Magcobar CANADA
DRILLING FLUID SERVICES

DRILLING FLUID PROGRAM

POTENTIAL DRILLING PROBLEMS:

The potential drilling problems are based on information from offset wells as well as MAGCOBAR'S information on geology and drilling experience in the area of the proposed well.

SURFACE HOLE:

1. **Lost circulation** can generally be expected while drilling in the loose, unconsolidated sand and gravels that are common to surface formation. MOBIL BELLOT HILLS M-63 (67°02"45"N 126°27'45"W) encountered lost circualtion @ 169 m (2-3/4 hrs) and @ 191 m (4 hrs). In the event of lost circulation raise the viscosity and initially mix SAWDUST and KWIK SEAL into the system at 5:1 ratio. Should lost circulation become severe, spot LCM plug over thief zone.

2. **Unstable formation and hole sloughing** are characteristic of surface hole drilling problems in this area. High fluid viscosities are quite often required to keep the hole clean and prevent stuck pipe. ASHLAND TEDJI LAKE (67°43'38"N 126°49'56"W) encountered some gravel and boulders on surface and worked stuck pipe @ 104 m (1 hr) and @ 137 m (3/4 hrs).

INTERMEDIATE AND MAIN HOLE:

1. **Lost circulation**, to varying degrees, appeared to be the most serious problem encountered while drilling the Main Hole interval. The common zones of loss were the up-hole formations and SALINE RIVER. MOBIL BELLOT HILLS (67°02'45"N 126°27'45"W), ASHLAND TEDJI LAKE (67°43' 38"N 126°49'56"W) and MOBIL COLEVILLE (67°14'18.2"N 126°18'25.6"W) experienced minor to severe lost circulation through these zones.

2. **Solids build-up** will cause excessive mud densities, resulting in poor penetration rates, high mud costs and undesireable rheological properties. Utilizing appropriate equipment and practicing solids control procedure will reduce any potential solids problems.

3. **Salt** in LOWER SALINE RIVER (SALT MEMBER) may cause fluctuation in mud properties and/or resulting in lost circulation (from excessive gels/viscosities).

4. **Sticking** in SALT may be a problem if drilling fluid is unsaturated. This is generally due to plastic nature of SALT (it "creeps" or "flows" until a saturation equilibrium is reached.

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POTENTIAL DRILLING PROBLEMS: (Cont'd...)

5. Fluid hydraulics should be optimized to prevent excessive "washing' through the SALT section.

6. Reciprocate and rotate pipe at all times while circulating in SALT. Avoid excessive pipe speeds (Swabbing) while reciprocating.

7. Deviation problems will be minimal, ranging from 1/4° - 3°, but 4 ° - 7° may be expected in PRECAMBRIAN formation.

8. Well flow was not indicated on any of the immediate offset wells. However, mud densities in the 1006 - 1246 Kg/m^3 were used to drill the CAMBRIAN and PROTEROZOIC formations.

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SURFACE HOLE

Anticipated Problems

* Possible lost circulation on Surface Hole.
* Incompetent surface formations.
* Hole sloughing and instability.
* Possible sticking problems.

Mud Type

VISGEL/XC POLYMER MUD

Mud Additives

VISGEL, CAUSTIC SODA, XC POLYMER, SODA ASH, lost circulation material (SAWDUST, KWIK SEAL) if required.

Preparation

1. Premix mud in tanks. The premixed viscosity should be in the 40 - 50 sec/l range. Spud well with the premixed mud.

2. Spud well with fresh water.
   a) Check the hardness of the make-up water and lower the Ca^{++} concentration of the water in the rig tanks to 100 mg/l or less with SODA ASH.

   b) Add VISGEL (34 Kg/m^3) and KELZAN at 8:1 ratio slowly through the hopper to viscosify the fluid, as hole conditions dictate.

   c) Obtain an initial funnel viscosity of 40 - 50 s/l. BENTONITE should not be mixed any faster than 5 minutes per sack. Adjust the rate so that viscosity does not rise more than 8 secs/circ. Note: Mixing it higher and diluting it back will shock the hole. This will require constant maintenance of the mud system and hole.

   d) Add 0.7 Kg/m^3 of CAUSTIC SODA slowly through the chemical barrel to increase pH to 9.0 - 9.5.

Drill ahead with the VISGEL/KELZAN XC POLYMER system and adjust mud properties as required.

Mud Properties

Density

a) 1040 - 1080 Kg/m^3
Maintain as low as possible with water dilution, desilting and dumping of tanks as required.

