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Deacetylated Crustacea Shells Innovation as Upgrade Material for High Performance Water Base Mud (HPWBM)

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Abstract

High-Performance Water Base Mud (HPWBM) is a water base drilling fluid that has been raised to overcome several hole problems such as wellbore instability, caving shale and depleted reservoir sands. HPWBM itself is a WBM that provides additional additives to minimize solid content when stabilizing clay which has a tendency to swelling, clog the lost circulation zone, and also to minimizes differential sticking potential caused by depleted reservoir sands. The additives used in HPWBM can be like Synthetic Polymer or Natural Polymer which both have their advantages and disadvantages. When we use HPWBM we must attentive to the composition contained in the HPWBM, and also regarding the environmental impact caused by the use of the composition of HPWBM. HPWBM uses Polymer as its additives to provide good cutting integrity so that the cutting will be non-sticking and we can maximize shale-shakers capabilities in the required flow rate. In HPWBM it is necessary to add Biocide material as a supporting material to avoid heat-resistant bacteria that will invade into drilling fluids and degrade the polymers contained in HPWBM resulting in HPWBM quality degradation. To solve the lost circulation zone we use Calcium Carbonate. We use crustacean shells because we want to take chitin extract, then the chitin will be deacetylated to get the chitosan. Based in drilling fluid research, chitosan has many functions that correlated with the polymer in drilling fluids, the first chitosan can be the lost circulation material with cellulosic fibrous type, the second one chitosan can be biocide companion material because chitosan is hemostatic, fungicidal, and bactericidal, chitosan can be disposal and corrosion control. The main thing is that chitosan is obtained from food-waste so that by using chitosan we can reduce the impact produced by the decomposition of incomplete organic waste.

Introduction

The goal of drilling activity is to make a hole, assess and complete a hydrocarbon well that will deliver the oil as well as gas productively. In order to maintain the drilling hazards, drilling fluid is being used. The responsibility for performing the drilling fluid function is the main job of mud engineer and all of the drilling crew in the operation.

Drilling fluid is designed by the mud engineer and of course with the approval of several authorities, for example rig crew and drilling contractor, the agreement is useful to ensure that drilling fluid designed by mud engineers is fluid drilling that is suitable for wells being drilled. Besides, that fluid drilling must be environmentally friendly because it is related to the problem of disposal of sewage sludge, if the drilling fluids contain materials that are less environmentally friendly, you should use a disposal method that is in accordance with the "Material Safety Data Sheet", so that the waste from drilling fluids will not damage the environment.

Drilling fluid has an important function in drilling activity, where the main role of drilling fluids is hole cleaning, and controlling the formation pressure, but drilling fluids have several other functions which are supporting. The magnitude of the function of Drilling Fluids depends on the condition of the well being handled, [1]*According to MI-Swaco Drilling Fluids Manual* here are some general functions of the drilling fluids:

1. **Maintain the Wellbore Stability**
   Wellbore stability is a very complicated thing because it is the process of balancing and mechanical (pressure and stress) caused by several chemical factors. The composition of chemical in drilling fluid must have a composition that can maintain the wellbore stability when it is suspended and then cemented properly and correctly so that in this phase it is very clear that the role of fluid drilling is very important in maintaining wellbore stability. Fluid drilling must also have mud weight that is in

accordance with the range of balance of mechanical forces acting on the well-being such as formation pressure, well stress stresses and orientation and tectonics. If our mud can't stabilize the wellbore is the sloughing formation, which causes the formation is collapse or fall down.

2. **Formation Pressure Control**
The first function of drilling fluid is to balance the formation pressures, the main function of drilling fluid is to make sure we do a drilling operation in a safe way, usually when formation pressure is increases the density of fluid drilling must also be increases too with adding weighting agents, for weighting agents usually can use barite to balance formation pressure and can regulate wellbore stability

3. **Seal the Permeable Formation**
Permeability is the ability to drain fluid through its pore. When the drilling fluid column pressure is higher than the formation pressure, the filtrate from the drilling fluid will invade the formation, and the solid particles possessed by the drilling fluid will be deposited on the wellbore wall to form a layer called the mud cake. Systems from fluid drilling must be treated in such a way as to produce a mud-cake that is thin and has low permeability to limit invasion from drilling fluid filtrate. When fluid drilling produces a filter cake that is thick enough (> 3mm) it will cause a stuck pipe because the filter cake is too thick.

