Ferrous Contamination of Drilling Fluids – A Generational Problem?

AADE Fluids Management Group Meeting

Houston - September 18th 2025

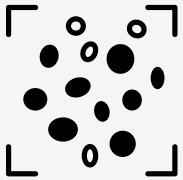
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Overview

Contamination of drilling fluids with ferrous magnetic debris has long been recognized as an issue for both premature wear on rig components and adverse effects on directional drilling operations. It has been shown from experience how much material is typically removed from current drilling operations, but the true extent of the contamination has been somewhat overlooked. This presentation will provide a brief overview on the following topics:

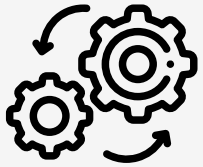
- ❖ Effects on Drilling Operations
- ❖ Quantities of debris in field
- ❖ Source of debris and debris properties
- ❖ Debris removal case histories
- ❖ Conclusion

Effects on Drilling Operations



Abrasion from hard metal particles flowing in fluid

- Downhole Tool failure
- Erosion in pumps, liners and tools



Jamming of magnetically activated parts (RSS, MWD)



Signal interference and shielding of MWD, NMR, and other logs

- Deviations in directional drilling

Base Study #1

1 gallon sample of 10.58 ppg 12.6% LGS field mud from Permian operations processed with magnet in lab environment

Debris removed cleaned with IPA and dried

Residual solids weighed and particle size analyzed







Calculated debris from field mud sample	
Sample Volume, gallons	1
Metal removed by magnet, grams	10.6
Active system volume, bbl	3080
Calculated ultra-fine metal in the active system, pounds	3023.0
Debris Pounds per Barrel	**0.98**

Base Study #2

Field test carried out offshore NCS

1 liter sample of field mud processed with magnet test kit

Debris cleaned with IPA and dried

Residual solids weighed















Calculated debris from field mud sample	
Sample Volume, liters	1
Metal removed by magnet, grams	3
Active system volume, bbl	1239
Calculated ultra-fine metal in the active system, pounds	1303
Debris Pounds per Barrel	**1.05**

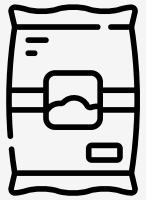
Most magnetic debris is from casing wear

Element	Abundance
Si	14.6 mass %
P	1210 ppm
Ti	1070 ppm
Cr	1660 ppm
Mn	1830 ppm
Fe	15.3 mass %
Co	93.0 ppm
Ni	193 ppm
Cu	209.0 ppm
Zn	173.0 ppm
Nb	71.3 ppm
Mo	197.0 ppm
W	412.0 ppm

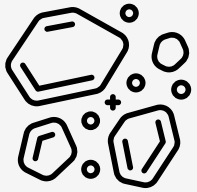
XRF of samples consistent with casing composition with trace of chromium, molybdenum, manganese and tungsten

Caliper studies have shown average of 5% casing loss (varies by profile and rotating hours)

Other minor sources



Natural drilling fluid additives (bentonite, barite, grinding process)



