

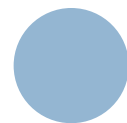
SURFACTANT ENHANCED SOIL WASHING OF 20,000 TONS OF BUNKER-C CONTAMINATED SOIL TO ACHIEVE REGULATORY CLEAN-UP GUIDELINES: BENCH TO FULL SCALE APPLIED CASE STUDY

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**IPEC CONFERENCE 2013
NOVEMBER 11 TO 14, 2013
SAN ANTONIO, TX**




SITE LOCATION



SITE INFORMATION

- **Soil treatment facility near St. John's NL**
 - **>20,000 Tons of Bunker-C #6 contaminated soil**
 - **TPH Concentration 5000 to >15,000 ppm**
 - **Clean-up Goal: <1000 ppm TPH**
 - **Soil Texture:**

Silt & Clay	<5%
Sand & Grave	85%
Coarse Gravel	10%
 - **Source Former Industrial site. Spills from large AST and associated on-site pipelines (Under redevelopment)**
 - **Environmental Consultant - Third-party Verification**
- 

>20,000 Tons of Bunker-C Contaminated Soil Pile



**LET ME TAKE YOU FOR A WALK
SEE THE SITE AND SOIL
WASHING PROCESS
STEP BY STEP**



FACT

**>90 % of All Organic Contaminants Are
Absorbed or Adsorbed (Sorbed) To Particles In
Soil, Sediments, Drill Cuttings, Bedrock, Sludge, Etc...**

Contaminant Sorption

Limits The 'Availability' of Contaminants For All Forms of:

Physical, Chemical & Biological Remediation!

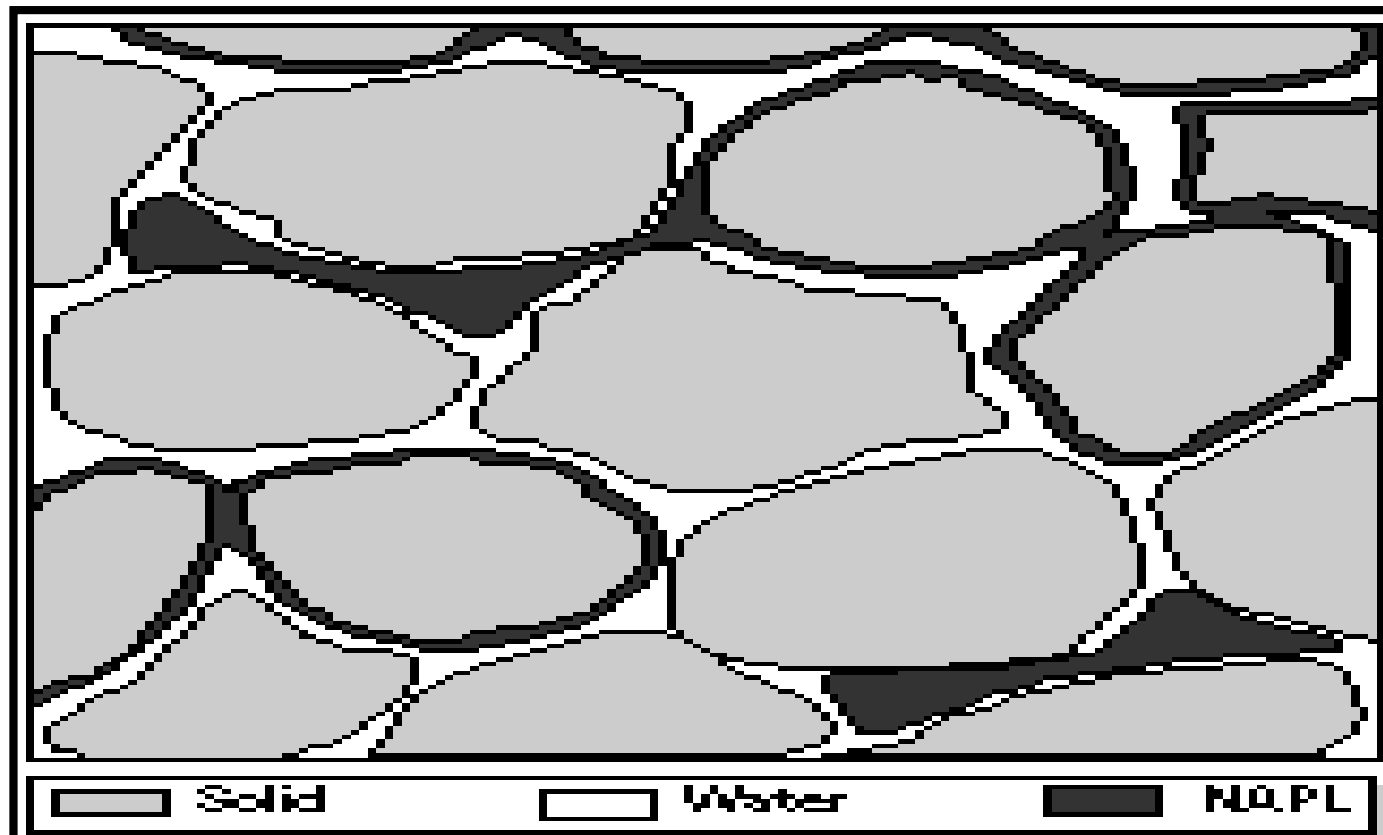
**Sorption Is The #1 Reason Why Many
Remediation Project Are Slow, Very Costly and/or Fail To
Achieve Their Objectives!**



