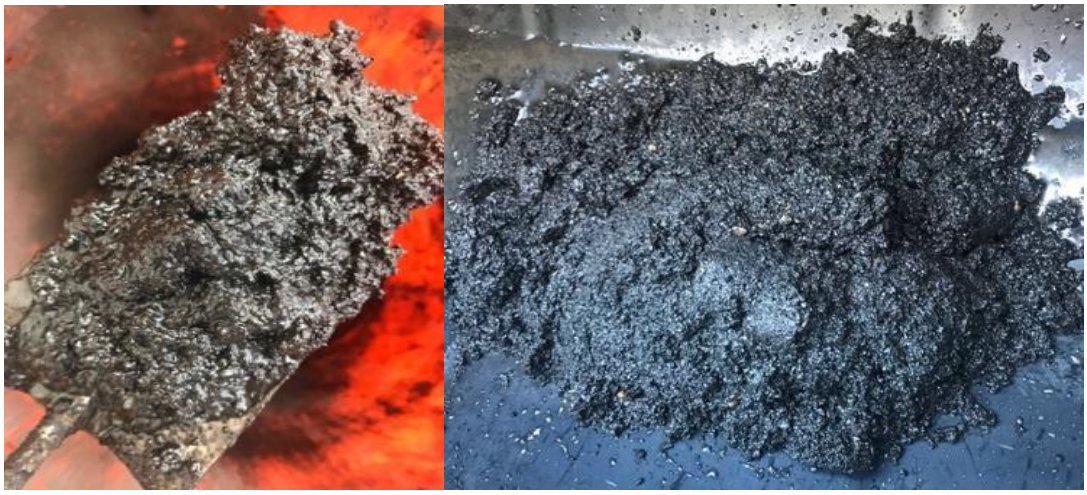

Permian Basin Drill Cutting Washing Treatment Pilot Test Report(Ex-Situ Wash Method)

Date: September 25
Test Objective: Reduce Drill Cuttings TPH using X4JH2000-HEP
Test Sample: Sample ID – 20180925
Method: Washing Process
Location: 14702 Jersey Shore Dr., Houston, TX

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1. Purpose

- The purpose of this drill cutting washing test is to simulate the drill cuttings washing method used in oil and gas operations (in-situ) and to record the TPH reduction over time for 1-hour and 3-hour washes.
- The test was conducted using drill cuttings from the Permian Basin, TX, USA, in an in-house simulation with a smaller-scale setup (pump, air compressor, wash tank) to observe the reduction in TPH levels.

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2. The Simulation

Pre-Test Analysis

- Before the test, the TPH level of the drill cuttings sample was determined. Background samples from the Permian Basin, TX, were sent to TestAmerica laboratory for TPH analysis.
- The initial TPH level was found to be **132,000 PPM** (mg/kg).

Client Sample ID: Drill Cutting: Midland-DC — **Lab Sample ID: 600-172359-2**

Date Collected: 09/08/18 00:00 — Matrix: Solid

Date Received: 09/11/18 15:28 — Percent Solids: 82.7

Method: TX 1005 - Texas - Total Petroleum Hydrocarbon (GC) - DL

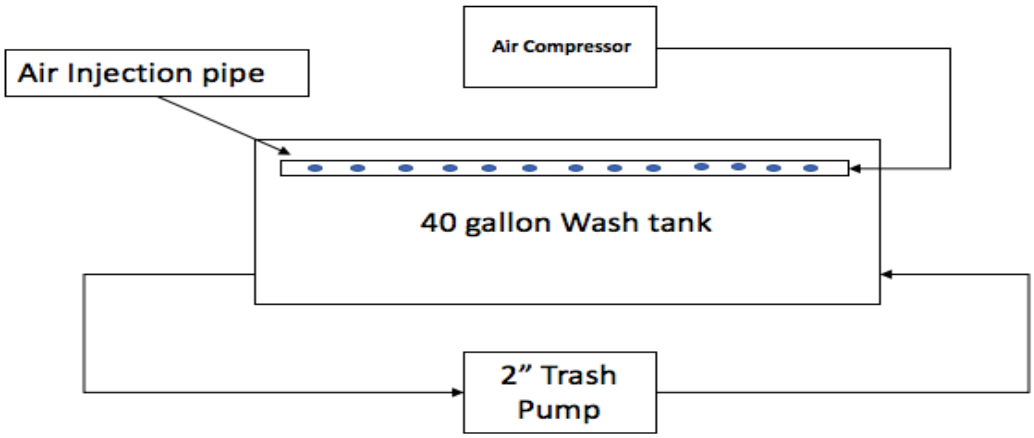
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
C6-C12	16800	H	4970	1890	mg/Kg	☼	09/13/18 11:34	09/13/18 18:16	100
>C12-C28	115000	H	4970	2020	mg/Kg	☼	09/13/18 11:34	09/13/18 18:16	100
>C28-C35	2020	U H	4970	2020	mg/Kg	☼	09/13/18 11:34	09/13/18 18:16	100
Total Petroleum Hydrocarbons (C6-C35)	132000	H	4970	1890	mg/Kg	☼	09/13/18 11:34	09/13/18 18:16	100

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*0*	*X*	*70 - 130*	*09/13/18 11:34*	*09/13/18 18:16*	*100*

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	17.3		1.0	1.0	%			09/13/18 10:32	1
Percent Solids	82.7		1.0	1.0	%			09/13/18 10:32	1

Washing Unit Setup



Equipment Used:

- 40-gallon wash tank
- 5.5 HP, 2-inch trash pump
- 8-gallon air compressor (120 PSI)
- 10 ft of 2-inch water hose
- 20 ft schedule 80 PVC pipe

Test Method

1. A mixture of **5 gallons of drill cuttings** and **1.5 gallons of X4JH2000-DC** was prepared with **10 gallons of water** (1.5:10 ratio).