Drill cuttings

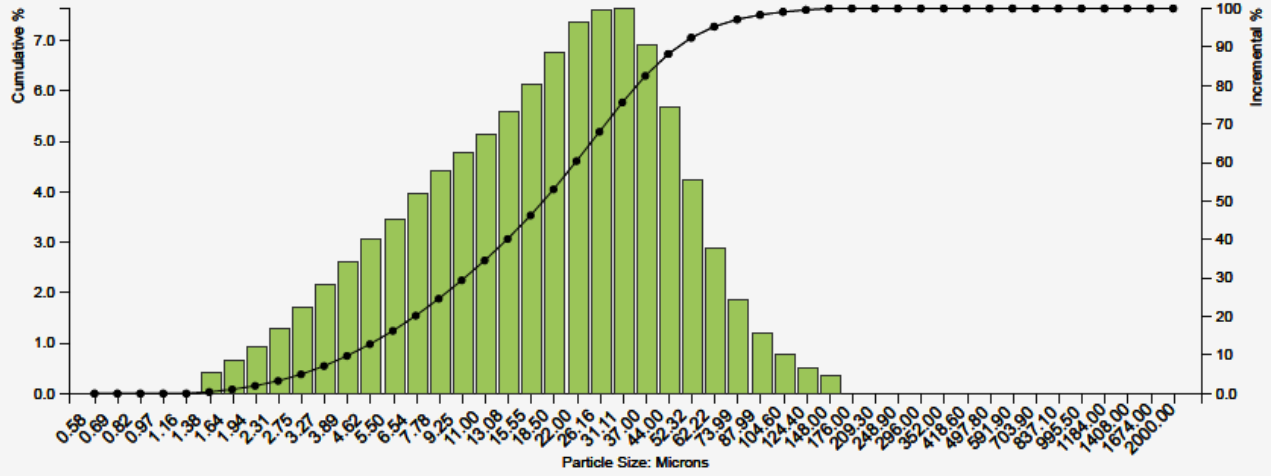
Element %	Al	Si	P	S	Ca	Cr	Mn	Fe	Sr
Rig 1	0.95	3.45	0.15	3.53	3.82	0.20	0.15	46.64	0.34
Rig 2	0.59	3.72	-	4.43	6.28	-	0.23	23.01	0.25

Particle Size Distribution

Percentile	Diameter, microns
D_{10}	3.94
D_{50}	17.15
D_{90}	47.09

Percentile	Diameter, microns
D_{10}	2.17
D_{50}	11.5
D_{90}	28.2

Particle Size Distribution			
Percentile	Size less than, µ	Diameter	Cumulative less
10	3.94	6	18.19
50	17.15	44	88.19
90	47.09	74	97.16



Ditch Magnets and Magnetic Field Strength



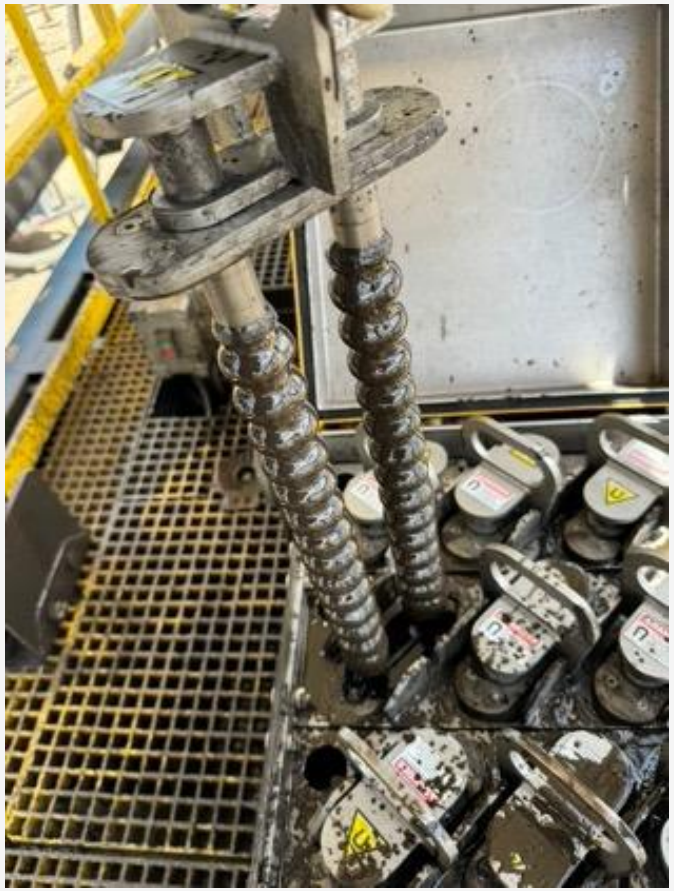




Conventional magnet systems have a typical surface field strength of 0.4 Tesla and remove particles in the100-150 micron range.