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b) Balance formation pressure with BARITE as required.

Funnel Viscosity	40 - 50 s/l Increase as required with VISGEL and KELZAN to clean the hole. 80 - 100 s/l for casing.
Plastic Viscosity	With the recommended mud densities, the PV should be in the 10 - 30 mPa.s range.
Yield Point	10 - 15 Pa
Gel Strengths	Initial gels - 2 - 4 Pa; 10 minute gels 4 - 10 Pa.
pH	9.0 - 9.5
Fluid Loss	No control.

Remarks

In the event of lost circualtion, raise the viscosity and mix SAWDUST and KWIK SEAL into the mud system at a 5:1 ratio. If lost circulation is severe mix a 3 - 4 m^3 LCM PLUG consisting of SAWDUST and KWIK SEAL at 5:1 ratio (approximately 66 Kg/m^3 SAWDUST) and spot over thief zone. For gravel and boulders raise viscosity as required to clean the hole 100 - 200 sec/l.

Product Concentrations

VISGEL	34.0 Kg/m^3
CAUSTIC SODA	0.7 Kg/m^3
KELZAN XC POLYMER	1.43 - 2.0 Kg/m^3

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MAIN HOLE

Anticipated Problems

* Solids build-up, hole cleaning.
* Sloughing shale.
* Possible lost circulation in up-hole formations and SALINE RIVER.
* Deviation may cause some problems.
* No abnormal pressures are expected.
* Salt.

Mud Type

VISGEL/XC POLYMER MUD

Mud Additives

VISGEL, CAUSTIC SODA, XC POLYMER, SODA ASH, STAFLO/STARCH, BICARBONATE OF SODA

Preparation

1. Maintain a funnel viscosity of 35 - 45 s/l with VISGEL. BENTONITE should not be mixed any faster than 5 minutes per sack. Adjust the rate so that viscosity does not rise more than 8 secs/circ. Note: mixing it higher and diluting it back will shock the hole. this will require constant maintenance of the mud system and hole.

2. Add 0.7 Kg/m^3 of CAUSTIC SODA slowly through the chemical barrel to maintain pH to 9.5^+.

3. Obtain an initial funnel viscosity of 35 - 45 s/l. BENTONITE should not be mixed any faster than 5 minutes per sack. Adjust the rate so that viscosity does not rise more than 8 secs/circ. Note: Mixing it higher and diluting it back will shock the hole. This will require constant maintenance of the mud system and hole.

4. KELZAN XC POLYMER is a high molecular weight linear POLYSACCHARIDE. it is an additive which provids a highly shear-thining viscosity in water based fluids. The viscosity of KELZAN XC POLYMER solution remains very stable from below freezing to 300°F. Add KELZAN (1.43 - 2 Kg/m^3) along with VISGEL @ 1:8 ratio to obtain optimum hole cleaning and suspension properties.

5. Treat out cement contamination with BICARBONATE OF SODA because if Calcium is present, KELZAN XC POLYMER may precipitate when pH is above 11.0. Therefore, it is highly desireable to avoid cement contamination.

Drill ahead with the VISGEL/XC POLYMER system and adjust mud properties as required.

Mud Properties		
	Density	a) 1040 - 1080 Kg/m^3 Maintain as low as possible with water dilution, desilting and dumping of tanks as required.
		b) Balance formation pressure with BARITE as required.
	Funnel Viscosity	35 - 45 s/l Increase as required with VISGEL and KELZAN to clean the hole. 60 - 70 s/l for logging, coring and casing.
	Plastic Viscosity	With the recommended mud densities, the PV should be in the 10 - 30 mPa.s range.
	Yield Point	10 - 15 Pa
	Gel Strengths	Initial gels - 2 - 4 Pa; 10 minute gels 4 - 10 Pa.
	pH	9.5^+
	Fluid Loss	12 - 14 cm^3 is the normal range for this system with no control. STAFLO/STARCH can be used to reduce F/L to the required level (8 - 10 cm^3) for zones of interest.
	Solids Content	Maintain below 0.06 volume fraction by mechanical means, water dilution and tank cleaning.

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	BENTONITE (GEL) Concentration	MBT is the check used to give the concentration of BENTONITE. Maintain in the 34 - 45 Kg/m^3 range. The BENTONITE concentration may be greater than 45 Kg/m^3 depending on viscosity requirements.
	Ca^{++} ion Concentration	Maintain at 100 mg/l or less by precipitating Ca^{++} with SODA ASH (Na_2CO_3).
	Cl^- ion Concentration	Chlorides may range ±120 to ±1200 mg/l depending on Cl^- content of the make-up water and salinty of formation waters. If Cl^- concentration increases along with the pit volume, gain would indicate water flow.