2. The solution was placed inside the wash tank. The wash tank was set up with a **2-inch suction outlet** on one end and a **2-inch inlet** on the other. A **2-inch trash pump** circulated the solution, while an **air compressor** injected ozone via a PVC pipe with air holes at the bottom of the tank.

3. The **trash pump** ensured continuous solution agitation, while the **air compressor** injected ozone to oxidize hydrocarbons.
4. **5 gallons of drill cuttings** were placed inside the circulating solution and washed for **3 hours**.
5. After **5 minutes**, hydrocarbon and mud were visibly separating from the drill cuttings, floating to the water's surface. Ozone injection and continuous agitation further broke down the hydrocarbons.

- **Agitation is key** to achieving effective hydrocarbon degradation. Greater agitation leads to better results and faster hydrocarbon breakdown.



3. Laboratory TPH Analysis

Analysis conducted by TestAmerica using Method 1005 with TCEQ protocol.

Method Summary

Client: X4 Environmental
Project/Site: Drill Cuttings & Water (1hr) 09/24/18

TestAmerica Job ID: 600-173275-1

Method	Method Description	Protocol	Laboratory
TX 1005	Texas - Total Petroleum Hydrocarbon (GC)	TCEQ	TAL HOU
2540B	Percent Moisture	SM20	TAL HOU
Frozen Preserve	Freezing Samples	None	TAL HOU
TX_1005_S_Prep	Extraction - Texas Total petroleum Hyrdocarbons	TCEQ	TAL HOU
TX_1005_W_Prep	Extraction - Texas Total petroleum Hyrdocarbons	TCEQ	TAL HOU

Protocol References:

None = None

SM20 = "Standard Methods For The Examination Of Water And Wastewater", 20th Edition."

TCEQ = Texas Commission of Environmental Quality

Laboratory References:

TAL HOU = TestAmerica Houston, 6310 Rothway Street, Houston, TX 77040, TEL (713)690-4444

Client Sample Results

Client: X4 Environmental
Project/Site: Drill Cuttings & Water (1hr) 09/24/18

TestAmerica Job ID: 600-173275-1

Client Sample ID: Drill cutting (Treated 1 hr) — **Lab Sample ID: 600-173275-1**
Date Collected: 09/24/18 09:00 — Matrix: Solid
Date Received: 09/24/18 14:23 — Percent Solids: 98.2

Method: TX 1005 - Texas - Total Petroleum Hydrocarbon (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
C6-C12	1490	H	509	194	mg/Kg	☼	09/27/18 14:54	09/28/18 07:34	50
>C12-C28	27100	H	509	207	mg/Kg	☼	09/27/18 14:54	09/28/18 07:34	50
>C28-C35	207	U H	509	207	mg/Kg	☼	09/27/18 14:54	09/28/18 07:34	50
Total Petroleum Hydrocarbons (C6-C35)	28600	H	509	194	mg/Kg	☼	09/27/18 14:54	09/28/18 07:34	50

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*0*	*X*	*70 - 130*	*09/27/18 14:54*	*09/28/18 07:34*	*50*

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	1.8		1.0	1.0	%			09/26/18 10:00	1
Percent Solids	98.2		1.0	1.0	%			09/26/18 10:00	1

Client Sample ID: Drill cutting treatment water (1 hr) — **Lab Sample ID: 600-173275-2**
Date Collected: 09/24/18 09:00 — Matrix: Water
Date Received: 09/24/18 14:23

Method: TX 1005 - Texas - Total Petroleum Hydrocarbon (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
C6-C12	4.14		2.00	0.830	mg/L		09/25/18 09:55	09/25/18 17:11	1
>C12-C28	50.8		2.00	0.960	mg/L		09/25/18 09:55	09/25/18 17:11	1
>C28-C35	3.51		2.00	0.960	mg/L		09/25/18 09:55	09/25/18 17:11	1
Total Petroleum Hydrocarbons (C6-C35)	58.5		2.00	0.830	mg/L		09/25/18 09:55	09/25/18 17:11	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*86*		*70 - 130*	*09/25/18 09:55*	*09/25/18 17:11*	*1*

Method Summary

Client: X4 Environmental
Project/Site: Drill Cuttings & Water (3hrs) 09/24/18

TestAmerica Job ID: 600-173275-2

Method	Method Description	Protocol	Laboratory
TX 1005	Texas - Total Petroleum Hydrocarbon (GC)	TCEQ	TAL HOU
2540B	Percent Moisture	SM20	TAL HOU
Frozen Preserve	Freezing Samples	None	TAL HOU
TX_1005_S_Prep	Extraction - Texas Total petroleum Hyrdocarbons	TCEQ	TAL HOU
TX_1005_W_Prep	Extraction - Texas Total petroleum Hyrdocarbons	TCEQ	TAL HOU

Protocol References:

None = None

SM20 = "Standard Methods For The Examination Of Water And Wastewater", 20th Edition."