High Powered magnet system has a surface field strength of 1.2 Tesla and has demonstrated removal of particles down to 0.5 micron

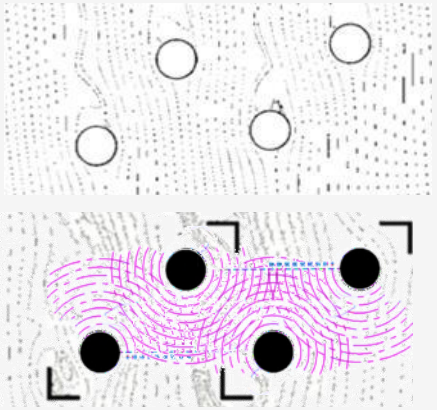
High Power Flow Positioned Ditch Magnets

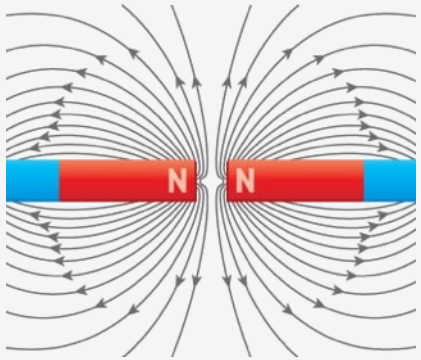


9 pairs of high-powered rod magnets with integrated wiper for easy cleaning and safe handling

Grid alignment designed for maximum contact area with optimized flow pattern

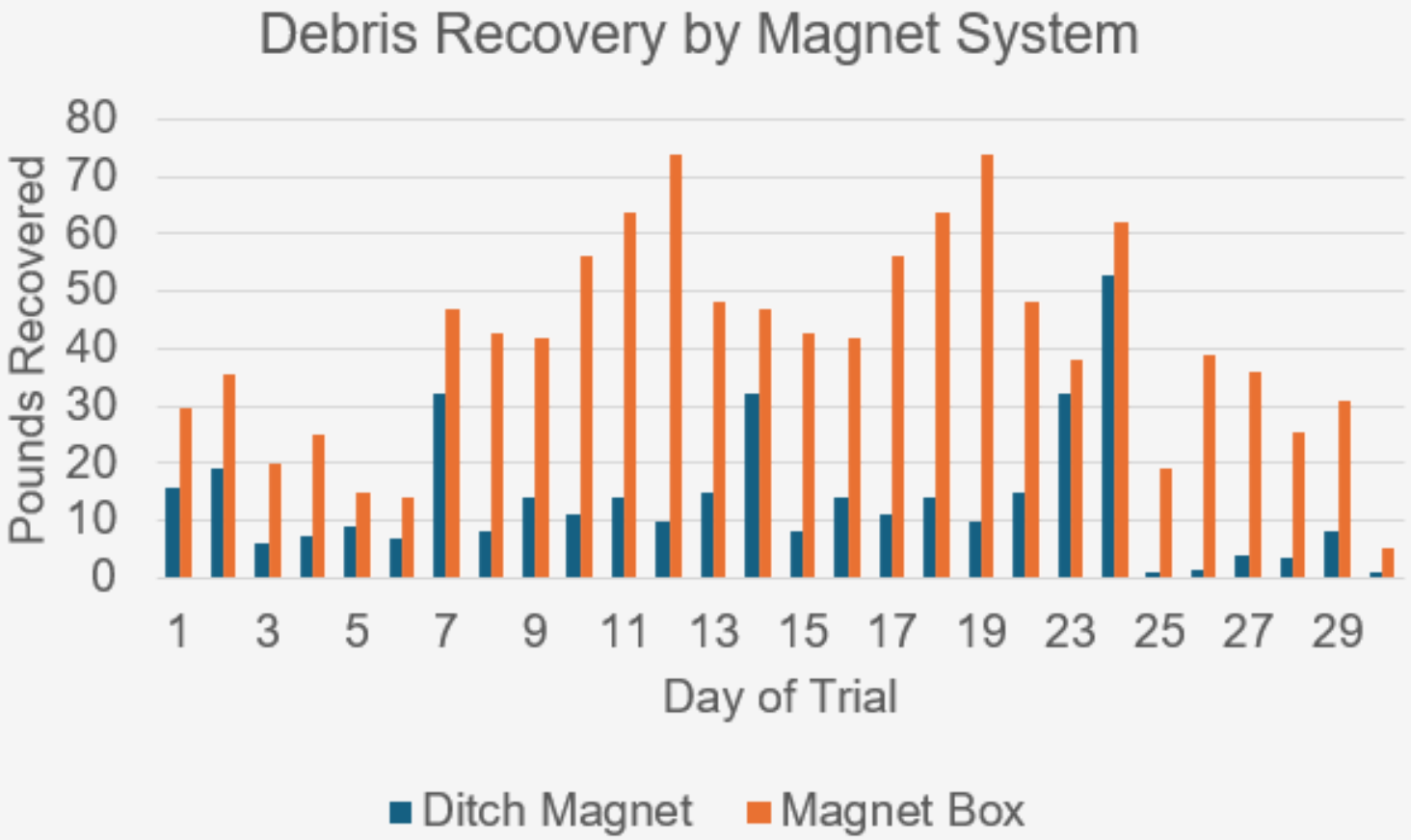
No rig modifications required, Rig up in ~1 hour







