

FIU

Applied Research
Center



DOE-FIU Cooperative Agreement Annual Research Review – FIU Year 3

Project 2 - Task 2.2

Humic Acid Batch Sorption Experiments with SRS Soil

Carolina Trummer (DOE Fellow)

Mentor: Dr. Ravi Gudavalli

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Overall Needs:

- The Cold War generated radioactive waste, leading to contamination of groundwater by seepage of the unlined basins.
- Various methods, including pump-and-treat systems, were used to address the issue, but they were costly and generated radioactive waste. In 2004, a funnel and gate system was introduced, injecting a solution to raise pH levels and enhance adsorption of contaminants, however there are still contaminants that need to be remediated.
- Radioactive contaminants are still mobile.

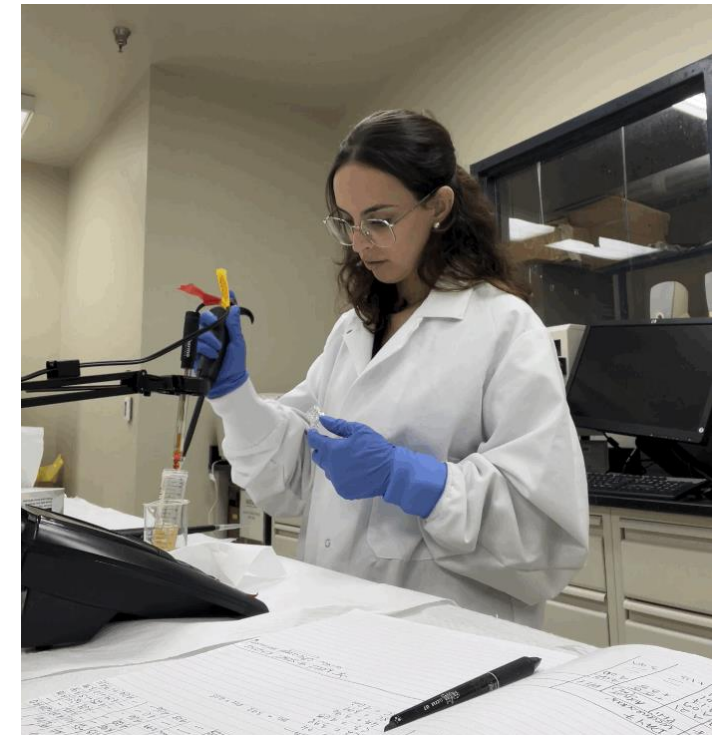
Objectives:

- To investigate the effect of sorbed modified humic acid (KW-30) to sequester commingled contaminants (uranium, strontium, iodine) at the SRS F-Area's wetlands under varying site-specific conditions as feasible remediation technology to deploy.
- The research assesses the potential for in-situ contaminant remediation at SRS Fourmile Branch with humic acid and suggests future applicability to other sites with different conditions.



Humic Acid

- An organic complex substance derived from decomposed plants and animals in soil.
- Composed of many different molecules with various functional groups.
- Has a natural metal-binding capability and helps control the mobility of metals, such as uranium.
- Influences the behavior of metals in the environment, potentially facilitating the movement of contaminants and contributing to environmental remediation processes.



pH adjusting samples with humic acid



- A synthetic groundwater recipe was formulated to match with the conditions of the F-Area at SRS using wells FOB 21 and FOB20.

