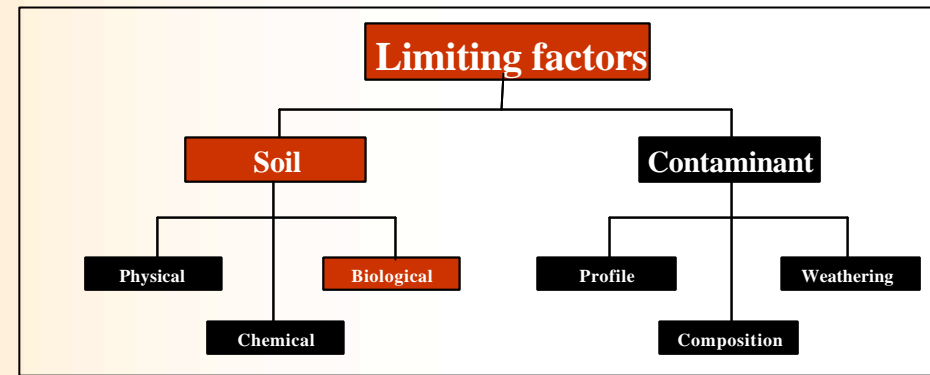
# Limiting factors

- **Total Heterotroph**

- >  $10^6$  CFU/g

- **Hydrocarbon Degraders**