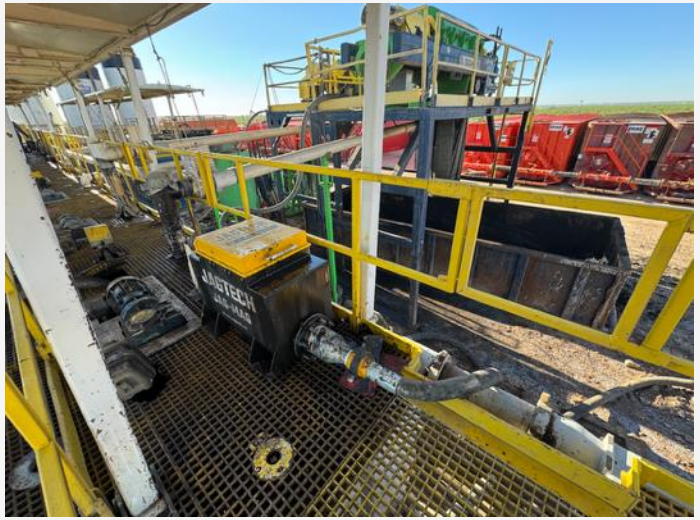
Case Study#1 High Powered Magnets downstream of ditch magnets during 30-day trial



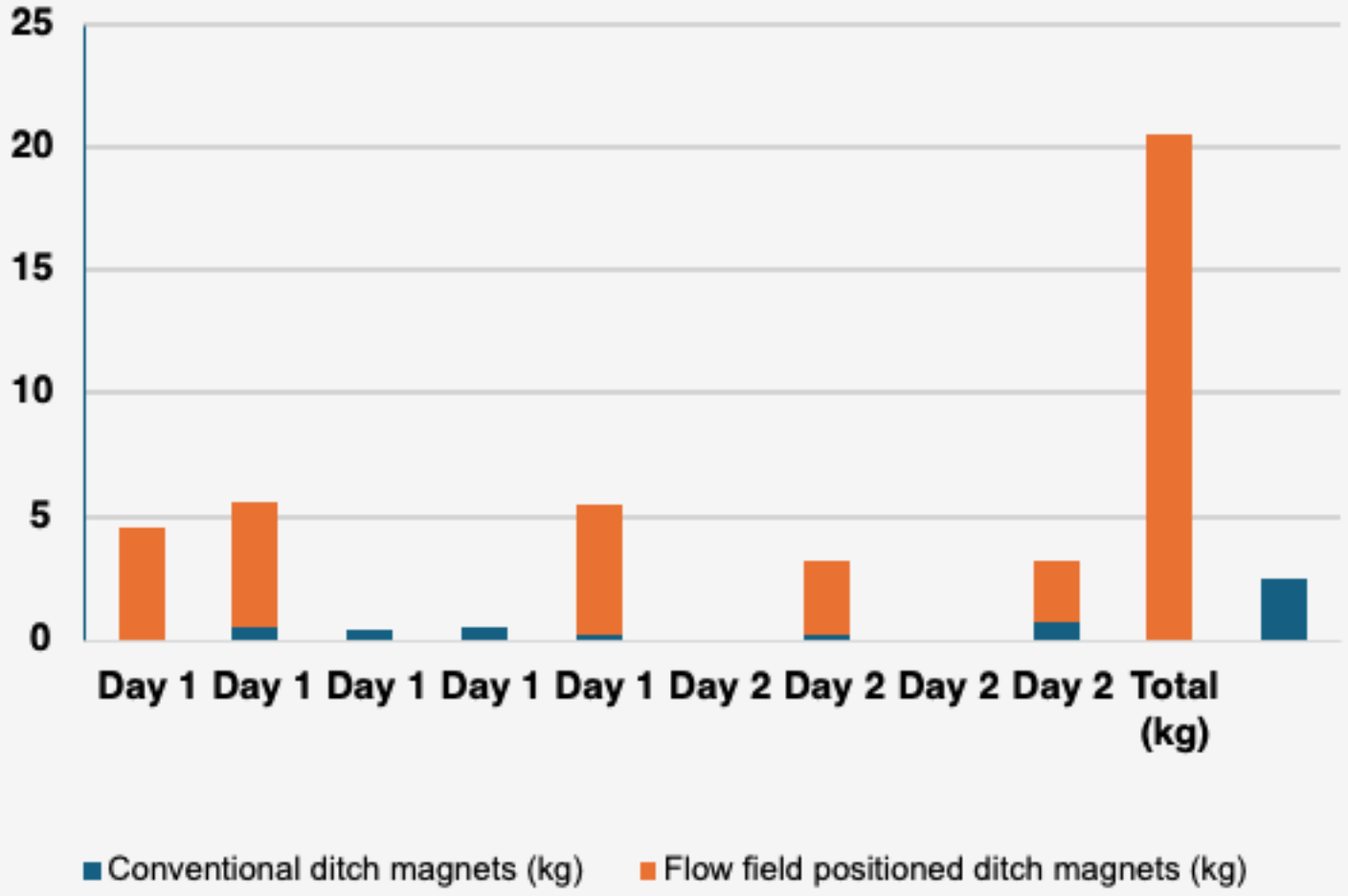
Cumulative Totals

Ditch magnets:
375.86 pounds

Magnet box:
1141.34 pounds



Case Study #2 High Powered Magnets downstream of ditch magnets during offshore trial



