Baroid Industrial Drilling Products

Harbor Bridge Project

Project Background

Harbor Bridge in Corpus Christi, TX. Replace existing bridge and as well as extending to connect to HWY 286 as well as Interstate 37. Project consisted of 40 holes with diameter up to 10 feet from depths 180 feet to 230 feet deep through Gulf Coast sediment, clay, silt and sand.

Challenge and Equipment

Initial test shafts commenced in the Spring of 2017 and from the load test data found excessive amount of skin friction from the building of solids in the hole and along the shaft walls. Influx of chlorides from the ship channel caused the bentonite to flocculate and separate in the frac-tanks. Baroid was challenged to come up with a solution that would combat both clay silt solids and saltwater intrusion from seawater entering from the ship channel. After significant pilot testing Baroid came up with a solution and presented the solution to the operator and client. Soda ash was used to balance the make up water from calcium hardness, AQUAGEL used for suspension and filtration control, and EZ MUD GOLD for clay inhibition and added filtration control. In addition the use of EZ MUD GOLD gave the fluid more resistance to seawater than bentonite on its own which extended the life up two to three shafts before disposing due to the excessive chlorides in the fluid.

The Solution

Baroid recommended to upgrade their current mixing system to 2* 6 inch centrifugal pumps and 4 inch venture hopper attached to 20,000 gallon frac tank to assist with mixing and rolling of the drilling fluid.

Drilling Fluid Additives

Soda Ash 0.2 ppb

AQUAGEL 8 ppb

EZ MUD GOLD 0.35 ppb

Solution Blast

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Sample Collection Date	9/22/17		
Sample Collection Location	Shaft #11		
Density, lb/gal	8.5	Funnel Viscosity, sec/qt	35
Total Hardness, mg/L	40	Chlorides, mg/L	1500
API Sand Content, %	0.25	pH	8.78
FANN Dial Readings			
600 rpm	17.0	300 rpm	10.0
200 rpm	8.0	100 rpm	5.0
6 rpm	1.0	3 rpm	1.0
PV, cP	7.0	YP, lb/100 ft^2	3.0
10 Second Gel Strength, lb/100 ft^2	1		
10 Minute Gel Strength, lb/100 ft^2	6		
30 Minute Gel Strength, lb/100 ft^2	8		
7.5 Minute Filtrate, mL	5.0		
30 Minute Filtrate, mL	11.5		
API Filtrate, mL	6.5		
30 Minute Filter Cake, 1/32 in	1		
30 Minute Cake Description	slick		
24 Hour Filtrate, mL	64.0		
24 Minute Filter Cake, 1/32 in	3		
24 Minute Cake Description	slick		
48 Hour Filtrate, mL	81		
48 Minute Filter Cake, 1/32 in	4		
48 Minute Cake Description	slick		

The Industrial Products Laboratory received a sample of drilling mud from the TXDOT Harbor Bridge Expansion Project in Corpus Christi, TX. The sample was taken from drill shaft #11 on 9/22/17, midway through installation of concrete via tremie to the bottom of the shaft. The sample was extracted by pump from the surface prior to entry into the mud system. The mud system is based on 0.48 lb/100 gallons soda ash, 20 lb/100 gallons AQUAGEL® Viscosifier (AQUAGEL®) and 0.95 lb/100 gallons EZ-MUD® GOLD Shale and Clay Stabilizer (EZ-MUD® GOLD). A request has been submitted for mud performance testing and filtration data at 24 and 48 hours.

The density, measured at 8.5 lb/gal, remained consistent compared to previous submitted samples. The sand content for this sample was low, measured at 0.25%. The chloride levels measured high at 1500 mg/L, as expected due to the influence of seawater at this site. However, the high chlorides likely contributed to the observed flocculated appearance of the mud after sitting static.

The Marsh funnel viscosity and FANN viscometer readings appeared to be lower than previous submitted samples. However, the collected filtration volumes and measured filter cake heights between the 30 minutes, 24 hour, and 48 hour readings, progressed as expected, typical to previous submitted samples.

Solution Blast

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Below was initial fluid slurry usage prior to adjustment on number of shafts and saltwater contamination.

GEOLOGICAL CONDITIONS		
PROPERTY	**VALUE**	**DESCRIPTION**
Ground Water (ft.)	Yes	Groundwater @ ~40 -Ft below ground surface.
Soil Log Available	Yes	Clay - soft to most, Clayey sand, stiff clay, sand, clay

DRILLED SHAFT CONSTRUCTION		
PROPERTY	**VALUE**	**DESCRIPTION**
# of Drilled Shafts	52	Drilled shafts 10' diameter
Diameters shaft Ft	10.00	Diameters 10'
Total Depth of drilled shafts	230	230 average excavation depth across all 56 drilled shafts
Total Volume of spoils (cubic yds.)	34,790	34,790cy spoils removed from the 52 drilled shafts
Neat Slurry Volume	7,026,240	= 7,026,240 Total gallons of slurry before reuse, recycle and accounting for fluid loss to formation
Total ft3	938,860	~938,860 ft3 Total
Gallons Before recycle & loss	7,026,240	~135,131 gallons slurry per drilled shaft based on 52 shafts to an average depth of 230' ft

TOTAL VOLUME ESTIMATE		
PROPERTY	**VALUE**	**DESCRIPTION**
Reused slurry Estimate	60%	Based upon mixing new and proceeding through phases of the project
Reused Estimate	4,215,744	
Loss of fluid Usage Estimate	15%	Based upon seepage, soil conditions and consumption or usage and spoils removal
Loss of fluid Estimate	1,053,936	
Estimated Total volume of slurry	3,864,432	Estimated gallons of slurry after reuse plus loss to formation.

ESTIMATED PRODUCT TOTAL

All Drilled Shafts

ADDITIVES

PRODUCT	TOTAL		=	UNITS	x	WEIGHT PER UNIT		@
Soda Ash	19,322	Lb	=	387.00	x	50	Lb bag	@
AQUAGEL™	966,108	Lb	=	19323.00	x	50	Lb bag	@
EZ-MUD®GOLD	38,644	Lb	=	967.00	x	40	Lb can	@
	0	Lb	=	0.00	x	40	Lb can	@
	0	Lb	=	0.00	x	40	Lb can	@
Trucking flatbed rate	0	Lb	=	23.00	x	0	Lb bag	@

All Products & additives have been priced FCA Colony, WY shipping point. Grand Tota

SLURRY Dosage TABLE		
Product	**Units/volume**	**DESCRIPTION**
Soda Ash	5	Lb. Soda Ash per 1,000 gal water
AQUAGEL™	250	Lb AQUAGEL per 1,000 gal water
EZ-MUD®GOLD	10	Lb. EZ MUD GOLD per 1,000 gal water
	0	