4. **Carry and Release Cuttings from Well**
When drilling, cutting and debris will appear that falls below the well, so we have to lift it to the surface. To do this the circulated fluid drilling to the drill-string through drill-bit then passes through the nozzle and brings the cutting to the surface through the annulus. Hole cleaning is the function of density, shape, and cutting size combined with the rate of penetration, drill string rotation, the viscosity of fluid drilling, density of drilling fluid and annular velocity drilling fluid. Viscosity has an important role in the rheological properties of drilling fluids having a significant effect on the adequate hole cleaning. Generally, higher-viscosity of drilling fluids will improve the cutting carry index, and also most of the drilling fluids are thixotropic, and it will be able to became a gel in static conditions. This characteristic can be suspended during a pipe connection and other situation when the mud is not circulated. Velocity also influences fluid drilling, when the annular velocity is high, it can increase cutting lift power. There are two different methods for the hole-cleaning process that occurs in a high-angle and horizontal wellbore, namely Low-Shear-Rate Velocity (LSRV) in laminar condition, and High-Flow-Rate Velocity and thin fluid to achieve turbulent flow.

5. **Lubricating the drill bit, and also support the bit and bottom hole assembly**
When drilling, drill-bit will scratch directly against the formation, this will result in frictional heat which is caused by mechanical and hydraulic forces on the bits that rotate and drill formation. Circulation of fluid drilling can help drill-strings reduce friction caused by rapid rotation during drilling, the drilling fluid here will cool and bring heat to the bit to the surface, so bits are not easily eroded, and of course, drill-strings will not overheating and will extend the life of the bottom hole assembly

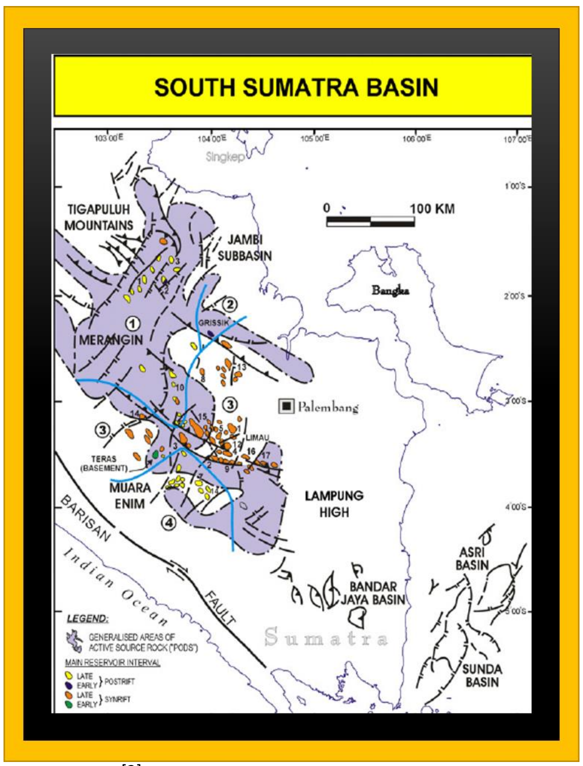
6. **Make the cementing and completion performance goes well**
In this phase drilling fluids are very important, before installing the casing, mud is prepared first in accordance with the specifications a/nd then will be pumped immediately after the casing is ready to be installed, when drilling fluids do not have good specifications, it will cause an unfavorable complexing process that may later it will cause damage (pseudo-skin completion damage). Cementing is critical effective zone isolation and successful well completion. When the casing enters, drilling fluids must minimize surge pressure so that fracture-induced lost circulation does not occur.