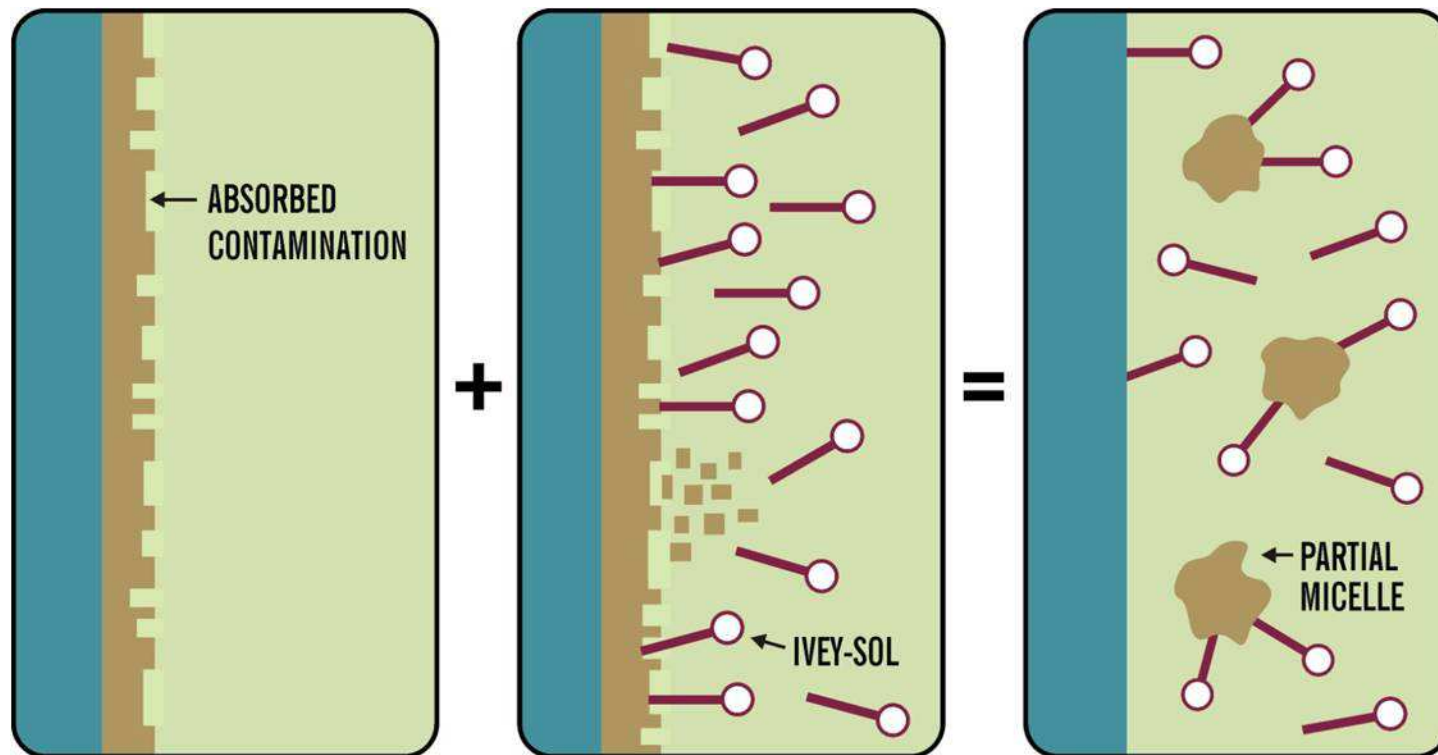
SORPTION

Adsorption and Absorption
Properties and Characteristics