TCEQ = Texas Commission of Environmental Quality

Laboratory References:

TAL HOU = TestAmerica Houston, 6310 Rothway Street, Houston, TX 77040, TEL (713)690-4444

Client Sample Results

Client: X4 Environmental
Project/Site: Drill Cuttings & Water (3hrs) 09/24/18

TestAmerica Job ID: 600-173275-2

Client Sample ID: Drill cutting (Treated 3 hrs) — **Lab Sample ID: 600-173275-3**
Date Collected: 09/24/18 12:00 — Matrix: Solid
Date Received: 09/24/18 14:23 — Percent Solids: 98.6

Method: TX 1005 - Texas - Total Petroleum Hydrocarbon (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
C6-C12	379	J H	507	192	mg/Kg	☼	09/27/18 14:54	09/28/18 08:13	50
>C12-C28	20300	H	507	206	mg/Kg	☼	09/27/18 14:54	09/28/18 08:13	50
>C28-C35	206	U H	507	206	mg/Kg	☼	09/27/18 14:54	09/28/18 08:13	50
Total Petroleum Hydrocarbons (C6-C35)	20700	H	507	192	mg/Kg	☼	09/27/18 14:54	09/28/18 08:13	50

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*0*	*X*	*70 - 130*	*09/27/18 14:54*	*09/28/18 08:13*	*50*

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	1.4		1.0	1.0	%			09/26/18 10:00	1
Percent Solids	98.6		1.0	1.0	%			09/26/18 10:00	1

Client Sample ID: Drill cutting treatment water (3 hrs) — **Lab Sample ID: 600-173275-4**
Date Collected: 09/24/18 12:00 — Matrix: Water
Date Received: 09/24/18 14:23

Method: TX 1005 - Texas - Total Petroleum Hydrocarbon (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
C6-C12	0.830	U	2.00	0.830	mg/L		09/25/18 09:55	09/25/18 17:46	1
>C12-C28	12.1		2.00	0.960	mg/L		09/25/18 09:55	09/25/18 17:46	1
>C28-C35	3.42		2.00	0.960	mg/L		09/25/18 09:55	09/25/18 17:46	1
Total Petroleum Hydrocarbons (C6-C35)	15.5		2.00	0.830	mg/L		09/25/18 09:55	09/25/18 17:46	1

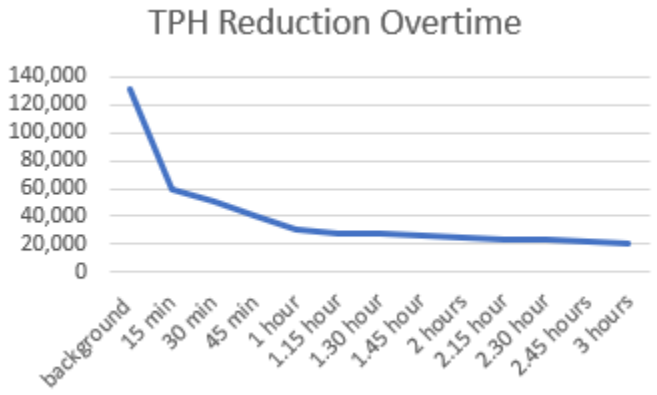
Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl	*90*		*70 - 130*	*09/25/18 09:55*	*09/25/18 17:46*	*1*

Drill Cuttings TPH Reduction

Sample	TPH (PPM)	Reduction (%)
Background	132,000	0%
1-hour treatment	28,600	78.33%
3-hour treatment	20,700	84.32%

Treatment Water TPH Analysis

Sample	TPH (PPM)
Background	--
1-hour treatment	58.5
3-hour treatment	15.5



4. Conclusion

- The drill cuttings sample from the **Permian Basin, TX**, contained **Oil-Based Mud and Barite** with an initial **TPH of 132,000 PPM**.
- After only **3 hours of washing**, the TPH level in the drill cuttings was reduced to **20,700 PPM**, achieving an **84.32% reduction**. The TPH concentration in the drill cuttings dropped to less than 2% after drying.
- The treatment water had a **final TPH level of 15.5 PPM**.
- The results demonstrate that **X4JH2000-HEP effectively breaks down hydrocarbons with agitation over time, even in a simplified, low-power setup**.
- **Variability in results** is expected due to differences in hydrocarbon composition, rock cuttings, and chemical content in drill cuttings.

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5. Visual Documentation

- **Photos of washed drill cuttings and treatment water samples**

  - *(Left: One-hour washing, Right: Three-hour washing)*

- **Photos of the treatment water sample**

  - *(Left: One-hour washing, Right: Three-hour washing)*