7. **Wireline and Mud Logging**
Mud logging is a method carried out in the drilling phase of a well whose function is to

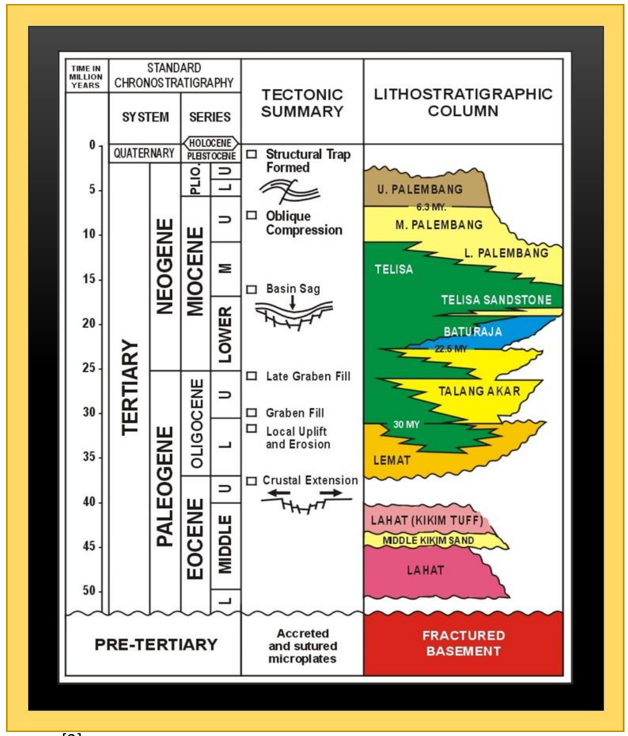
identify the stratigraphy of a formation based on age and lithology. Mud logging also functions to determine whether the well contains hydrocarbons or not. Mud loggers will interpret a cutting carried by drilling fluid and then analyze the gas contained in the cutting. In this case, wireline logging is running poorly due to possible formation damage caused by imperfections in the previous drilling phase.

After discussing the main function of Drilling Mud, here is a general explanation of the geological state, well schematic, and general information about the well to be drilled using the formulated HPWBM (High Performace Water Base Mud).

The wells to be drilled are located in South Sumatra, more precisely in the South Sumatra Basin. Next is Stratigraphy from the South Sumatra Basin



[2]Figure 1.1 : South Sumatra Basin



[3]Figure 1.2 : Stratigraphy South Sumatra Basin

The stratigraphic data above can be a reference in the process of identifying drilling hazard during the determination of drilling hazard (Geohazard) in the following discussion. In this stratigraphy some things can be drawn, namely regarding the petroleum system contained in "XYZ Well" located in the South Sumatra Basin. The configuration of the Petroleum System is, first is about source rock, in the south Sumatra source rock basin is in Baturaja Formation to Talang Akar formation, and with the dominance of Limestone and Shale. Then the reservoir rock in South Sumatra Basin is located from M. Palembang Formation to Talang Akar formation. Then for Seal rock found in M. Palembang Formation to Talang Akar formation, with traps in the form of Structural Trap and Stratigraphic Trap. After discussing the location of the South Sumatra basin along with the stratigraphy of the South Sumatra basin, what will be discussed in this paragraph is about the well profile and the well schematic that will be drill at a predetermined location in the South Sumatra Basin

The drilled wells are directional well with a specified inclination. Well, located on Onshore Sumatra with the state of Discharge Operation and using drilling mud with the type of Water Base Mud, and the well is expected to minimize waste generation generated by the use of water base mud, and in the well must be designed to minimize environmental hazard that might be happen. And for increase the effectivity of drilling mud, the drilling mud should be low production cost, no operational problem, can prevent from the wellbore collapse, maintain wellbore stability, minimize the formation damage that can happen such as pack-off, and then drilling mud must facilitate a successful wireline program, and also can work properly when we do a pressure testing and fluids sampling, and last but not least the important thing is Drilling Mud should be very eco-friendly and not harmful to either human being or environment.

In this paragraph, we will explain about the geomechanical evaluation, wellbore schematic and the drill-plan that will be carried out at "Well XYZ".

As we can see in the Table xx : Pore Pressure and Fracture Gradient are provided, and with the pore pressure and fracture gradient data, we can do a critical analysis of geo-mechanics that occurs in the wellbore. The Evaluation of Geomechanical itself has a lot of aspects, but the important aspects are Pore Pressure, Fracture Gradient, and Wellbore Stress. here are data on pore pressure and fracture gradient owned by "Well XYZ".