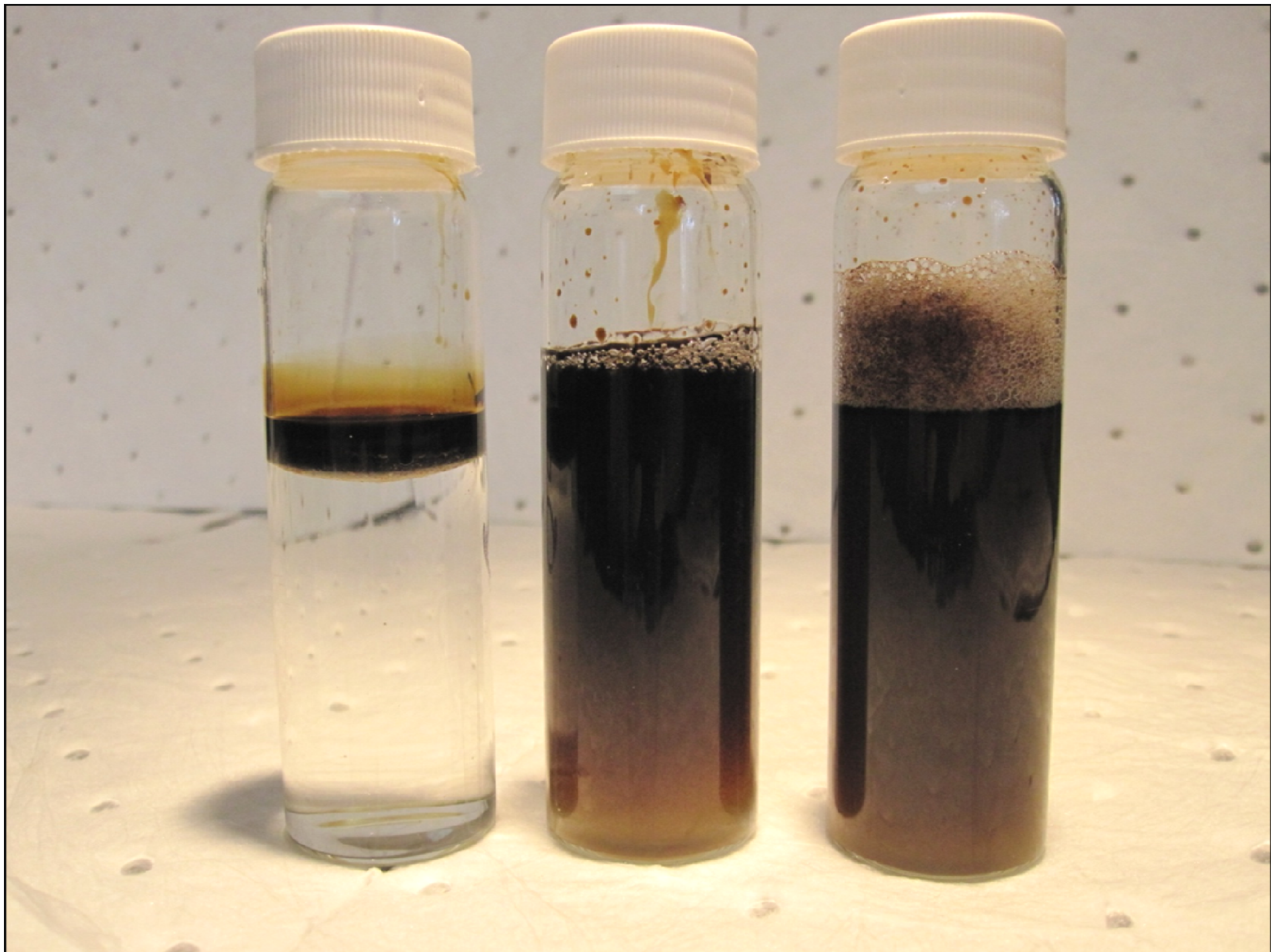
Soil & Solids Remediation Must Address
This Factor to be Successful!



