Osorb®

Novel Technology Systems for the Treatment of Produced Water PWUnit#1 and SkidUnit#1

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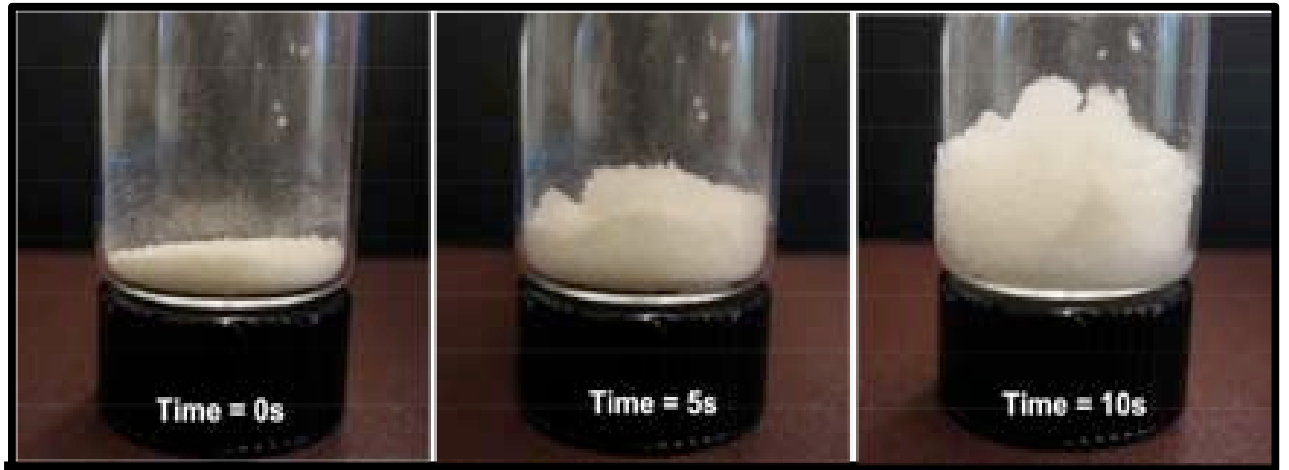
Swelling Glass. A novel material.

ABSMaterials makes **Osorb**; a glass engineered to rapidly swell and absorb “O”rganic molecules.

Produced Water Absorbers, LLC is a division established to develop solutions for Oil Waters.

Osorb captures:

- BTEX
- Hydrocarbons
- Natural Gas
- Acetone
- Methanol
- Pharmaceuticals
- Halogenated Solvents
- Non-Ionic Surfactants
- Organic Acids



Osorb does not absorb water.

Osorb for Produced Water Treatment

Osorb is hydrophobic and will not absorb water.