TABLE 1.1.
PORE PRESSURE AND FRACTURE GRADIENT WELL XYZ

Depth	Pore Pressure	Fracture Gradient
1580	7.8	14.8
1760	8.3	15.18
2180	8.35	14.84
2680	8.38	15.8
2950	8.39	15.4
3000	9	15.8
3010	9.1	15.94
3020	9.2	15.78
3120	8.5	15.24
3180	8.62	15.31
3184	8.57	15.35
3280	8.78	15.8
3300	8.5	15.82
3340	8.82	15.78
3420	8.38	15.44
3570	8.64	15.64
3600	8.4	15.84
4025	8.4	16.11
4030	8.4	15.84
4520	8.52	15.8
4528	8.29	15.2
5570	8.29	17.8

After we know the value of the pore pressure and fracture gradient from "Well XYZ" we can do a calculation to calculate the Safety Factor of each parameter known in **Table 1.2. : Safety Factor Pore Pressure and Safety Factor Fracture Gradient Well X**

Pore Pressure, and Safety Factor Fracture Gradient have different ways. For the calculation of the Safety Factor Pore Pressure, you can plus 0.5 ppg from the Pore Pressure values known. Then for Safety Fracture Pressure, you can reduce 0.5 ppg the Fracture Gradient values known.

TABLE 1.2.
SAFETY PORE PRESSURE AND SAFETY FACTOR FRACTURE GRADIENT WELL XYZ

Depth	Safety Factor Pore Pressure	Safety Factor Fracture Gradient
1580	8.3	14.3
1760	8.8	14.68
2180	8.85	14.34
2680	8.88	15.3
2950	8.89	14.9
3000	9.5	15.03
3010	9.6	15.44
3020	9.7	15.28
3120	9.2	14.74
3180	9.12	14.81

3184	9.07	14.85
3280	9.28	15.3
3300	9	15.32
3340	9.32	15.28
3420	9.38	14.94
3570	9.14	15.14
3600	8.9	15.34
4025	8.9	15.61
4030	8.9	15.34
4520	9.02	15.3
4528	8.79	14.7
5570	8.79	17.3

