APPRAISAL REPORT ON THE LOW DAMAGING DRILLING FLUID USED FOR SHELL ON "BORGNY DOLPHIN" 31/2-11

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FOR

SHELL ON

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Introduction

Anchor Drilling Fluids' proposal for a calcium carbonate/hydro-hydroxyethylcellulose (HEC) system to drill and core through the reservoir sands was accepted by Shell. Anchor Drilling Fluids would provide a mud engieneer to look after the system and a consultant, familiar with HEC/brine fluids, to advise on rheology and chemical treatment.

Summary

On-site materials were checked and a sample of brine obtained from the ship waiting to transfer. Test batches were made up for rheological analysis to confirm the proposed formulation. No changes were proposed other than the modifications made by Shell to increase the $CaCo_3$ content and use fresh water instead of sea water.

The system was made up and the contents of the hole chased out and dumped. On drilling through the shoe, the bit dropped and ca. 10 bbls of old mud were circulated out. It proved not possible to separate this old mud out at the surface due to intermixing with the new fluid.

Drilling proceeded to the top of the reservoir sand which proved very fine. Coring operations began and the first two cores jammed in the barrels giving only 14 m coring instead of 18 m. Less than 100% core recoveries were deemed to be due to unconsolidated sand sections. At this point the fluid had a high water loss attributed to the presence of the fine sand. Additional fine carbonate and HEC were added and coring gave no further problems. Recoveries were satisfactory.

The hole was opened and drilling proceeded to TD with no problems. The flud loss of the drilling fluid was 4.4. ml at the time of pulling out to log. Progress was better than prognosed by about 50%.

An extensive logging programme was carried out without difficulty, an inter mediate RT for hole cleaning proved un-necessary despite reported RFT runs. No bad sticking or cable drag were experienced.

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Recommendations

1. Before running casing and prior to the use of a special low-damage competion fluid, a weighted polymer pill should be spotted on the bottom. This avoids contamination of the new system after drilling out the casing shoe.

2. When running at SG 1.14 to 1.14, surge pills pills of 1.28 - 1.30 proved not heavy enough to prevent backflow. Use 1.35 to 1.40 in future.

3. The polymer/brine has a tendency to retain gas bubbles, especially when drilling through gas sands. An appreciable difference was shown between SG reading on the Halliburton and on the Baroid mud balance. The pressurised Halliburton balance gave consistently higher readings. The following observation were made :

- at the shakers	Baroid M.B. reading	SG 1.12
- at the suction pit	" " "	SG 1.14
- " " " "	Halliburton "	SG 1.17
- bottom of hole	Schlumberger hydrostatic head	SG 1.20

4. When using polymer viscosified brine, weighted with $CaCo_3$, solid particles of up to 200 microns in diameter, then filtration with fine mesh is not possible nor may desanders be used. Best method to control solid is to dump settling pits that have become loaded with drilled solids.

Appendix :

1. Chemical consumption.
2. Rheological tests of laboratory samples.
3. Further tests.
4. Problem solving - remedial action to condition mud.

APPENDIX 1

CHEMICAL CONSUMPTION FOR $CaCl_2$ BRINE/POLYMER FLUID

Chemicals

DATE	Brine bbls	$CaCl_2$ sx	NaOH sx	HEC sx	$CaCO_3$ sx	Enerflo S drms	Biocide pails	Defoamer pails
08.4.83	830			40	551	12	1	1
09.4.83	230	110		18	297	5		
10.4.83				5	116			
11.4.83			1	3	76			
12.4.83					30			
13.4.83					40			
TOTALS	1060	110	1	66	1110	17	1	1

06.4.83 APPENDIX 2

COMPLETION FLUID - ON-SITE TESTS PRIOR TO MIXING

"BORGNY DOLPHIN" 31/2-11

SAMPLE/ READING	A	A1	B	B1	C	C1	C2	C3	D	D1
F 600	55	41	86	64	99	109	119	91.5	143	113
A 300	40	29.5	64	48	76	85	92	71	113	89
N 200	33	24	54	40	64	73	80	60	99	77
N 100	23	17	40	29.5	49	57	62	46	78	59
R 6	6	3.5	12	7	13.5	18	20	12.5	28	18
P 3	3.5	2	8	4.5	9	13	14	8.5	20	12.5
M 10' gel	-	-	-	-	-	-	-	-	23	-
AV	27.5	20.5	43	32	49.5	54.5	59.5	45.8	71.5	56.5
PV	15	11.5	22	16	23	24	27	20.5	30	24
YP	25	18	42	32	53	61	65	50	83	65
Temp C°	11	27	10	27.2	11	-	10.6	29	11	28.3
pH	-	7.5	-	7.5	8.3	-	7.55	7.5	-	7.5
$CaCl_2$Sol SG1.13ml	132	132	132	132	132	132	132	132	100	100
Seawater SG1.03ml	198	198	198	198	198	198	198	198	150	150
HEC grms	1.0	1.0	1.35	1.35	1.7	1.7	1.7	1.7	1.5	1.5
Enerflow S ml x)	3.3	3.3	3.3	3.3	0	3.3	3.3	3.3	2.5	2.5
NORCAL N-5	2	2	2	2	0	0	2	2	1.5	1.5
NORCAL N-15	20	20	20	20	0	0	20	20	15	15
NORCAL N-40	20	20	20	20	0	0	20	20	15	15
3 hrs. settling mm sed	-	6.7	-	3	-	-	-	2	-	1