Works at temps up to 210 C and pH up to 10.5

Captures 2-8x its own weight in target compounds

Osorb rapidly swells and holds targeted species

Osorb is a fully reversible and reusable material

Treatment of Gulf PW w/ Osorb

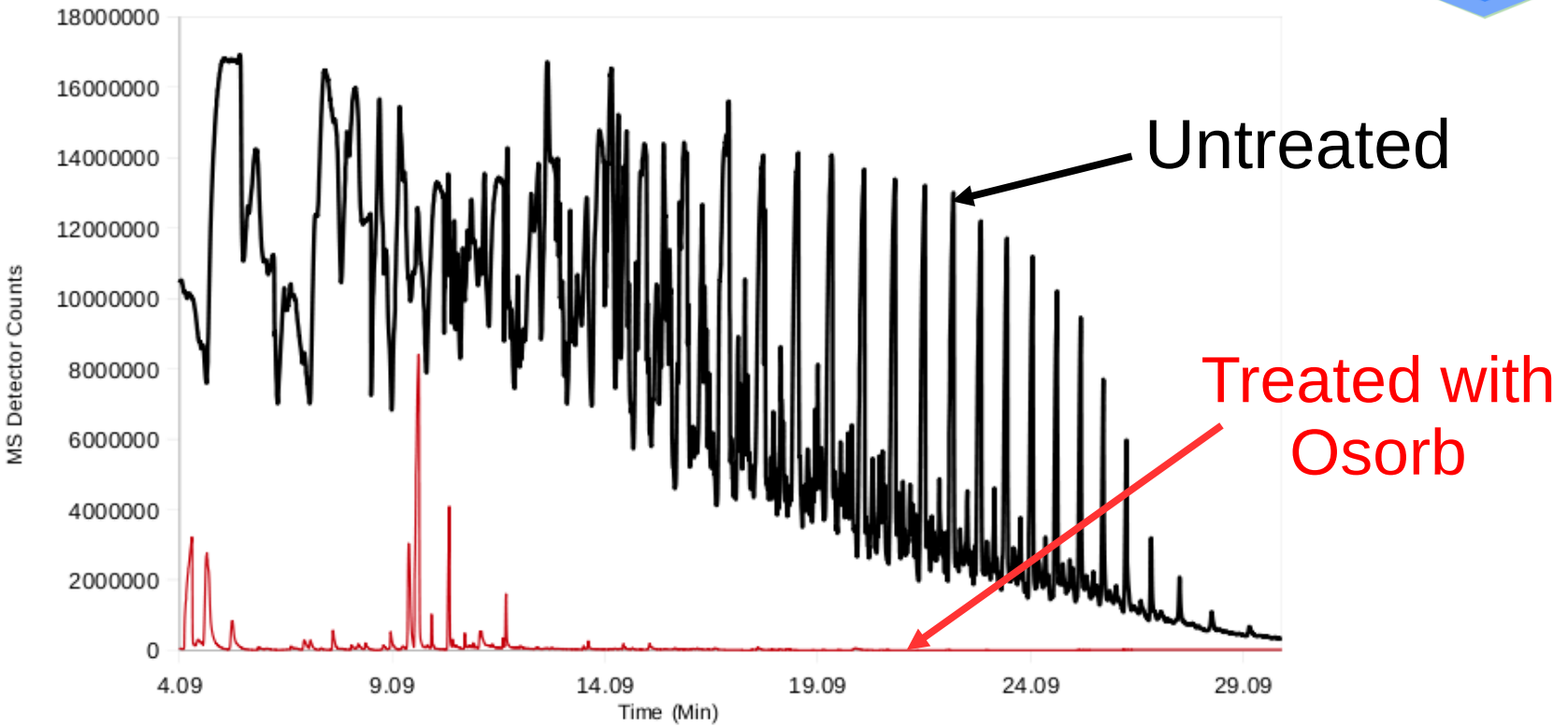
- Lab scale of Osorb glass for PW treatment.

Produced water sample from a Gulf platform

Treatment with Osorb

Resulting water

WY Flowback + PW Evap Pond



GC-MS analyses of **(black)** untreated Wyoming produced water and (red) water after 60 second treatment with 10% w/v Osorb. Note the huge number of surfactants+polymers