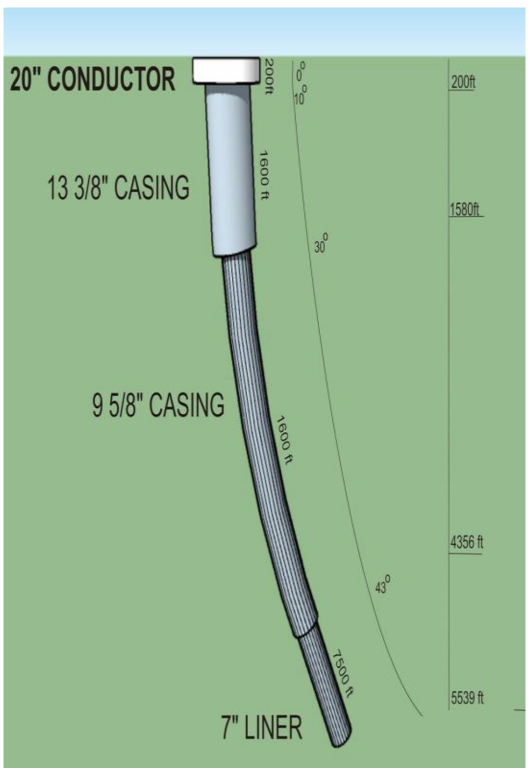


Figure 1.3. : Well Schematic "XYZ" Well

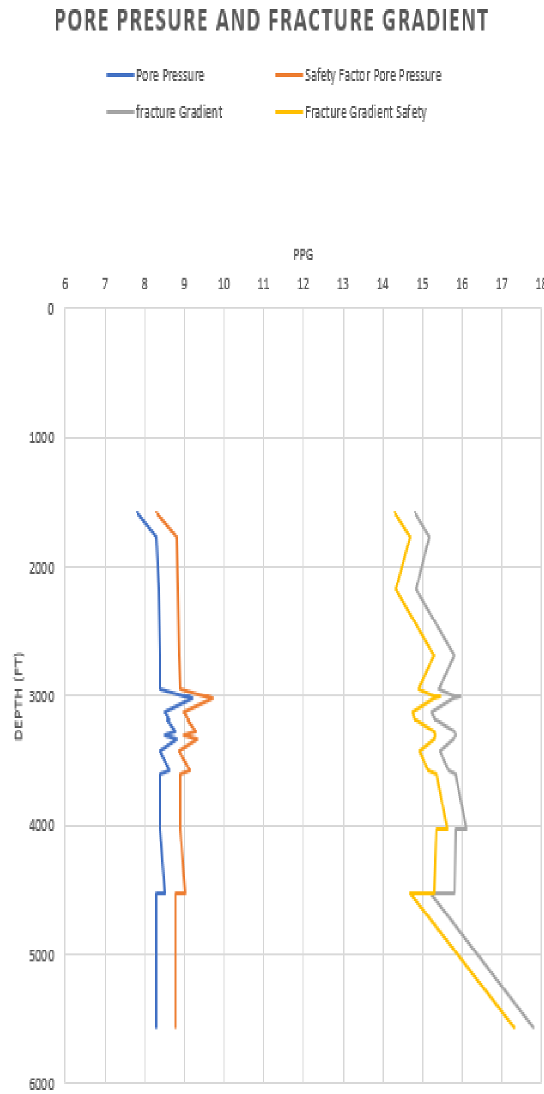


Figure 1.4. : Plot Geomechanical Evaluation

Then after discussing the geo-mechanical evaluation, the next thing is to do a description of the well schematic which the function of the Wellbore Schematic explanation is to provide crystal clear information about the plan in drilling, and also the characteristics of the well that will be drill.

In the Figure 1.3. : Wellbore Schematic Well XYZ, we can see that Well XYZ is an J-Type type well, with the casing set as follows :

TABLE 1.3.
CASING SETTING DEPTH WELL XYZ

Hole Section / OD Casing Size	Section TD / Casing Shoe ftMDRT	Mud Type
26” Hole / 20”	200	HPWBM
17.5” Hole / 13.375”	1600 / 1590	HPWBM
12.25” Hole / 9.575”	5000 / 4990	HPWBM
8.5 Hole / 7” Liner	7500 / 7490 TOL 7” 4900	HPWBM

After discussing the geo-mechanical evaluation and then the casing set design, the next thing that became the reference material in carrying out the design of drilling mud was the drilling hazard that was encountered when carrying out the drilling process at Well XYZ. Drilling hazard is defined as any potential problem that will happened in drilling operations. Drilling hazard management (DHM) focuses on wellbore stability and consequential hazards such as fluids loss, equivalent circulating density (ECD) , and stuck pipe management. Drilling hazard is an important thing to know, when we ignore drilling hazard, it is likely that hazards will occur more, so drilling hazards must be considered properly, here are flat drilling hazards that are in accordance with the given case.

TABLE 1.4.
DRILLING HAZARD WELL XYZ

24” / 20” Casing	17-1/2” / 13-3/8” Casing	12-1/4” / 9-5/8” Casing	8-1/2” / 7” Liner
Gumbo, bit baling	Interbedded lithology, reactive claystone, fine loose sandstone, bit balling, hole cleaning	Interbedded lithology, reactive and dispersive silty shale, loose sandstone, wellbore instability, geomechanic stress, depleted sandstone, hole cleaning, stuck pipe, lost circulation	Interbedded lithology, reactive and dispersive shale, coal stringers, wellbore instability, geomechanic stress and fault, depleted sandstone, hole cleaning, differential sticking and mechanical stuck pipe, lost circulation, gas kick, formation damage

The table above is a table that intends to explain what drilling hazards are likely to occur in various hole sections, and each section has a very varied problem. [2]*According to MI-Swaco Drilling Fluids Manual* Following is the definition of each problem that arises from the case :

1. Gumbo
   When some type of shale that becomes sticky when wet and adheres aggressively to surfaces. It makes plugging in the annulus, the flowline and shale-shaker screens. Gumbo is likely to contain appreciable amounts of Ca+2 smectite clays. It is dispersed in a water mud, causing rapid accumulations of colloidal solids. How to prevent gumbo we can use shale inhibitor.

2. Bit Balling
   When drilling of formation that containing water-sensitive clays, such as clays it can makes bit balling happened. We will discusses a new technique for eliminating this problem that establishes an electric potential between the formation and the bit with the bit as the cathode in this paper. How to prevent bit balling we can use shale inhibitor and lubricator.