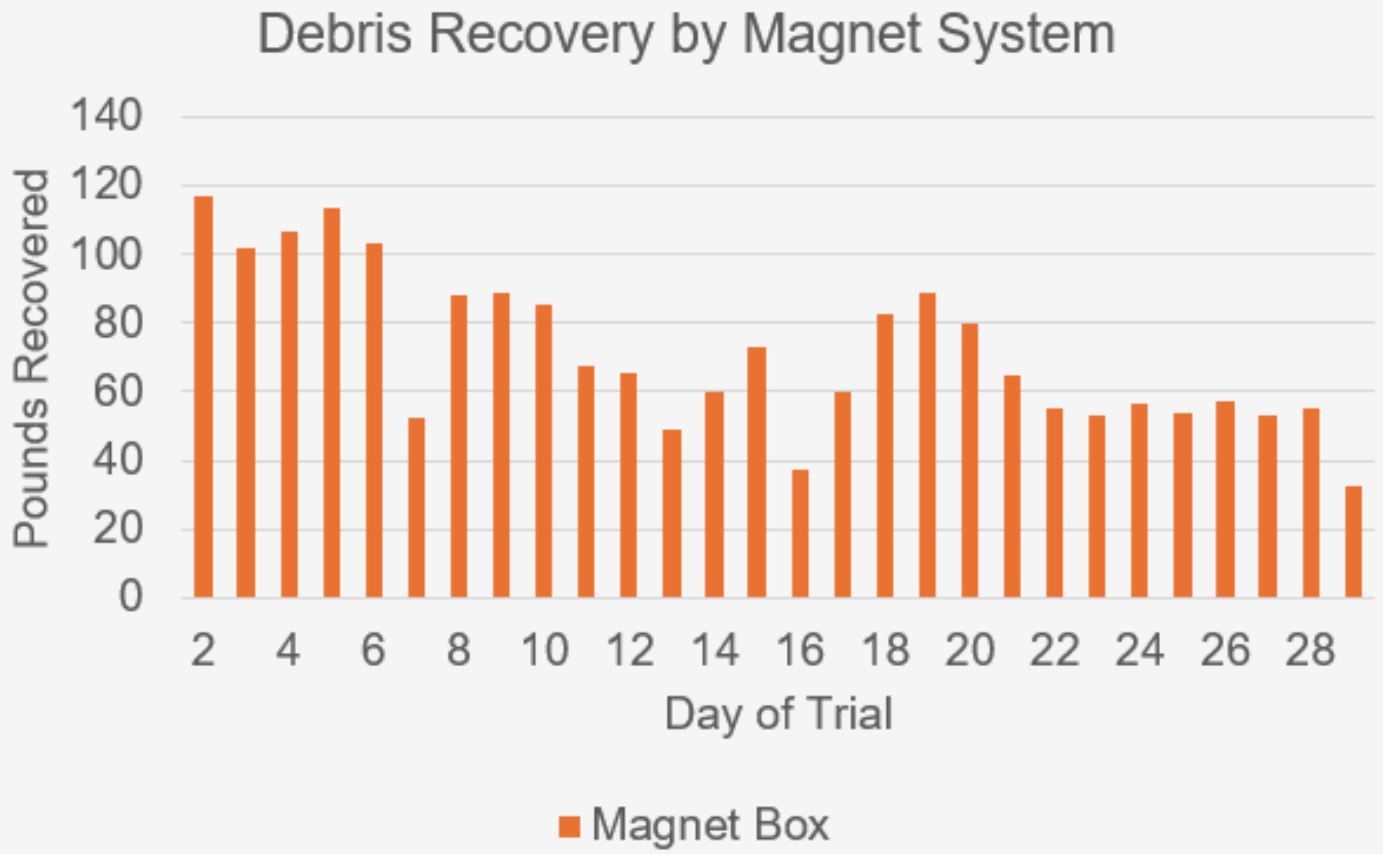
Cumulative Totals

Ditch magnets:
5.5 pounds

High Power Magnets:
45.1 pounds



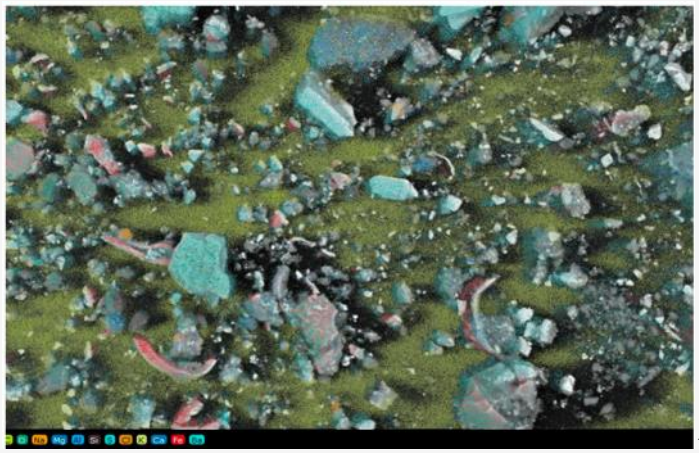
Case Study #3 High Powered Magnets downstream of ditch magnets during 28 day trial