These results were repeatable when only using **.5% w/v** Osorb

Extraction efficiency of **99.2%** was maintained at **33.5 F**

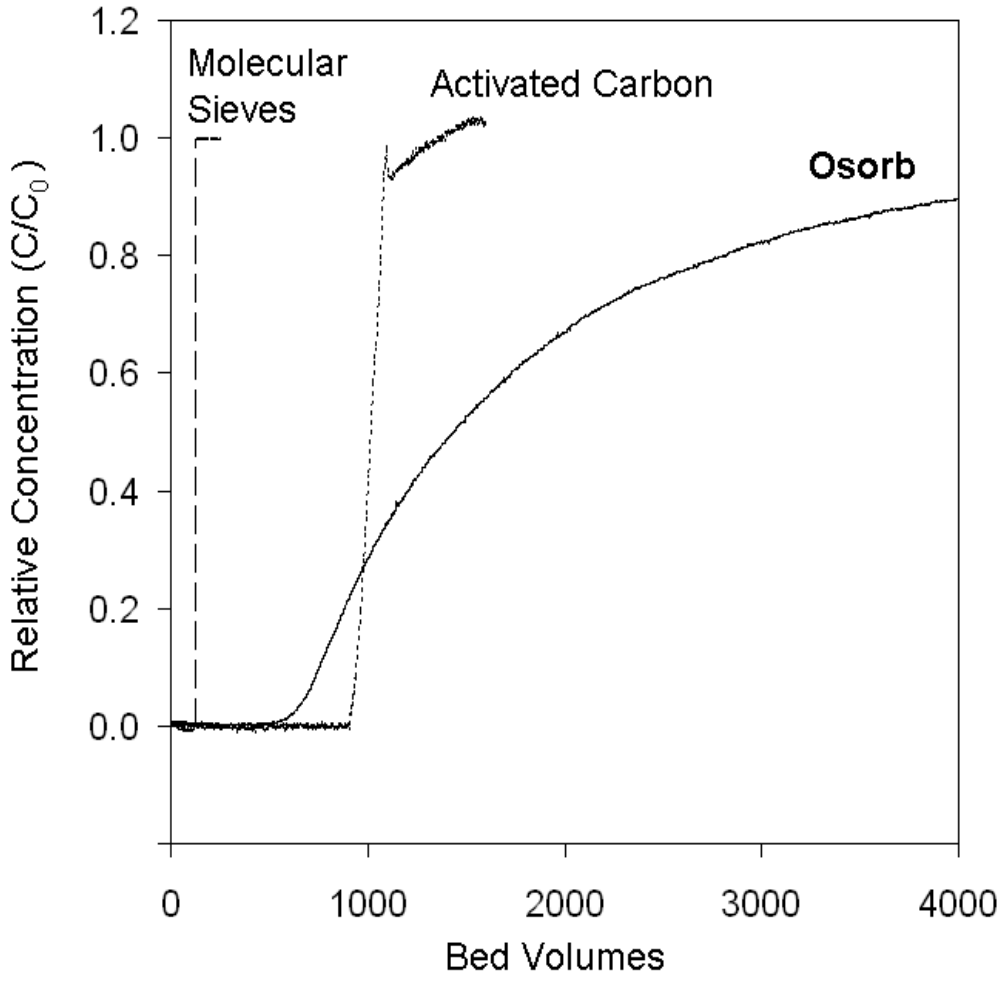
Dissolved Toluene Pulled from PW

Osorb will remove 5-7 times its weight of Toluene:

Similar results for:

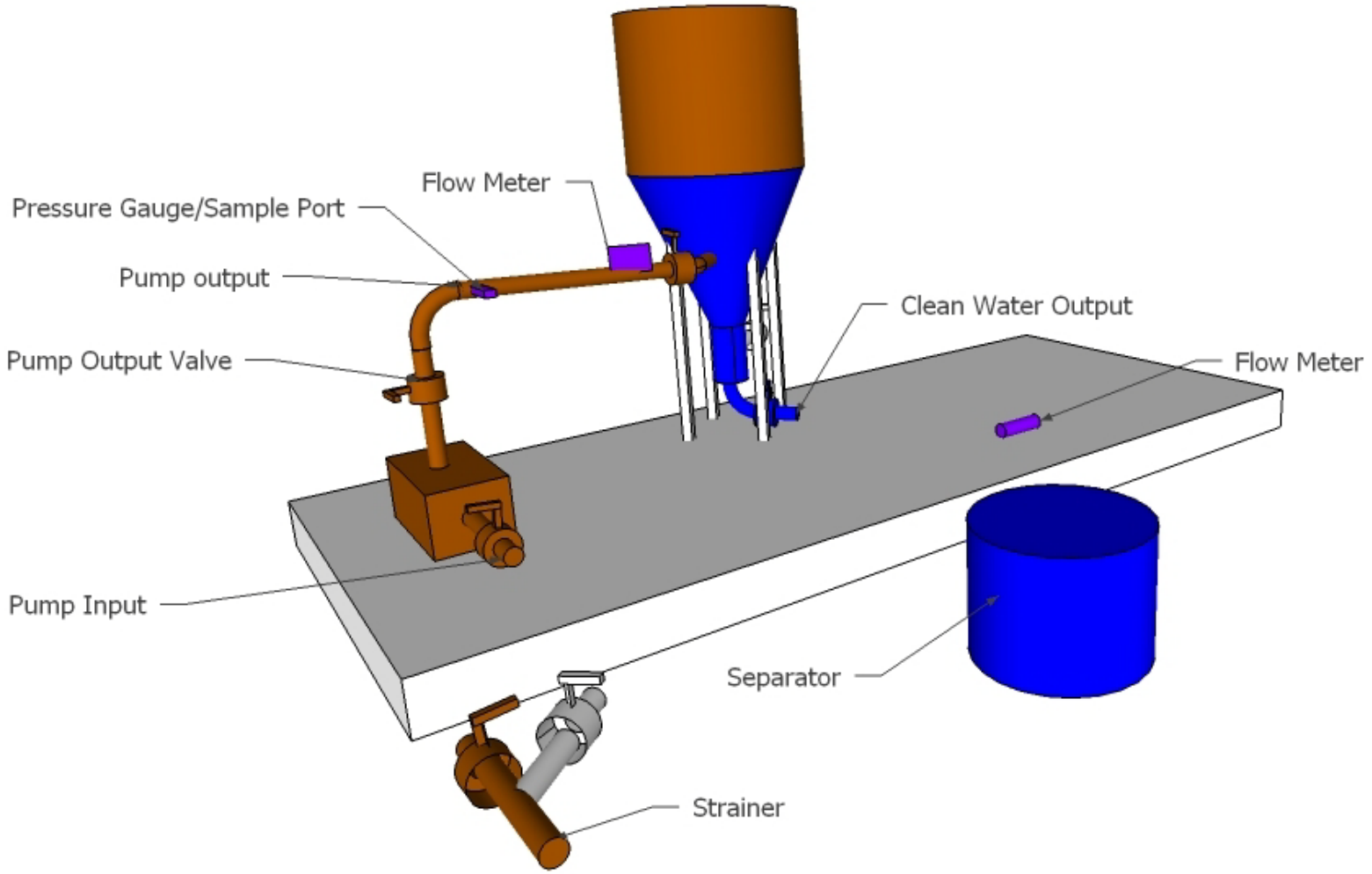
Other BTEX compounds
Hydrocarbons
Organic Acids
most Biocides
some Frac Fluids

Osorb is fully regenerated with heat and/or rinsing.



Extraction of 400 ppm toluene from water comparing Osorb to activated carbon and molecular sieves.

System #1 - The PWUnit#1



System Specifications

- Designed to treat produced water, flowback water, and slop water at 1.5 bbl/min
- Trailer-mounted, self-contained system including on-board diesel generator
- Designed to handle contaminant concentrations requiring 0.5-12% w/v Osorb.
- Flow-through design in which Osorb is in a continuous cycle between contaminant capture and regeneration.

Right: Production Manager Doug Martin prepares the system for treatment of Clinton formation produced water at the ABS test facilities in Wooster, OH.