3. Interbedding Lithology
   Interbedding occurs when beds of a particular lithology buried between or alternate with beds of a different lithology. For example, sedimentary rocks may be interbedded if there were sea level variations in their sedimentary depositional environment. Interbedded lithology can occur a washout phenomenon, so the volume of drilling fluid that we need is higher than the actual volume

4. Reactive Claystone
   Clay is fine-grained sediments less than 0.0039 mm in size. Clay will swell. Clay swelling will occur when the claystone contains mineral type such as smectite, montmorillonite. Reactive clay can cause clay swelling which is where clay swelling is caused by ion exchange or significant changes in salinity. However, only certain clays are reactive to brine. When clay is swelling, the thing that can happen is a stuck pipe. We can prevent clay swelling with clay inhibitor such as polyamine.

5. Loose Sand
   Loose sand is a phenomenon when sandstone is not perfectly compiled and has a low density so that the sand easily to collapses. This is because the loose sand has a tendency to compress when a load is applied. When this happens, it is possible that when the Bottom-Hole Assembly enters the formation then the loose sand collapses so that bottom-hole assemblies can be buried in the well due to sand that is not fully compiled. We can prevent the loose sand phenomenon with PAC LV.

6. Hole Cleaning
   One of drilling fluid ability is to transport debris and cutting from wellbores. The main function of drilling fluid is for cutting lifting capacity. The annular velocity, hole angle and flow profile of the drilling fluid is to determining Carrying capacity, but is also affected by mud weight, cuttings size, and pipe position and movement.

7. Wellbore Instability
   Borehole Instability is something that is not desired by the drilling engineers. Wellbore instability is a condition in which an open-hole interval cannot set the gauge size and shape of the wellbore consistently, which is the wellbore instability caused by several things such as erosion caused by poor fluid circulation, then mechanical failure caused by inert situ stresses, and the last is chemical which is caused by the interaction of fluid drilling with borehole walls We can prevent wellbore instability with low shear rate yield point, if overburden pressure occur we don't need afraid with the wellbore instability.

8. Depleted Sandstone
   The situation where there are isolated sections from the reservoir where the pressure formation has a significant decline, the press has dropped below the adjacent zones or the main body of the sandstone formation. We can prevent with maintain the mud weight as low as possible.

9. Stuck Pipe
   During drilling operations, there is a probability stuck pipe if it cannot be freed from the hole without damaging the pipe, and without exceeding the drilling rig's maximum allowed hook load. We can classified pipe sticking under two categories: differential pressure pipe sticking and mechanical pipe sticking. Stuck pipe occur due to clay swelling and high angle inclination, so we can prevent the stuck pipe with maintain the thickness of the filtrate cake, and we can use clay inhibitor for the clay swelling phenomenon.

10. Lost Circulation
    A lack of mud returning to the surface after being pumped down a well. Lost circulation occurs when the drill bit encounters natural fissures, fractures or caverns, and mud flows into the

newly available space. Lost circulation may also be caused by applying more mud pressure (that is, drilling overbalanced) on the formation than it is strong enough to withstand, thereby opening up a fracture into which mudflows. We can prevent the lost circulation with lost circulation materials.

11. Influx Kick
The kick is physically caused by lower wellbore pressure than the formation pressure. There is two ways why it will happened, First, if the mud weight is too low, then the hydrostatic pressure exerted on the formation by the fluid column may be insufficient to hold the formation fluid in the formation. This can happen if the mud density is suddenly lightened or is not to specification to begin with, or if a drilled formation has a higher pressure than anticipated. This type of kick might be called an underbalanced kick. The second way a kick can occur is if dynamic and transient fluid pressure effects, usually due to the motion of the drill string or casing, effectively lower the pressure in the wellbore below that of the formation. This second kick type could be called an induced kick.

12. Coal Stingers
Properties of coal in the formation is acidizing with the drilling fluids. To prevent it we need to control the pH of our drilling fluids

After discussing the geomechanical evaluation, casing set design and the drilling hazard, in this paragraph we will discuss the analysis that has been carried out based on analysis and evaluation of drilling hazard and wellbore schematic, which results from the analysis and evaluation will produce output in the form of mud specification that must be fulfilled when making mud drilling, and the mud specification will be a basic reference in making efficient mud drilling and can fulfill all the drilling mud function criteria mentioned earlier in this paper. The following are the results of analysis and evaluation of drilling hazard and wellbore schematic.