MECHANISM

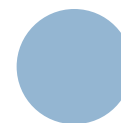


**Ivey-sol Interaction With Oil On A Surface
With Partial Micelle Encapsulated of Oil Droplet**
(Ivey-sol is Effective Below The CMC)





Pre and post Ivey-sol Surfactant washed solids impacted with heavy-end petroleum hydrocarbons



TERMS OF REFERENCE

- **Surfactant Enhanced Soil Washing (SESW) Using Ivey-sol Surfactant Technology (Concentration of Ivey-sol <0.5%)**
- **Ratio of solids to liquids – Approximately 1:1**
- **Washing Duration <1 minute (Based on >50 tons/hour)**
- **Soil washing rate was between 50 to 150 tons/hour, but generally averaged was between 50 to 75 tons/hour**
- **Cleaned sand and gravel was compliant for reuse as specified aggregate for commercial and industrial site use. Client actually sold the sand and gravel for >\$25/yd³**
- **Waste water treatment was physical settling (ponds), phase separated oil recovery, and polishing with GAC**
- **Oil Recovery using skimmer on ponds – yielded slop oil (\$ Refinery)**





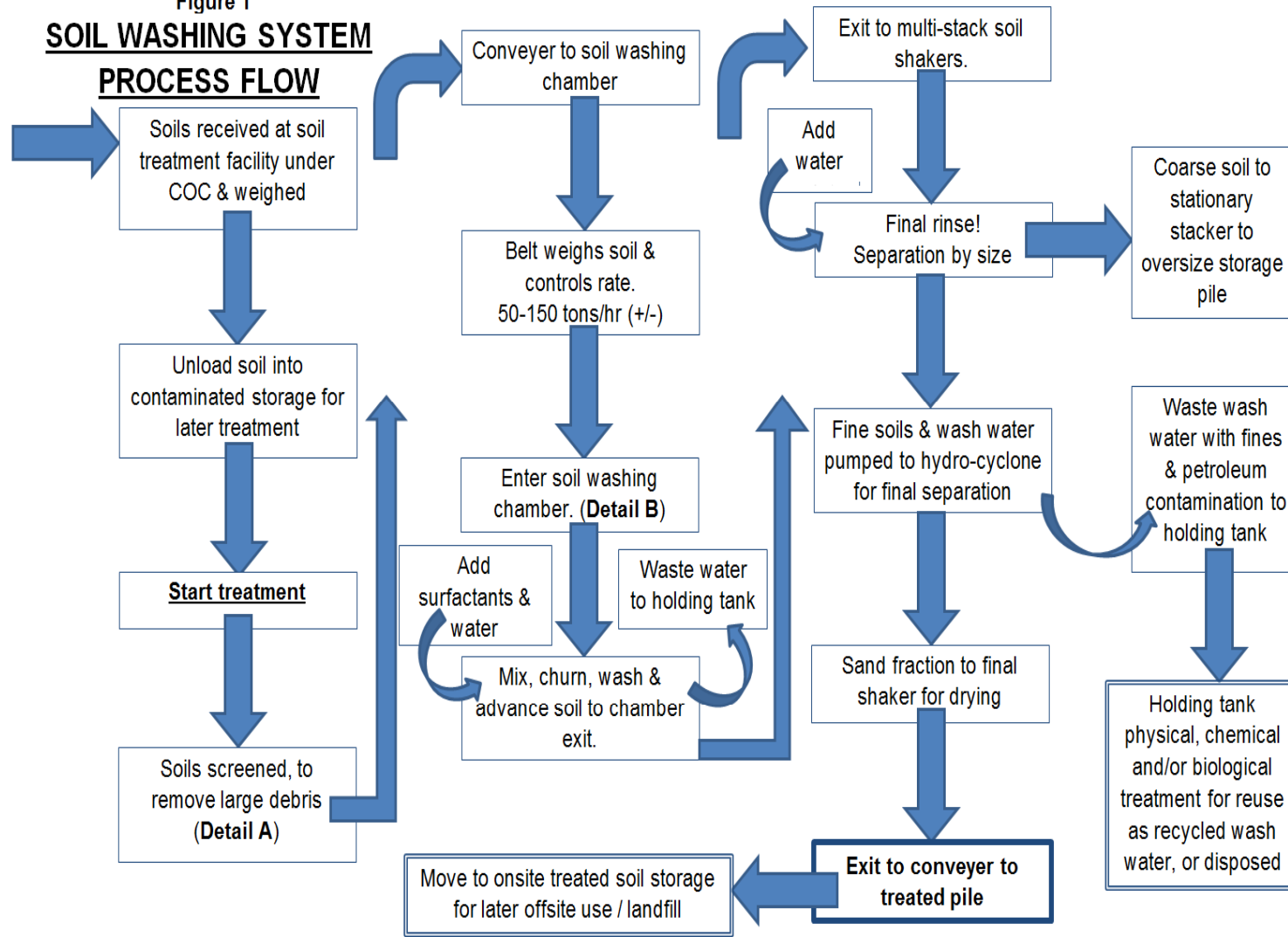
**CONTINUOUS SOIL WASHING SYSTEM
50 TO 150 TONS/HOUR**