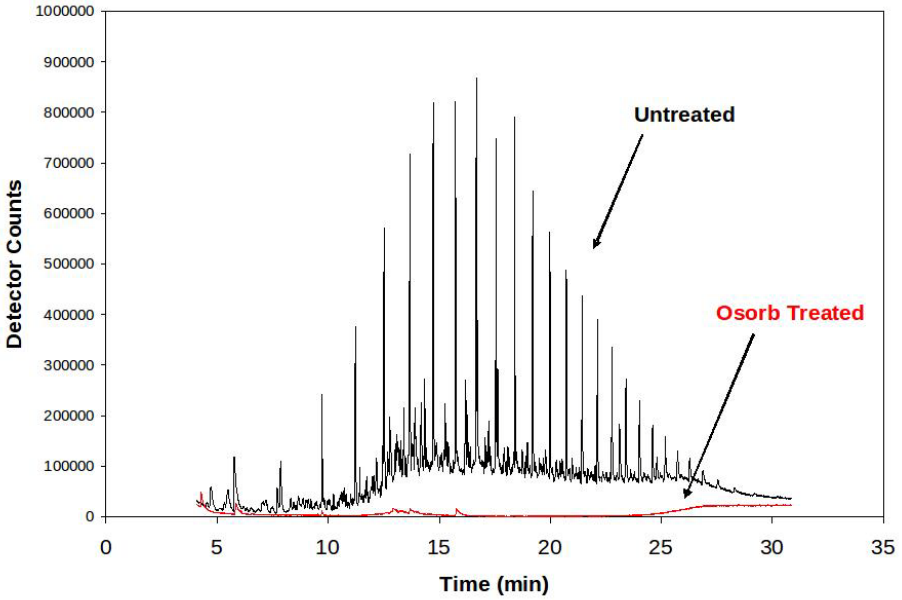
Collection of Osorb for Regeneration

Above: Clean water and spent Osorb after treatment with PW Unit #1.

Pictured: Dr. Stephen Jolly and Doug Martin

Below: Contaminant-laden Osorb has been separated from the treated water and is ready for regeneration

Field Pilot: Clinton Formation PW



The system reduced the 277 ppm TPH in the untreated produced water to 0.1 ppm TPH.

A 99.9% reduction in TPH

PW Unit #1 Regeneration System

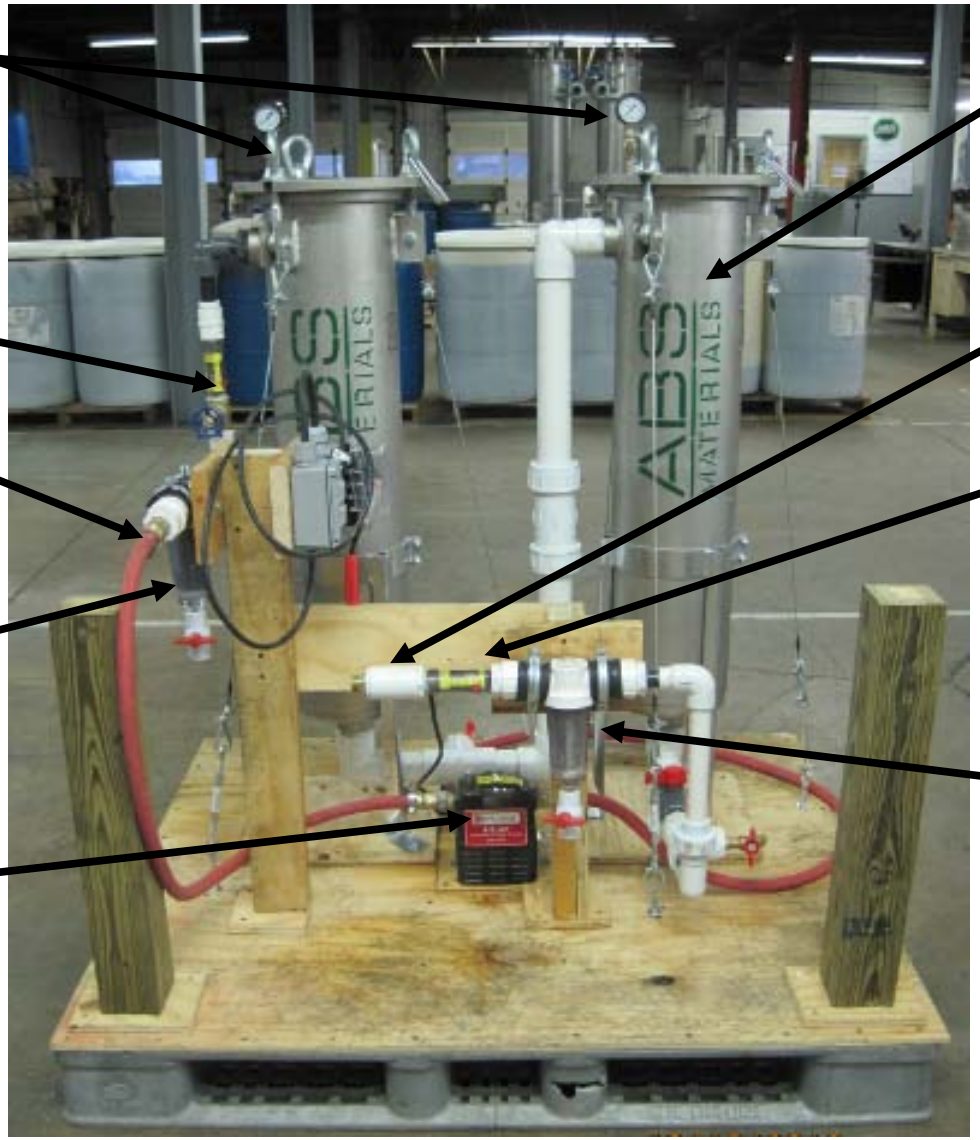
- The Regeneration System will be used to restore the glass for reuse in the system.