- > 10% of the Total Heterotroph

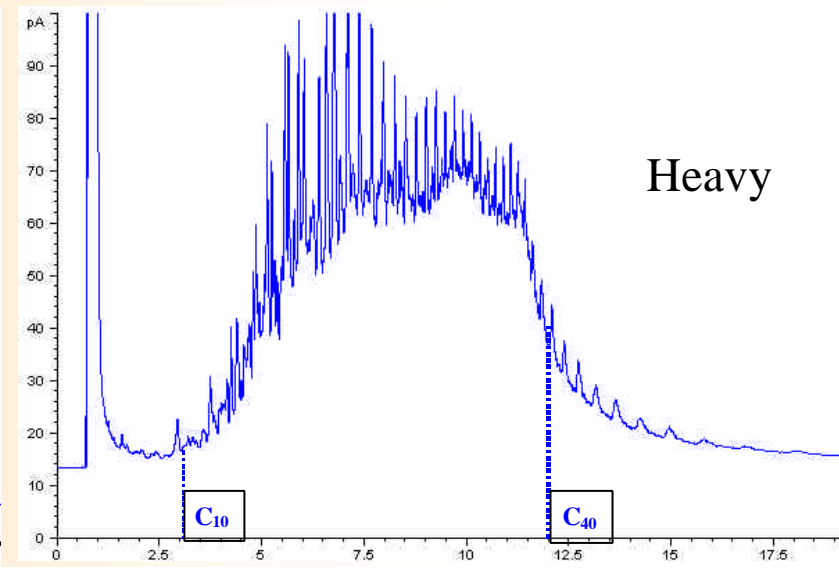
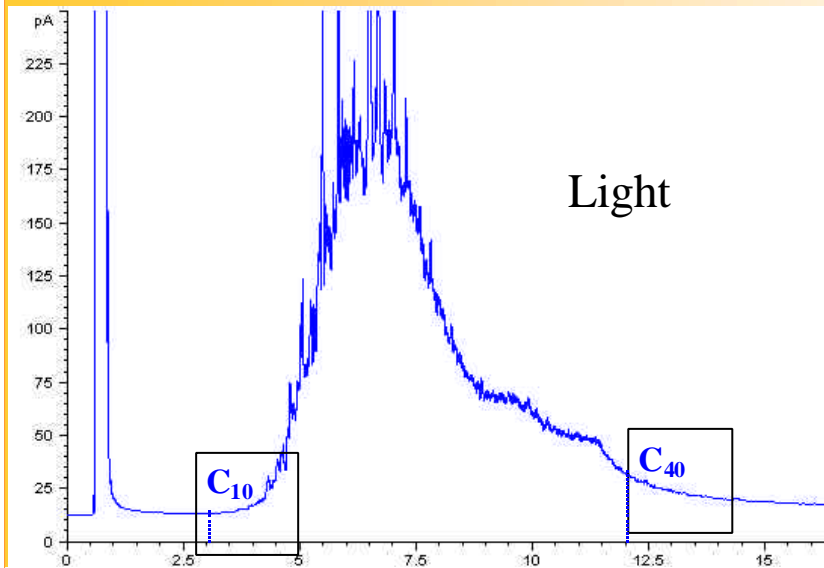
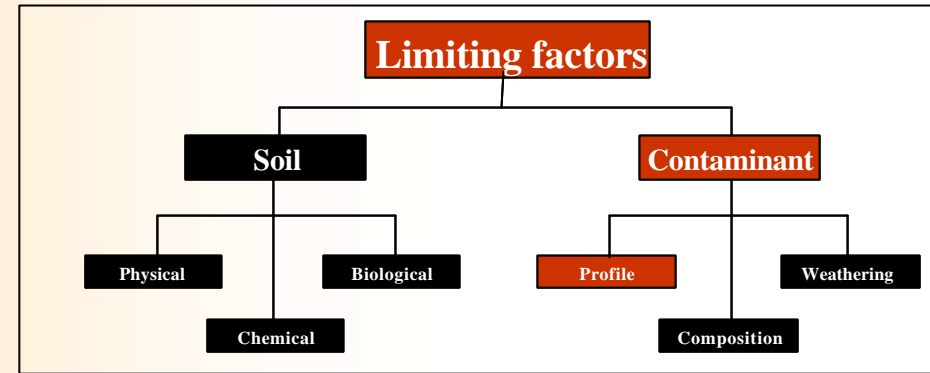