Hole section / casing size	Hole inclination (degree)	BHST (°F)	Mud Density (lbs/gal)
24" / 20" Casing	0	120	9 - 9.5
17-1/2" / 13-3/8" Casing	0 - 30	150	9 - 9.5
12-1/4" / 9-5/8" Casing	0 - 50	200	10-10.5
8-1/2" / 7" Liner	30 - 50	250	9.5-10

Figure 1.5. : Mud Specification 1

Hole section / casing size	Plastic viscosity (Cp)	Yield point (lbs/100ft2)	6-RPM	pH
24" / 20" Casing	ALAP < 20	20 - 30	10-12	9.5 – 10.5
17-1/2" / 13-3/8" Casing	ALAP < 20	24 - 32	10-14	9.5 – 10.5
12-1/4" / 9-5/8" Casing	ALAP < 25	24 - 36	10-14	9.5 – 10.5
8-1/2" / 7" Liner	ALAP < 30	24 - 36	10-12	9.5 – 10.5

Figure 1.6. : Mud Specification 2

Hole section / casing size	Gel strength 10 sec / 10 min	Fluid loss API / HTHP FL (ml/30min)	Drill solid (% volume)	MBT (lbs/bbl)
24" / 20" Casing	8 - 12 / 10-24	12 - 15 / NC	≤5	<15
17-1/2" / 13-3/8" Casing	8 - 14 / 10- 30	8 - 12 / NC	≤5	≤15
12-1/4" / 9-5/8" Casing	8 - 14 / 10 - 30	4 - 6 / 8 - 12 @200°F	≤4	≤10
8-1/2" / 7" Liner	8 - 12 / 10-24	4 - 6 / 8 - 12 @250°F	≤3	≤10

Figure 1.7. : Mud Specification 3

Data and Method

The basis of writing this paper is used in several study literature sourced from books such as "Composition and Properties of Drilling and Completion Fluid fifth Edition" by H. C. H. Darley and George R. Gray and "MI Swaco Engineering drilling fluid".
Then in order to analyze the data, we used the results of Test laboratory testing with several properties carried out testing, such as Density, PV / YP, Gel Strength, Cake and Filtrate, MBT Test, Drill Solids, Heating Test (Roll Oven Mechanism)

Density measures the value of pounds per gallon of mud, the measurement is using mud balance. PV / YP is a test for mud viscosity, PV / YP can also determine whether the well or hole cleaning is good, PV / YP is measured using a Rheometer. Gel strength test to find out whether the cutting can settle as long as the circulation of mud stops. then the Heating test is to determine whether there was a decrease in the quality of the mud when the mud was later circulated into the wellbore. LPLT filter press is used to test the filtrate by giving a pressure of 100 PSI, the purpose is to remove the mud filtrate, this can be interpreted as simulating mud when getting pressure in the wellbore, the mud gets pressure and can remove the filtrate, how many and the quality.

Result and Discussion

Water Based Mud (WBM) is a type of composition mud basically from water, mud whose basic composition of water can make clay become swelling, and can cause several disadvantages such as gumbo, bit balling, and pipe sticking. But the mud type in this paper is a High-Performance Water Based Mud (HPWBM), which is a modification of WBM, HPWBM has characteristics resembling Oil Based Mud so that the potential for clay undergoes little swelling.

The problem that we highlight is the problem found in Section 3 (9 5/8 "Casing) and Section 4 (7" Liner) which is the problem of "Lost Circulation" lost circulation itself is a situation where volume of mud that we are pumped is lost to formation, so the returning volume is lower. Lost circulation occurs when the drill bit encounters natural fissures, fractures or caverns, and mud flows into the newly available space. Lost circulation may also be caused by applying more mud pressure (that is, drilling overbalanced) on the formation than it is strong enough to withstand, thereby opening up a fracture into which mudflow, In order to prevent loss, we need to be added additive for preventing, we need loss circulation material (LCM). This paper proves the results of HPWBM given additional chitosan as an additive LCM or loss circulating material and can reduce the effect of Soltex which makes the color of the filtrate brighter.