Fluid Monitoring

These drilling fluid properties are a guideline. Conditions at the wellsite determine mud properties and product usage that ill best drill the well.

Mud density control is of prime importance from a penetration standpoint. Dilution and tank cleaning will be minimized by optimue use of available solids control equipment (Desander, Desilter, Centrifuge).

If a noteable decrease in yield point is noticed, more XC POLYMER can be used with VISGEL for more carrying capacity in the POLYMER system.

Solids Control

In conjunction with water dilution and tank dumping, the use of one or more mechanical aids of solids removal is recommended to conserve water, decrease product cost and facilitate disposal;

1. Run 20 - 30 litres of water per minute to hold the mud density below 1060 Kg/m^3.
2. A high speed double shaker using fine mesh screens is efficient with this system.
3. Have the desilter and/or desander operating at maximum efficiency.

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4. Make sure the first two compartments in the mud tanks (risers up) are giving a maximum solids settling effect.

5. Dump and clean settling tanks as volume permits.

Product Concentrations	VISGEL	34.0 Kg/m^3
	XC POLYMER	1.43 - 2.0 Kg/m^3
	CAUSTIC SODA	0.7 Kg/m^3

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MAIN HOLE: SATURATED SALT MUD

CONVERT THE VISGEL/XC POLYMER TO A SATURATED SALT MUD:

1. Reduce fluid volume in the mud tanks by discarding 1/3 to 1//2 of the VISGEL/XC POLYMER system.

2. Add salt to saturate the VISGEL/XC POLYMER mud. (Fresh water requires about 125 lbs/bbl or 356 Kg/m^3 of NaCl to reach saturation and after saturation the salt will contain 315,000 mg/l (minimum of 260,000 mg/l salt and weight about 10 ppg or 1200 Kg/m^3)

3. At the same time, add enough water to maintain a pumpable mud. If the salt is dissolved into the solution quickly enough, the mud will be salted over the viscosity hump by the time it is circulating down hole. Although the organic thinning agents lose their effectiveness in saturated salt water, additions of spersene will help thin the mud.

4. Settling and dehydration of the clay particles often cause reduced viscosity after the salt additions, requiring a viscosity building chemical. We recommend adding Prehydrated Bentonite or Salt Gel into the existing saturated salt system to achieve desireable hole cleaning properties.

Comments

Saturated salt muds are highly inhibitive mud system, and drilled shales do not readily disperse or increase viscosity; consequently abnormal viscosity problems are rare. Alkalinity control is important and the advantages to be gained are as follows:

1) reduction of corrosion
2) suppression or removal of free Calcium which aids in fluid loss control
3) a more stable mud; and,
4) reduction of foaming

foaming of saturated salt muds is quite common and increasing the p-filtrate is often successful in decreasing the degree of foaming. Should this become a problem, a defoaming agent such as Magconol (1 to 2 gal/100 bbl of mud) is employed in saturated salt water systems. If foaming persists after initial treatment, additional treatments may be necessary.

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Convert to a saturated salt mud system and treat any calcium contamination to 100 mg/l or less with Soda Ash.

Minor salt water flows, sat, gypsum and anhydrite do not appreciably upset saturated salt water muds. Calcium can cause problems of filtration control when present in abnormal amounts. As mentioned previous, precipitate excess Ca^{++} with Soda Ash.

Control pH at 10.0 - 10.5 with Caustic Soda.

Water Loss can be maintained around 30 cm^3 by using MY LO JEL. If further water loss control is desired, additions of MY LO JEL will be effective in reducing the fluid loss. (See the accompanying information on MY LO JEL for its properties).

Monitor the Chloride (Cl^{-1}) content at about 180,000 mg/l for total saturation of the mud.

Drill ahead to total depth with the salt mud system adjusting mud properties as required.

Suggested Mud Properties:

Density	1200 Kg/m^3 (10 ppg)
Viscosity	40 - 45 s/l drilling
	70 - 80 s/l completion
Fluid Loss	8 - 10 cm^3
pH	10.0 - 10.5

Prior to logging and running casing the funnel viscosity could be raised to the 70 - 80 s/l range to clean the hole. If hole conditions have been good, a major rheological change is not recommended.