- System consists of a double cone vacuum dryer (conoform dryer), condenser, and thermal fluid temperature controller.

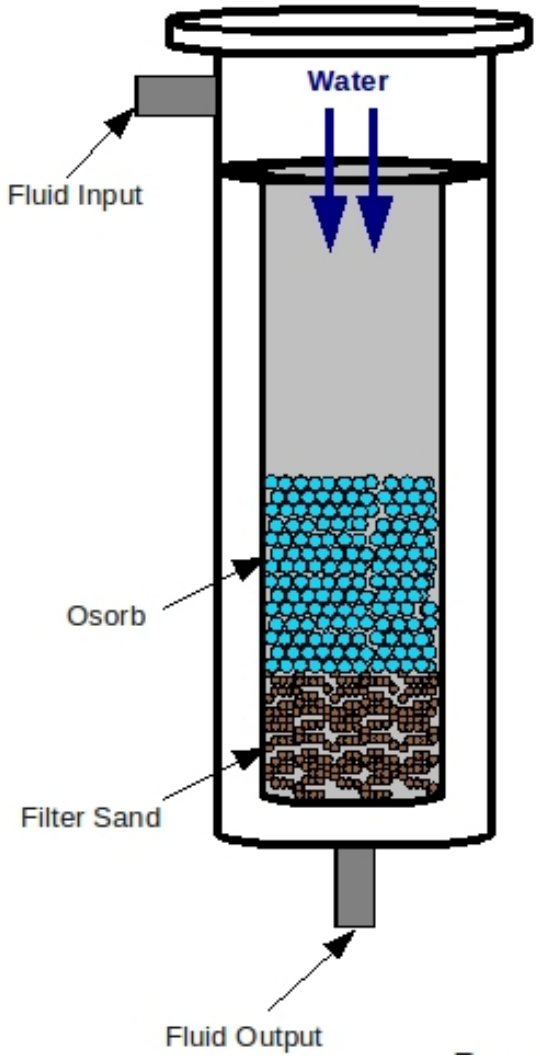
- Thermal desorption, and solvent rinsing when necessary, will be used to restore the Osorb.

- System will be mounted on an additional trailer for mobility

System #2 - Fixed Bed SkidUnit#1



Capture-Only Fixed Bed Pilot Unit



- Utilizes a fixed bed of Osorb
- No regeneration system
- Changeable filter bags
- Flow rates of 1-4 gpm
- Flow rate, # of vessels, and amount of Osorb can be modified as necessary

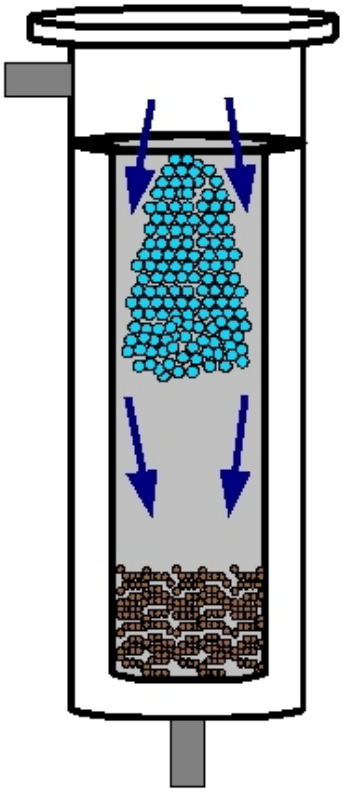
Capture-Only Fixed Bed Pilot #1

Collaborative testing with the Global Petroleum Research Institute (GPRI) at Texas A&M – 100 gallon test runs at 2 gpm