x) 7.5% active material

07.4.83 APPENDIX 3.1

COMPLETION DRILLING FLUIDS : ON-THE-SPOT TESTS USING ON-SITE MATERIALS "BORGNY DOLPHIN" 31/2-11

Observations : Brine clear with minor particulate sediment.

Drill water yellow. On standing, flocs formed and pricipitated out of solution. Additions of acid gave clear solution with no precipitates.

Laboratory samples made up using 60% $CaCl_2$ brine of SG 1.12 and 40% drill water (SG 1.00)

Added polymers to prepared brine of SG 1.07.

Observations : HEC dispersed fully under very low shear conditions. Hydration took place in about 30 mins., the fluid became water clear and developed appreciable viscosity.

Enerflo S added by means of a hyperdermic syringe, would not disperse under conditions of fast (vortex) stirring. High shear stirring achieved dispersion and subsequent dissolutionment. No tendency to form fish-eyes was evidenced.

It was judged best to add Enerflo S before HEC in order to reduce the time to make fully hydrated solutions.

APPENDIX 3.2

HEC was added in three concentrations : 1, 1.5 and 2 lbs per bbl.

After testing the stability of the solution overnight, $CaCO_3$ was added as follows : 20 ppb N-40, 20 ppb N-15 and 2 ppb N-5.

Result :

SAMPLE/ READING	A	B	C	A	B	C	A	B	C
Date 1983	7.4	7.4	7.4	8.4	8.4	8.4	8.4	8.4	8.4
HEC ppb	1	1.5	2	1	1.5	2	1	1.5	2
$CaCO_3$ ppb	0	0	0	0	0	0	42	42	42
pH	-	-	-	7.93	8.0	8.0	7.65	7.68	7.69
Temp ^oC	14.0	14.0	14.8	14.2	14.2	14.2	13.5	13.8	13.8
600	47	85	100	47	84	100	56.5	95	110
F 300	34	65	77	34	64	78	40	72	85
A 200	28	54	66	28	54	67	33	61	73
N 100	20	41	50	20	41	51	23.5	46.5	56
N 6	5	11	15	5	12	15	5.5	14	17.5
3	3	8	10.5	3	8	11	3.5	9.5	12.5

Conclusion : With + 10% solids and high viscosity solution is required since HEC exhibits no thixotropy. To use : 1.5 ppb HEC. Use of high viscosity fluid does not allow fine mesh (100) to be used. Check shaker screens in operation at full circulation rate.

LABORATORY TESTING AND REMEDIST SECTION TO CONDITION MUD.

Date	SAMPLE	Fluid loss ml Spurt	Fluid loss ml 30 min	SG	pH	T	FANN 600	FANN 300	FANN 200	FANN 100	FANN 6	FANN 3	Gel 0/10
9.4	Mud developed high fluid loss, considered to be due to high content of well sorted fine sand in the mud (± 3%). From suction	22	95	1.14	8.58	12.9	87	66	55	40	10	6.5	
	Lab samples added N-40 3 ppb	17.5	58.5										
	6 ppb	16.5	57										
	10 ppb	18	83										
	Added 40 sxs N-40 (ca. 3 ppb) overnight.												
10.4	Sample	11	22.5	1.14	8	13.0	84	62	52	39	8.5		5/5
	Lab sample added 0.25 ppb HEC Cake 0.5 mm	6.5	13.5			17.0	92	69	58	42.5	10	6	
	Added 6 sxs HEC over 1 hour												
	17.45 Sample Cake 1.0 mm, sand 3.5%	5	12.5				92	67	55	39	7.5		15
11.4	10.00 am Sample Cake 0.3 mm, total solids 12.8, sand 3%. Mud rheology improved.	3	9.5	1.15			99	74	61	44	9	5.5	
12.4	9.15 am 60" 30'												
	Control sample 0.2 4.4			1.15	7.3	14.5	92	66	54	37	6	3.5	35/40

T.D., pulling out to run Schlumberger.