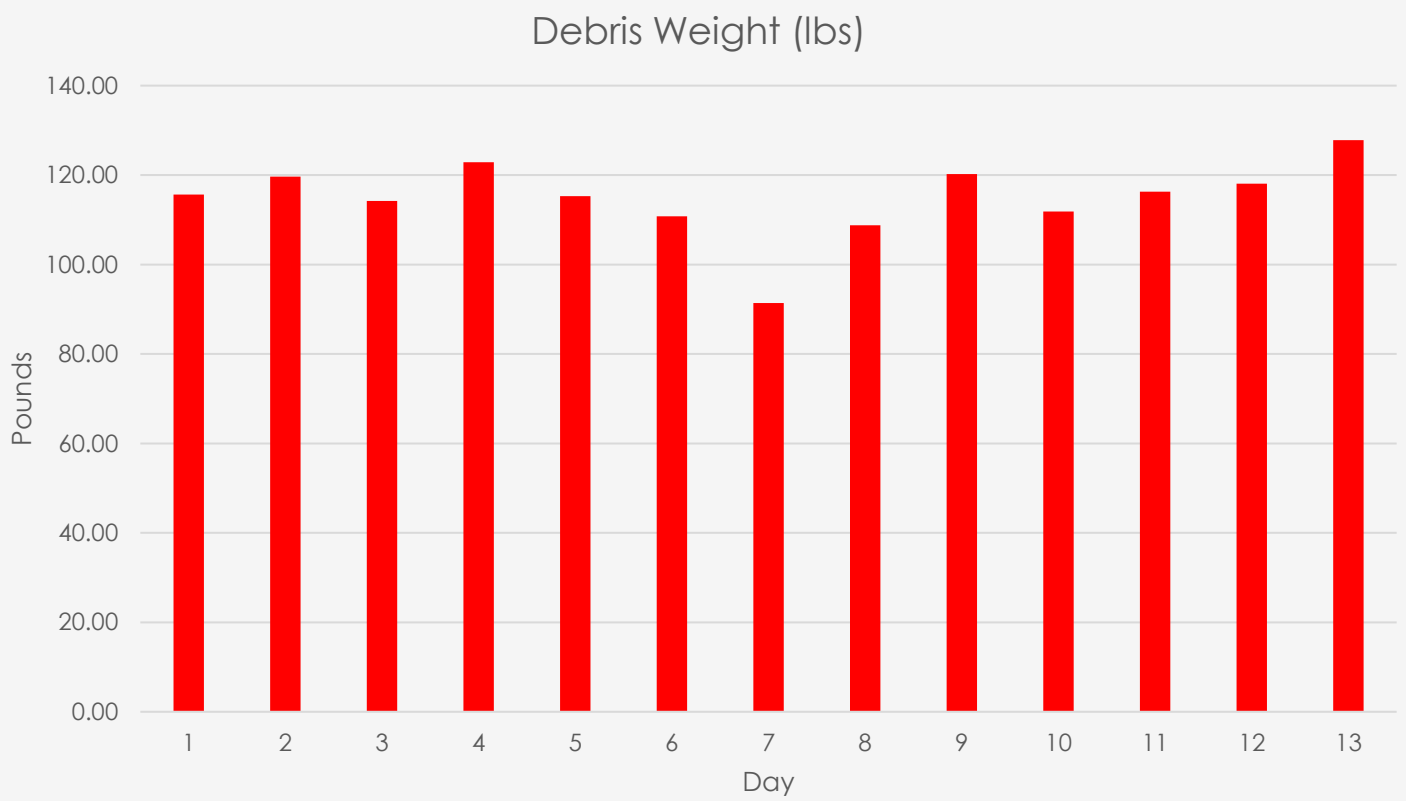
Cumulative Total

Magnet box:
2,022 pounds
72.2 pounds/day

Percentile	Diameter, microns
D_{10}	2.41
D_{50}	13.2
D_{90}	47.6

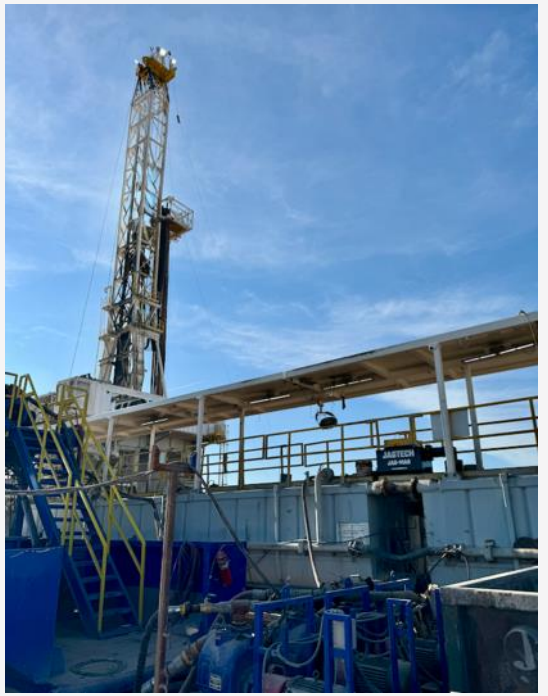


Case Study #4 Drilling a 16,193’ section of 6 ¾” hole

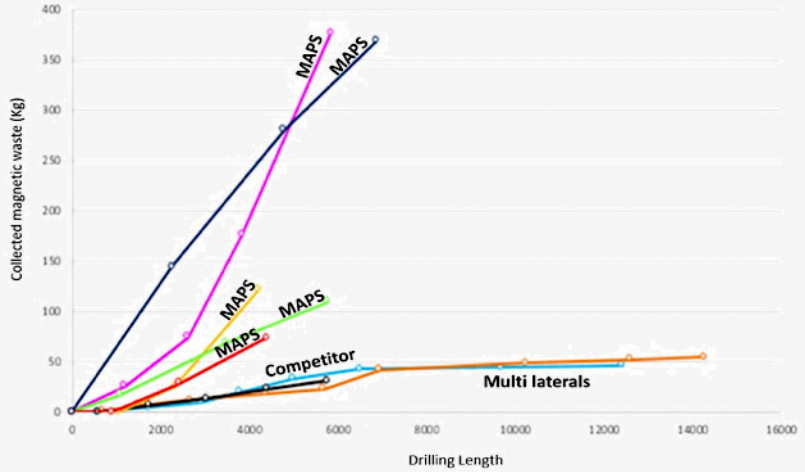


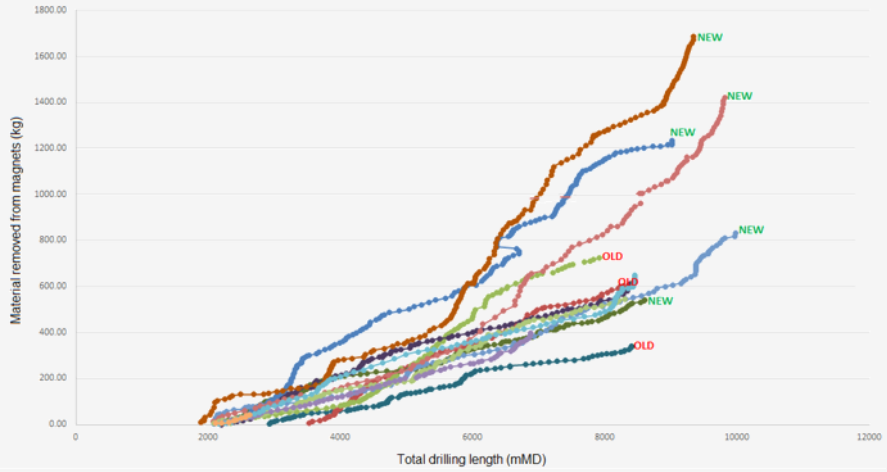
Cumulative Total

Magnet box:
1492.84 pounds
114.83 pounds/day



Other References





Offshore NCS wells Ref#1

- Average removal with High Power magnets 460 pounds per well compared to 100 pounds per well with conventional magnet system

Offshore NCS wells Ref#2

- Average removal with High Power magnets 2,800 pounds per well compared to 1,232 pounds per well with conventional magnet system

Conclusions

- Magnetic debris is generated in significant quantities at the rigsite, primarily through casing wear and drilling processes
- Optimized, high-powered magnets extract significant amounts of debris that traditionally remain in drilling fluid
- Filtering magnetic debris from drilling fluids can improve log quality and reduce operational inefficiencies
- Removing additional metal debris has the capacity to reduce failure incidents and improve reliability for downhole drilling tools, as well as surface equipment. Analysis of these benefits is ongoing

Questions?

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