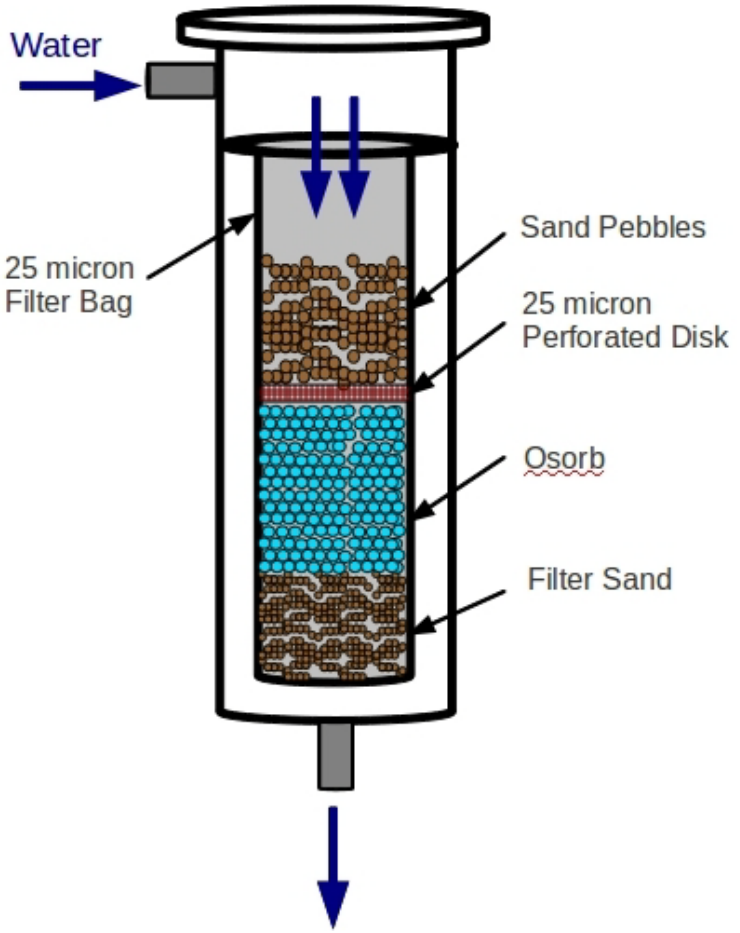
Analyte	Untreated Water (ppm)	25 gal (ppm)	50 gal (ppm)	75 gal (ppm)	100 gal (ppm)	% Reduction
Benzene	4.24	0.114	0.139	0.194	0.206	95.14%
Ethylbenzene	0.094	0.0016	0.0022	0.0025	0.0027	97.12%
Toluene	0.244	0.046	0.55	0.088	0.094	61.47%
1,2,4-Trimethylbenzene	0.01	0.0011	0.0014	0.0019	0.0019	61.47%
Total Xylenes	0.062	0.011	0.015	0.018	0.019	69.35%
Oil&Grease	11.5				0	100.00%

Capture-Only Fixed Bed Pilot Unit

Low density Osorb created preferred paths



Modified for improved capture efficiency



Capture-Only Fixed Bed Pilot #2

Clinton Formation PW– 50 gallon test run at 2 gpm

Analyte	Untreated Water (ppm)	50 gal (ppm)	% Reduction
Benzene	1.28	0	100.00%
Toluene	1.4	0.08	94.20%
p-Xylene	2.83	0.18	93.80%
Oil&Grease	290	2.48	99.10%

System Design Comparison

Fluidized Bed

- Requires less Osorb
- Less complicated regeneration
- Higher flow rates
- Continuous operation

Fixed Bed

- More predictable interactions between Osorb and contaminants
- Smaller system footprint
- Fewer moving parts
- More complicated regeneration

Development Process

- The PWUnit#1 – Last Phase Testing of Restore
  - To be deployed – March 2011 – Wamsutter, Wy
- The SkidUnit#1 – Additional pre-filtration being added
  - To be deployed – March 2011
- Downhole Tools – deal under negotiation

Thanks

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