POSSIBLE UTILIZATION OF PALM KERNEL SHELL AS AN ALTERNATIVE LOST CIRCULATING AGENTS DURING OIL WELL DRILLING

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Synopsis

Palm kernel shell is a byproducts from the palm oil milling process. The viability of using the palm kernel shell as a lost circulating agent will be studies. An initial study is carried out to determine the characterisation require, to combat lost circulation.

Then further tests are carried out to evaluate the characteristics for lost circulation materials and the effect of palm kernel shell on the mud properties.

The test results showed that palm kernel shell can be used as a lost circulation agent with better performance when compared to walnut shell. And the effect of palm kernel shell on the mud properties is negligible if the pericarp surrounding the shell is properly removed.

Introduction

The loss of an appreciable part or the entire volume of drilling fluid from the borehold happen when drilling through cavernous, vuggy, fractured, and/or highly porous formation with permeability in excess of 14 darcys. This has presented one of the greatest problems to the drilling industry and it can take place while drilling is in progress or during the 'trips'.

After the occurence of lost circulation, the level of the drilling fluid in the annulus is lowered causing the hydrostatic pressure in the annulus to become lower than the formation pore pressure. This can lead to a disastrous blowout, increased in mud cost, pipe sticking and lower productivity in a pay zone. [1]

Once it has been established that there is a lost circulation zone, the point of loss should be accurately determined and then reliable means of properly healing the hole and regaining circulation must be used. In most cases, a lost circulation material is spotted in the zone of loss. Numerous brand names of lost circulating materials are commercially available and the feasibility of using palm kernel shell as an alternative lost circulating material during oil well drilling is being investigated in this paper.

Basic Properties Requirement For Lost Circulation Materials

For the lost circulation materials to be effective, its must have the following basic properties:-

a) The material must be capable of forming a mud-tight seal for the remainder of the drilling operation,
b) The seal must be strong and not easily broken or removed,
c) The material should not cause sticking of the drillpipe,
d) The material should not damage the productive zone.

The materials used for prevention of lost circulation can be classified as

i) Fibrous materials. Fibrous materials include raw cotton, bagasse, wood fiber, bark fiber, textile fiber, mineral fiber, leather, glass fiber, peat moss, feathers and beet pulp,
ii) Flaky materials. Flaky materials include cellophane, cork, mica, corn cobs, cotton-seed hulls, and vermiculite,
iii) Granular materials. Granular materials include perlite, coarse bentonite, ground plastic, nut shells, nut hulls, ground tyres, asphalt, wood, corn cobs and coke.

The best sealing agents are granular and the mechanism of sealing by these lost circulation materials is either fracture seal at the face of wellbore or fracture seal within the wellbore[3].

Experimental Method

Initially, the palm kernel shell is grinded and the particle size distribution of the palm kernel shell is selected to match the particle size distribution of the walnut shell.

The ability of palm kernel shell to overcome lost circulation is measured using the lost circulation test cells

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as shown in Fig. 1 in accordance with the API RP 13B for 'Standard procedures for testing drilling fluids – bricking materials for regaining lost circulation'[4]

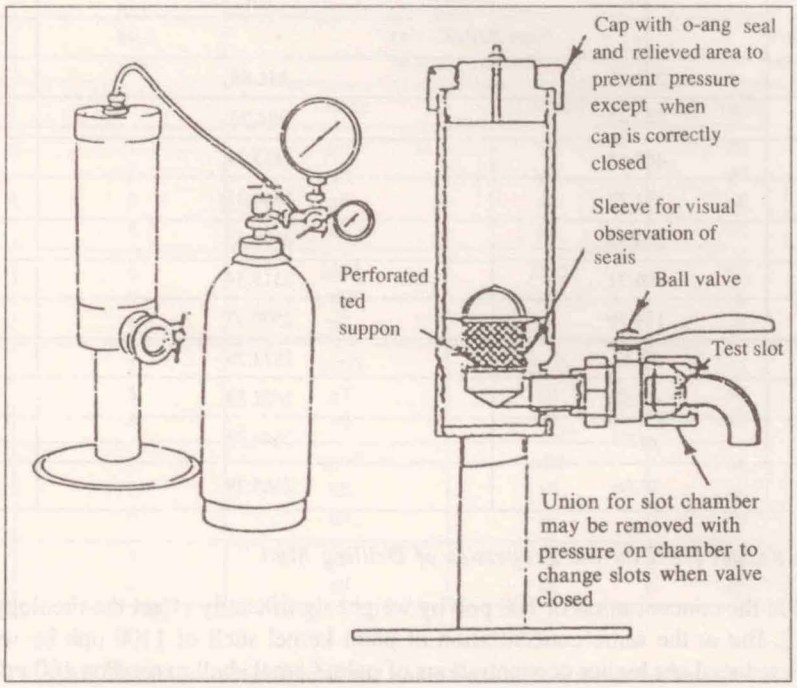

Figure 1 Lost circulation testing equipments

The efficiency of palm kernel shell as a lost circulating material is measured using the slot test (simulating a fractured formation), the BB shot test (simulating a highly permeable formation) and the marble-bed test (simulating an unconsolidated formation). The performance of palm kernel shell as a lost circulating material is compared with commercially available walnut shell commonly used in Malaysia.

Finally, the effect of the concentration of the palm kernel shell as a lost circulating material onto the properties of drilling fluids are measured. The following properties are measured; apparent viscosity and get strength, filtration properties and pH.

Result And Discussion

Table 1 shows the particle size distribution of the palm kernel shell and the walnut shell.