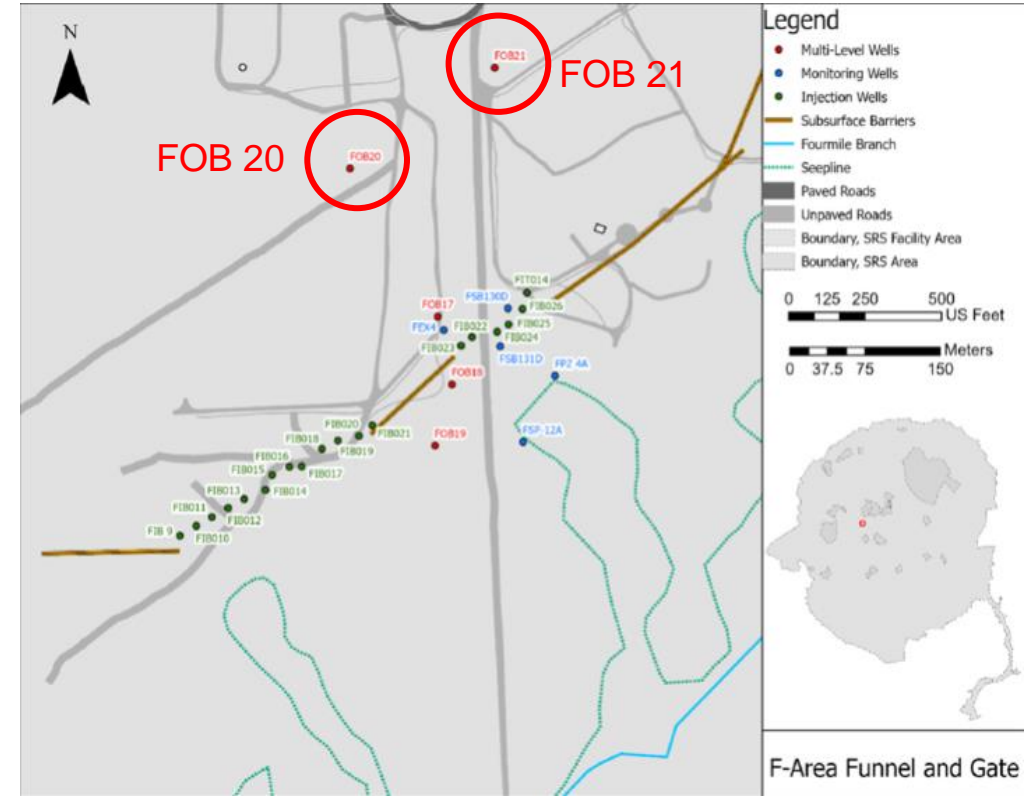


Table 1 (below): The concentration of ions from wells FOB21 and FOB20. Converted to mmol/L for average, maximum, and minimum values between the wells

Elements	FOB 21 (mg/L)	FOB 20 (mg/L)	Average (mg/L)	Molar Mass (g/mol)	Average (mmol/L)	Min Value (mmol/L)	10% less of Min	Max Value (mmol/L)	10% more Max
POTASSIUM	1.33	0.625	0.9775	39.1	0.025	0.016	0.015	0.034	0.037
SULFATE	1.15	11.6	6.375	96.09	0.066	0.012	0.011	0.121	0.133
MAGNESIUM	8.35	1.86	5.105	24.03	0.212	0.077	0.070	0.347	0.382
CALCIUM	34.3	1.8	18.05	40.08	0.450	0.045	0.041	0.856	0.941
CHLORIDE	18.5	15.2	16.85	35.45	0.475	0.429	0.390	0.522	0.574
NITRATE	104	41.7	72.85	62.01	1.175	0.672	0.611	1.677	1.845
SODIUM	74.9	49.6	62.25	22.99	2.708	2.157	1.961	3.258	3.584



Salts	Molecular Weight (mg/mmol)	Concentration (mmol/L)	Concentration (mol/L)	Concentration Calculations [x1000] (mg/L)	g/L
$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$	147.02	0.04	40.83	6002.45	6.00
NaSO_4	142.04	0.13	132.79	18861.80	18.86
MgCl_2	95.21	0.08	77.40	7369.64	7.37
NaCl	58.44	0.31	312.59	18267.56	18.27
KCl	74.55	0.03	25.00	1863.78	1.86
NaNO_3	84.99	1.84	1844.86	156803.64	156.80

Table 2: The salt amounts needed to formulate 1L of synthetic groundwater at 1000x concentration.



Sorption of Humic Acid Experiments with DIW and SGW

- Samples were prepared with 200 mg of SRS sediment + 50 ppm KW-30 with DIW or SGW in triplicates.
- pH adjusted and maintained to 4 daily for the duration of 7 days.