**BATCH SOIL WASHING SYSTEM
25 TO 35 TONS/HOUR**

GENERAL SOIL WASHING SYSTEM APPROACH

Figure 1
**SOIL WASHING SYSTEM
PROCESS FLOW**









SHAKERS – SEPARATE ATE SOILS FROM WATER













OIL RECOVERY - POST SOIL WASHING





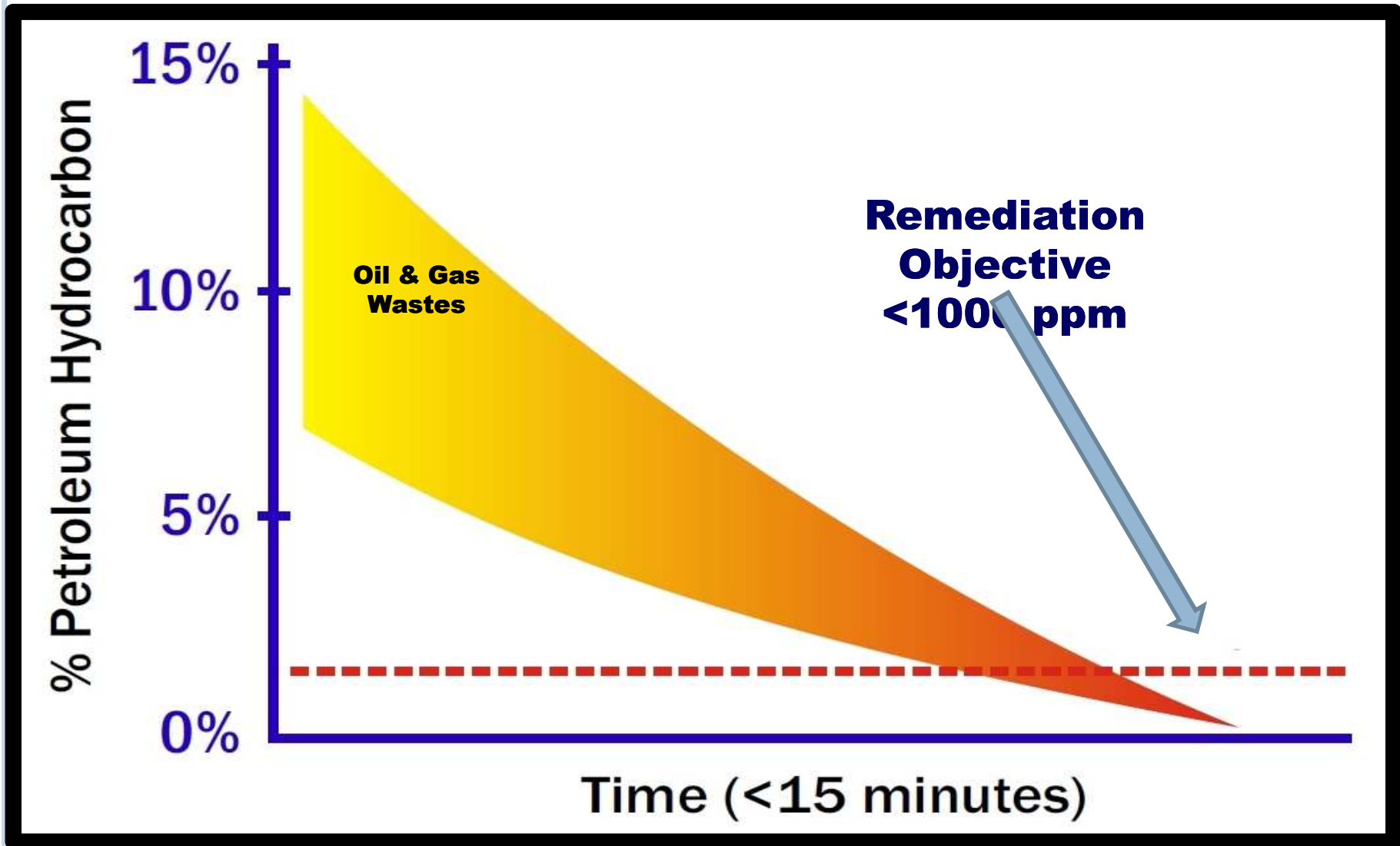


**CLIENT CAN REUSE UPWARDS OF
80% OF MORE OF THEIR WATER.
ONLY CLEANING TO A REUSE
(NOT DRINKING WATER)
STANDARD**



We need an innovative, cost effective, sustainable way to treat TPH contaminated soil!

Surfactant Enhanced Soil Washing (SESW)



**THIRD PART ENVIRONMENTAL
CONSULTANT COMPLETED ALL
VERIFICATION TESTING TO ENSURE
TREATED SOILS ACHIEVED THE <1000
PPM TPH REGULATORY STANDARD**




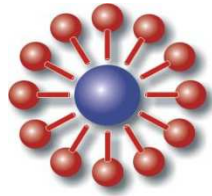
**CLIENT TOOK APPROXIMATELY
50 WORKING DAYS
TO TREAT THE 20,000 TONS OF
BUNKER-C CONTAMINATED SOIL**

**(BASED ON A RATE OF 50 TONS/HOUR WITH
8 HOUR WORKING DAYS)**



CONCLUSIONS

- **Surfactant Enhances Soil Washing (SESW) using Ivey-sol is an effective tool for remediation of TPH (petroleum hydrocarbon) contaminated soils**
 - **SESW is effective for treating contaminated soils (i.e., silty-sand, sand, gravel and boulders);**
 - **SESW may allow for oil recovery from waste water;**
 - **SESW is rapid (Takes only minuets per ton)**
 - **SESW can achieve stringent regulatory standards**
 - **SESW is cost effective remediation method**
 - **Very low green house gas emission footprint (Green Technology)**
- 



Ivey International Inc.

"Today's Environmental Solutions For A Better Tomorrow"

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