*Treatment conditions should aim at increasing the proportion of hydrocarbon degraders to 100%*

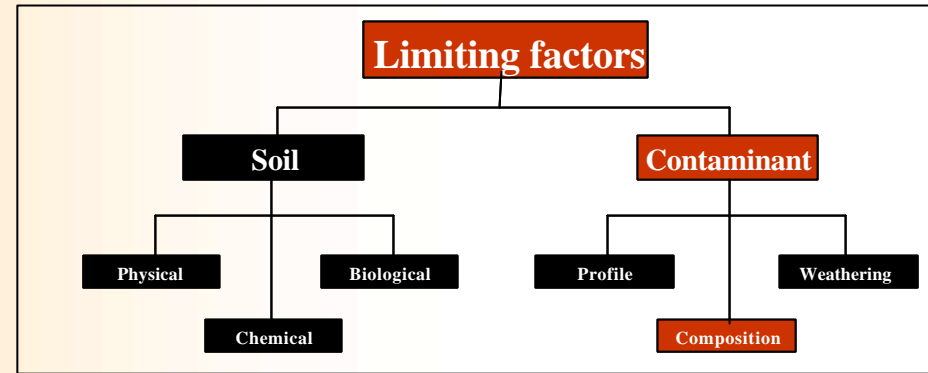


# Limiting factors

- **Light or Heavy**



# Limiting factors



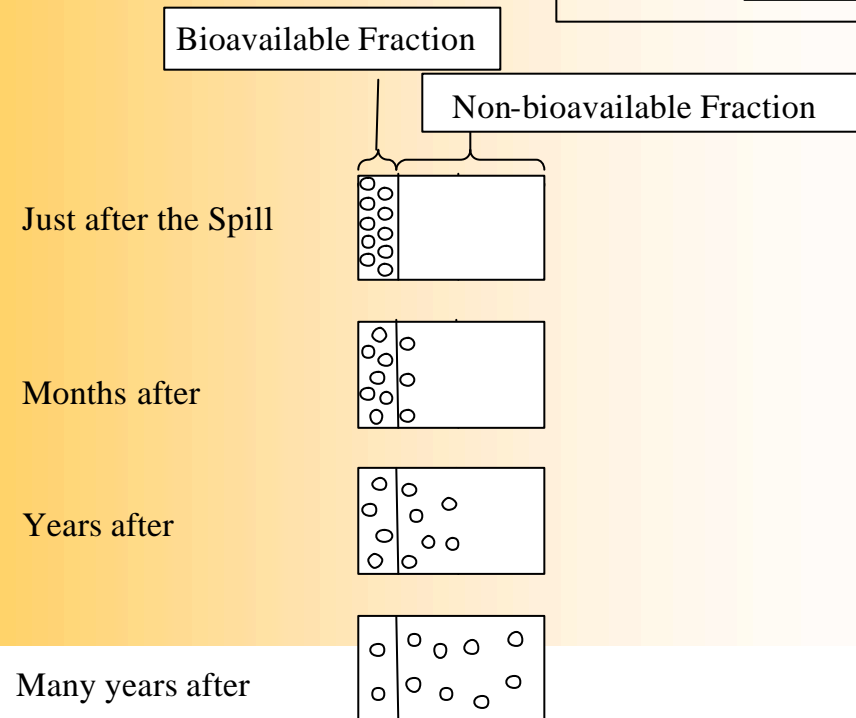
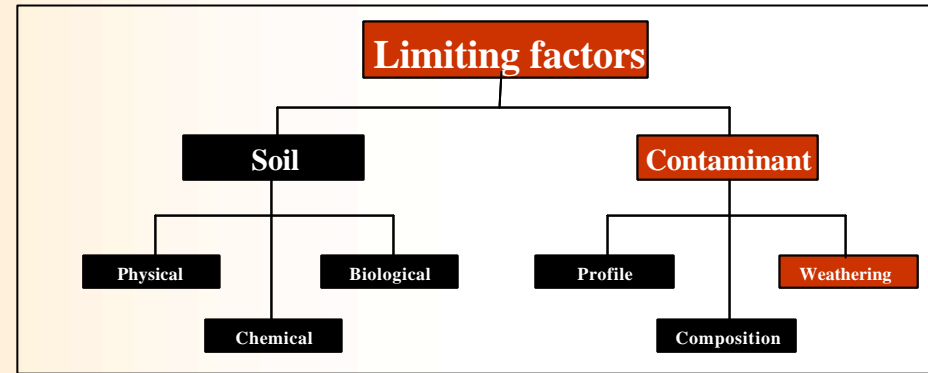
- **Relative Proportion of Constituents**

- Aliphatics
- Aromatics
- Resins
- Asphaltens



# Limiting factors

- Adsorption, Diffusion and Sequestration



# Biogenie's R&D Services - Treatability



# Biogenie's R&D Services - Treatability



# Common Technologies

## LANDFARMING

- Soil Characteristic (limited to coarse soil matrix)
- Temperature (difficult to maintain optimal range)
- Moisture content (difficult to maintain optimal level)
- Microbial activity (100% degraders not attainable)
- Type of contaminants (proportion of heavy PHC)
- Composition of contaminants (proportion of F3 & F4)
- Wheatering (limited)