Table 1a Size distribution of palm kernel shell

Aperture Size mm	Weight gm	Cumulative Weight gm	Cumulative
2.36	364.18	364.18	7.3029
1.70	1515.90	1880.08	37.7014
1.18	1696.33	3576.41	71.7180
0.85	484.06	4060.47	81.4249
0.60	276.36	4336.83	86.9667
0.425	163.37	4500.20	90.2428
0.300	140.32	4640.52	93.0566
0.212	127.68	4768.20	95.6170
0.150	64.13	4832.33	96.9030
0.106	48.50	4880.83	97.8756
0.075	38.08	4918.91	98.6392
< 0.075	67.86	4987.77	100.0000

Table 1B Size distribution of walnut shell

Aperture Size mm	Weight gm	Cummulative Weight gm	Cummulative
2.36	–	–	–
1.70	241.88	241.88	9.0735
1.18	742.42	984.30	36.9234
0.85	468.84	1453.14	54.5107
0.60	391.27	1844.41	69.1881
0.425	264.92	2109.33	79.1259
0.300	206.21	2315.54	86.8613
0.212	184.79	2500.33	93.7932
0.150	73.43	2573.76	96.5477
0.106	48.57	2622.33	98.3697
0.075	24.60	2646.93	99.2925
< 0.075	18.86	2665.79	100.0000

The Effect of Palm Kernel Shell on the Properties of Drilling Mud

Palm kernel shell at the concentration of 100 ppb by weight significantly effect the rheology of the mud system as shown in Table 2. But at the same concentration of palm kernel shell of 1100 ppb by weight, the fluid loss into the formation is reduced. At higher concentrations of palm kernel shell exceeding 100 ppb there is no further effect on the properties of drilling muds.

Eventhough palm kernel shell reduced the rheological properties of drilling mud as tested, the effect is not that critical since only 10 – 40 ppb of lost circulating materiall are used in normal lost circulation control operations. Here the reduction of rheological properties of drilling mud as tested is small.

Table 2 Effect of palm kernel shell on the properties of drilling mud

	Base Mud	Base Mud + Weight of Palm Kernel Shell, gm			
		10	20	30	40
600 rpm	114	82	71	71	69
300 rpm	80	51	47	47	45
Apparent Viscosity	57	41	35.5	35.5	34.5
Plastic Viscosity	34	31	24	24	24
Yield Point	46	20	23	23	21
Gel Strength	29/62	15/47	14/41	14/41	14/41
pH	8.90	8.53	8.44	8.01	7.82
Filtrate API	12	10.25	10.00	10.25	10.25

Comparison of Performance Between Palm Kernel Shell and Walnut Shell as a Lost Circulating Material

Table 3 shows the performance of palm kernel shell and walnut shell as a lost circulating material using the slot test. Palm kernel shell is effective in controlling lost circulation through 1 mm slot at a concentration of 10 ppb and this is comparable to the performance of walnut shell. For 2 mm slot, only palm kernel shell is effective in controlling lost circulation at a concentration of 20 ppb whereas walnut shell is not effective eventhough at higher concentration.

Table 4 shows the performance of palm kernel shell and walnut shell as a lost circulating material using the BB shot test. Palm kernel shell is more effective as compared to walnut shell since smaller discharge volume through the beads is recorded when palm kernel shell is the lost circulating material.

Table 5 shows the performance of palm kernel shell and walnut shell as a lost circulating meterial using the marble bed test. Both palm kernel shell and walnut shell fail to arrest the lost circulation.

Table 3 Lost circulation slot test under static and dynamic conditions

Concentration ppb	Slot Size mm	Palm Kernel Shell		Walnut Shell	
		Volume discharged at 1.000 psi (ml)		Volume discharged at 1,000 psi (ml)	
		Static	Dynamic	Static	Dynamic
10	1	125	90	50	70
	2	all	all	all	all
	3	all	all	all	all
	4	all	all	all	all
20	2	2695	2215	all	all
	3	all	all	all	all
	4	all	all	all	all
30	2	2400	2000	all	all
	3	all	all	all	all
	4	all	all	all	all
40	2	1490	500	all	all
	3	all	all	all	all
	4	all	all	all	all
100	3	all	all	all	all
	4	all	all	all	all

Table 4 Lost circulation marble test under static and dynamic conditions

Concentration ppb	Palm Kernel Shell Volume discharged at 1,000 psi (ml)		Walnut Shell Volume discharged at 1,000 psi (ml)	
	Static	Dynamic	Static	Dynamic
10	all	all	all	all
20	all	all	all	all
30	all	all	all	all
40	all	all	all	all
50	all	all	all	all
100	all	all	all	all
150	all	all	all	all

Table 5 Lost circulation beads test under static and dynamic conditions

Concentration ppb	Palm Kernel Shell Volume discharged at 1,000 psi (ml)		Walnut Shell Volume discharged at 1,000 psi (ml)	
	Static	Dynamic	Static	Dynamic
10	all	all	all	all
20	1300	1105	1650	1600
30	1230	1060	1250	1100
40	1000	960	1100	1050

Eventhough the performance of palm kernel shell as a lost circulating material is promising there are problems relating to the chemical properties of the attached palm oil pericarp that need to be resolved e.g. the presence of lignin.

Concluding Remarks

Several conclusions can be infered from this studies.

1. Palm kernel shell could be used as a lost circulating material.
2. Palm kernel shell effect the properties of drilling mud at concentration of 100 ppb and at this concentration, it would reduced fluid loss into the formation.
3. The performance of palm kernel shell as a lost circulating material as compared to walnut shell is better during the 2 mm slot test.
4. In the BB shot test, the volume of mud discharged before lost circulation stopped is smaller for the palm kernel shell as compared to walnut shell.

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