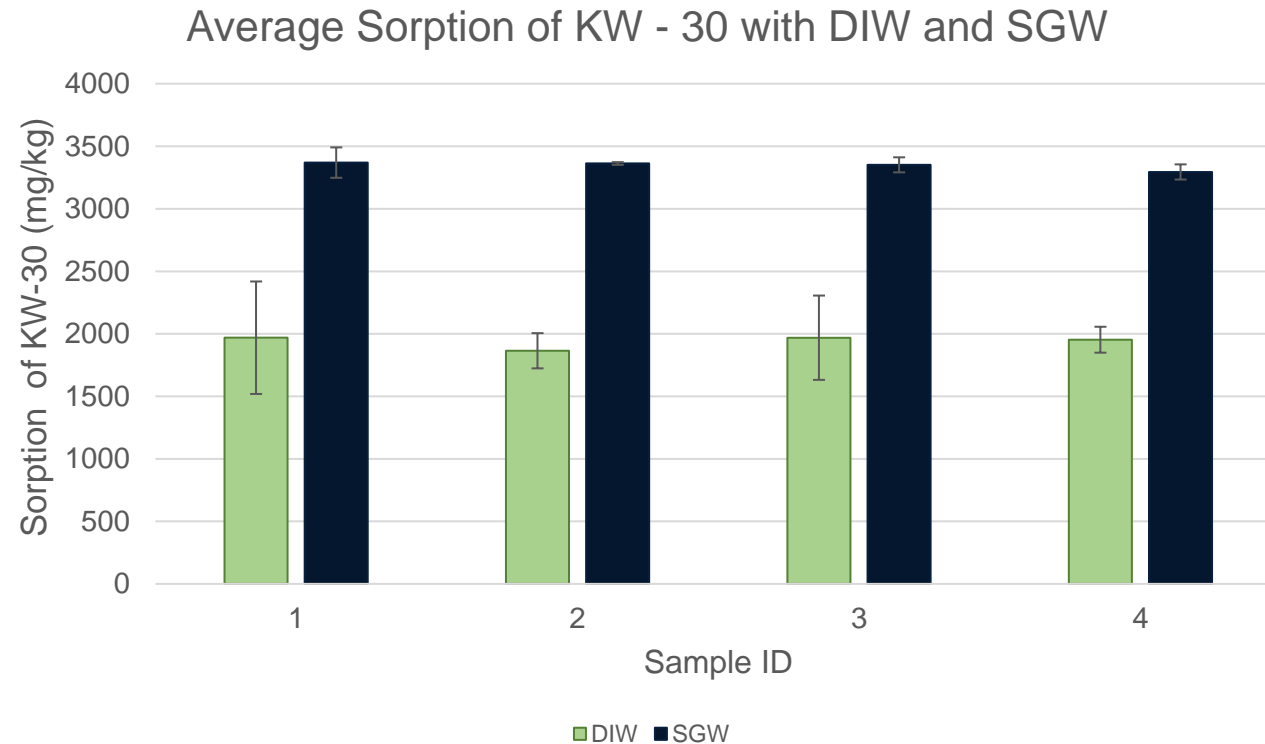


Figure 1: Average sorption of humic acid with deionized water ~2000 mg/kg (left) and with synthetic groundwater ~3300 mg/kg (right).



SRS soil with Uranium and KW-30. All samples were prepared in triplicates with an initial concentration of 700 ppb of U and were adjusted daily to maintain pH 4 given site conditions for the duration of 14 days.

- **Control Samples** – no sediment, only 700 ppb of uranium.
- **Uncoated Sediment Samples** - 200mg of sediment with no KW-30 + 700 ppb of uranium.
- **Coated Sediment** – 200mg of sediment coated with KW-30 + 700 ppb uranium.