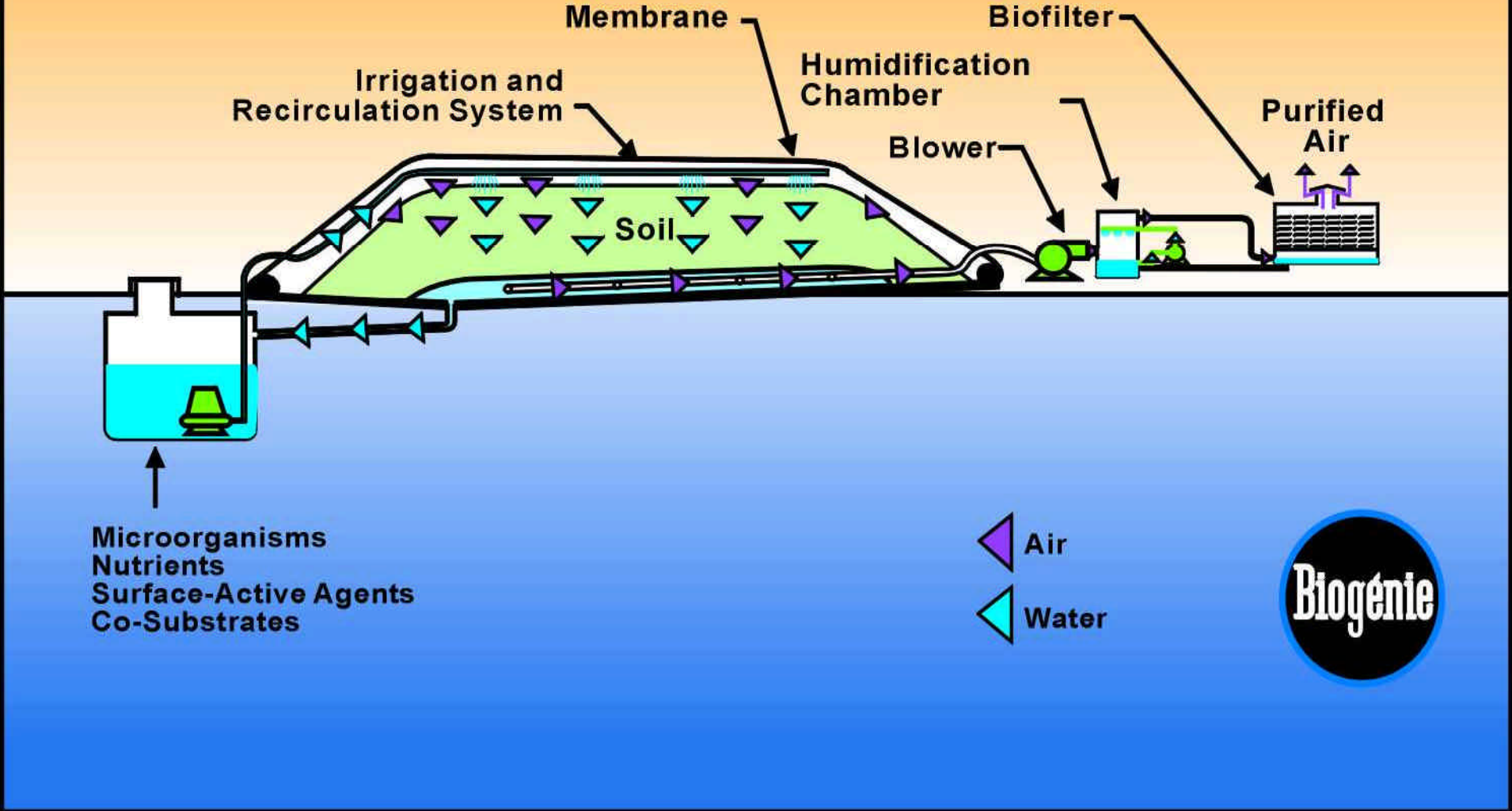
# Common Technologies

## WINDROW

- Soil Characteristic (coarse and fine soil matrix)
- Temperature (difficult to maintain optimal range)
- Moisture content (heterogenous distribution)
- Microbial activity (100% degraders not attainable)
- Type of contaminants (proportion of heavy PHC)
- Composition of contaminants (proportion of F3 & F4)
- Wheatering (limited)



# EX SITU VENTILATION TREATMENT (BIOPILE)



# Common Technologies

## ENGINEERED BIOPILE

- Soil Characteristic (coarse and fine soil matrix)
- Temperature (optimal range)
- Moisture content (optimal level)
- Microbial activity (best condition for 100% degraders)
- Type of contaminants (greater proportion of heavy PHC)
- Composition of contaminants (greater proportion of F3 & F4)
- Wheatering (limited but not as critical)







# In-Situ Biopile

