



World Oil[®] HPHT
DRILLING, COMPLETIONS & PRODUCTION CONFERENCE

October 30–31, 2018

Norris Conference Centers – CityCentre, Houston, Texas

HPHTConference.com

Introduction and Case History of a HPHT High-Performance Water-based Fluid in Tarim Basin China

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Daqing Oilfield China

First Trials Non-HTHP

Case History— Daqing Oilfield

Challenges and Performance:

- Drilling shale and sandstone formations lead to wellbore instability and pipe-sticking issues on offset wells. Environmental issues with OBM.
- Successfully finished 6 wells. Horizontal interval lengths between 1000 to 1960m. ROP higher than OBM when using EVOLUTION.

Item	EVOLUTION (6 wells)	OBM (6 wells)	EVOLUTION VS OBM
Average ROP (m/hr)	6.66m	6.21m	7.2% higher ROP
Highest ROP (m/hr)	7.98m	7.84m	1.8% higher ROP
Longest Horizontal length	1960m	2051m	



Sichuan Oilfield

China

Second Trials

Case History— Shale Gas Well

Challenges and Performance:

- Shale gas well 8 ½" hole, interval 2595-4700m, interval length 2105m, horizontal length 1510m
- The first shale gas trial well for EVOLUTION
- EVOLUTION has been the only WBM to date which successfully reached the planned total depth without displacing with OBM. Other wells using WBM had to displace with OBM before running casing or during drilling due to wellbore instability issues.
- Wellbore stability: Open hole for 83 days while maintaining wellbore stability
- Washout: 5%
- Max density: 2.20g/cm³



Tarim Oilfield China

19.6 ppg Brine Evolution

Hot Roll at 155°C (311°F) 16 hrs

Samples mixed to formulations and hot rolled at 155°C (311°F) for 16 hours. HTHP run at 155°C. Sample 2 shows Gypsum contamination that will provide a reduction in viscosity while slightly improving the HTHP Filtrate Control.

Tarim Oilfield China

21.7 ppg Brine Evolution

Hot Roll at 170°C (338°F) 16 hrs

10 Day Static Age at 182°C (360°F)

Properties, After

1.0 mm of settled Barite

Case History—KeS8-5

- Prior well information

Lithology		Formation layer	Bottom depth(m)	Thickness(m)	(m)	
库车组 N ₂ k	N ₂ k Kuche Clay with small conglomerates sands	TN ₂ k	2909	2099	-1442	
	N ₂ k Kangcun: Upper: Clay, silts, fine sands with conglomerates; Lower: fine sands, silts with clays	TN ₂ k	4069	1160	-2602	
	N ₂ j Jidike: Upper: Clay and silt; Middle: sands with conglomerates, fine sands; silt Lower: Clay, clay with silt	TN ₂ j	4739	670	-3272	
苏维 E ₂₂ s	Suveiyi :Clay, clay with gypsum, clay with silt	TE ₁₋₂ km ¹	4969	230	-3502	
	Clay, clay with gypsum		5119	150	-3652	
	Salt and gypsum		6504	1385	-5037	
	Dolomite		6511	7	-5044	
	Salt and gypsum		6559	48	-5092	
	Sand and conglomerates		6567	8	-5100	
库 E ₁₋₂ m Kumugeliemu	K ₁ bs Bashijiqike	TK ₁ bs	Section 1: Middle-size sands with layer of clay	6618	51	-5151
			Section 2: Sands with layers of clay	6794	176	-5327
			Section 3: Fine and middle-size sands with layers of clay, conglomerate at bottom	6889	95	-5422
			K ₁ bs Baxigai: Sands and silts	6939	50	-5472

Fluid Density Schedule

Intervals (m)	Mud Density	BHT	Potential	Challenges	Remarks
0~500	1.10-1.15			Bore collapse	
500~5119	1.15-1.70	~125°C		Hole collapse, stuck pipe	
5119~6523	2.25-2.35	~175°C	High pressure brine with EMW 2.47sg	Stuck pipe, loss, kick	Currently OBM
6523~6939	1.80-1.95	~180°C		Loss	Currently OBM

Fluid Property Expectations

	Hole Size	Interval m	MWV	API ml	PH	HTHP ml	Friction coefficient	Gels		PV mPa.s	YP Pa	CI ⁻ ppm
								10 s	10 min.			
Salt Water	12.25	5119~6523	2.20~2.35	≤5	8.5~10	≤14 @175° C	≤0.2	1~5	5~15	ALAP	4~15	≤175000
Fresh Water	8.5	6523~6939	1.8~1.95	≤5	8.5~10	≤10 @180° C	≤0.2	1~5	5~15	ALAP	4~15	≤40000

➤ Case History—KeS8-5

Formation		Depth (m)	Pressures In EMW g/cm ³				
Lithology	Pore Pressure		Collapsing Pressure	Fracture closing pressure	Breaking Pressure		
	Kick		Hole Collapse	Loss with fractures	Fracturing		
N ₂ k	Kuche Clay with small conglomerates, sands	2909	1.08	1.22	1.81	2.35	
N ₁₋₂ k	Kangcun: Upper: Clay, silts, fine sands with conglomerates; Lower: fine sands, silts with clays	4069	1.24	1.35	1.85	2.37	
N ₁ j	Jidike: Upper: Clay and silt; Middle: sands with conglomerates, fine sands; silt Lower: Clay, clay with silt	4739	1.44	1.46	1.93	2.40	
E ₂₋₃ s	Suweiyi: Clay, clay with gypsum, clay with silt	4969	1.60	1.62	1.93	2.42	
E ₁₋₂ km	Kumugeliemu	Clay, clay with gypsum	5119	1.78	1.81	2.01	2.37
		Salt and gypsum	6179	1.84	1.86	2.04	2.38
		Salt and gypsum	6429	1.90	1.93	2.06	2.39
		Salt and gypsum-conglomerates	6567	1.78	1.82	2.07	2.42
K ₁ bs	Bashijiqike	6889	1.77	1.79	2.05	2.42	
K ₁ bx	Baxigai	6939	1.76	1.78	2.06	2.42	

➤ Case History—KeS8-5

Challenges and Performance:

- Deep HTHP well drilling salt & gypsum formations
- Utilized EVOLUTION to replace OBM to meet environmental standards
- TVD 7027m (designed), BHT >165 °C (Test temperature 180 °C, MW 2.35 sg in lab.)
 - 22" @200m
 - 17" @3802m
 - 13 1/8" @6600m
 - 9 1/2" @6837m
 - 6 5/8" @7027m
- Completed 9 1/2" interval containing salt, clay and gypsum formations
 - Saturated saltwater system ,BHT >155°C, MW 2.32 sg
- Operation has been successful and reduced drilling time by 34 days (18%)

Thank you