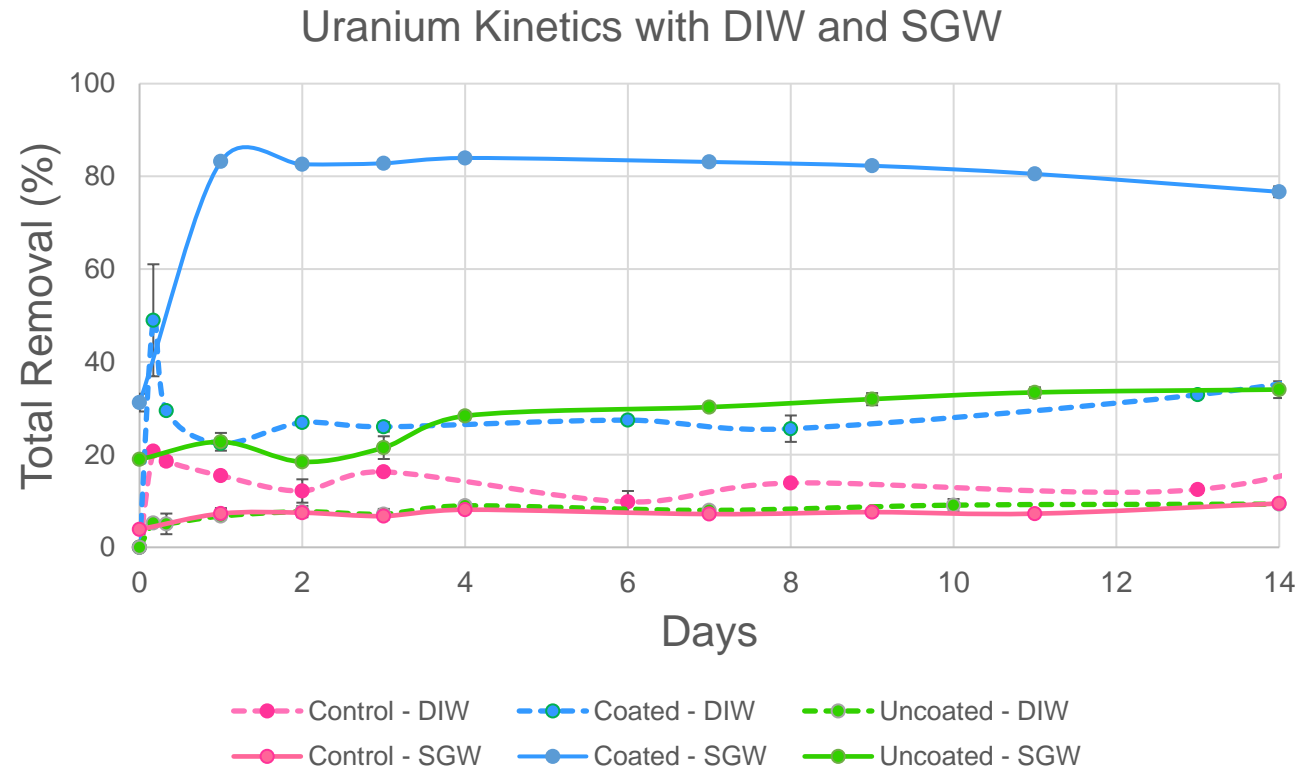
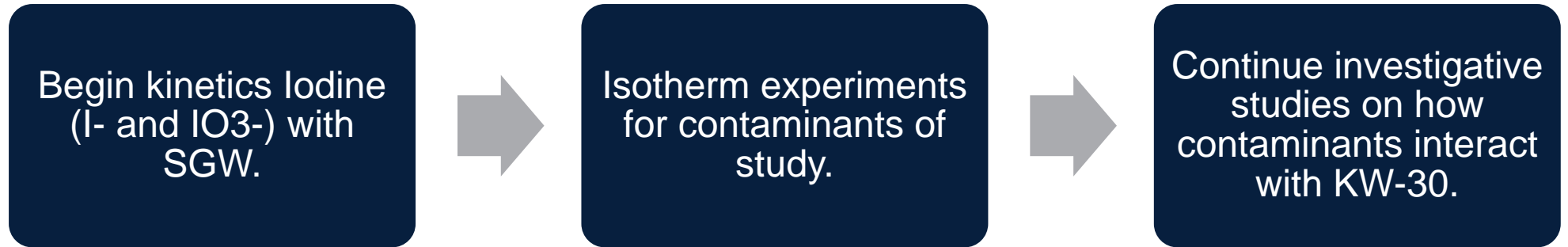


Figure 2: Uranium kinetics with DIW (dotted) and SGW (solid). Average time for equilibrium is 2 days.



Future Work



Contaminant Variations of Study		
Uranium	Iodine	Strontium
Uranium + Iodine	Uranium + Strontium	Strontium + Iodine
Uranium + Iodine + Strontium		



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Thank You. Questions?