Which lost circulation material matches the lost circulation zone we are facing, so chitosan is a lost circulation material alternative that coexists with fine-grained CaCO3. Then according to research that has been done in the medical world and foodstuffs, Chitosan can function as hemostatic, fungicidal, bactericidal, so Chitosan is a companion ingredient of Biocide, which can be useful as an anti-bacterial and anti-fungal, if bacteria and fungi are not treated with well it will cause damage to the polymer due to polymer degradation found in High-performance Water Bases (HPWBM) caused by bacteria and fungal. Following is our basic hypothesis that we made regarding the use of chitosan innovation in our drilling fluids:

1. Can be a caco3 companion material for lost circulation material
2. Can reduce the mud filtrate significantly
3. Can be a biocide companion material for anti-bacterial and anti-fungal
4. Can be used as materials for disposal treatment for the not environmentally friendly ingredients

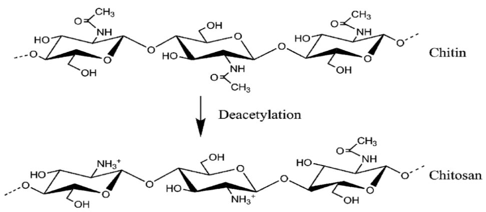


Figure 1.8. : Chitin and Chitosan Carbon Chain

Chitin, a homopolymer of N-acetyl-D-glucosamine (GlcNAc) residues joined by β-1-4 bonds, is that the most widespread renewable natural resources following polysaccharide (Deshpande, 1986). the most supply of polyose is crustacean waste, that is additionally the most cytomembrane material in most fungi (Nicol, 1991). polyose and its derivatives have high quantity thanks to their versatile biological activities and agrochemical applications (Hirano, 1996; Wang and Huang, 2001). The natural antibacterial and/or antifungal characteristics of chitosan. Chitosan is a very promising biopolymer that's isolated primarily from food process wastes. This chemical compound possesses variety of valuable properties. it's much one polycation of natural origin. Chitosan is nontoxic, biocompatible, and biodegradable; as a result, it's not accumulated in the body and within the setting thanks to its distinctive properties, chitosan has found wide use in medicine; the pharmaceutical food, fragrance, and cosmetic industries; agriculture; and waste material treatment within the food business, chitosan is utilized as a thickener and stabilizer of dietary foodstuffs and as a biologically active additive that destroys infective microflora and binds and removes fats, toxins, serious metal ions, and radionuclides from the body.

The addition of chitosan is used for sections 3 and 4 of the XYZ well because in the production zone we have to minimize the volume loss that occurs.

Here is the composition that we used for XYZ well for section 3

Table 1.5 Composition for section 3

Product Name	Weight (ppb)
AQUA	319.80
NaCl (Natrium Chloride)	40.00
Biocide	0.20
Soda Ash (Sodium Carbonate/Na2CO3)	0.35
XCD Polymer	1.75
PAC LV	1.50
PAC R	0.75
Polyamine	8.75
CaCO3 (Ultra fine)	60

We adding the addition of chitosan 2 ppb.
This is the properties of mud section 3 before the addition of chitosan and after the addition

Table 1.6.
Properties for section 3

Heat Aging Temp (°F)	200	200
Heat Aging Duration (hours)	16	16
Initial (I)/ Static (S)/ Rolling (R)	Rolling	Rolling
Mud Weight (ppg)	10	10
Plastic Viscosity (cP)	19.1	17.6
Yield Point (lbs/100 ft^2)	33	29.5
6 RPM	11.2	10.8
Gel Strength 10 secs (lbs/100 ft^2)	10.3	9.5
Gel Strength 10 mins (lbs/100 ft^2)	17.2	16.9
pH	9-10	9-10
API Filtrate (ml/30")	5.2 /9.6	3.5 /6.2
API Cake (mm)	1	1
Drill Solid (%volume)	≤ 4	≤4
MBT	<5	<5

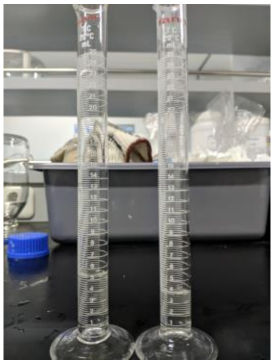


Figure 1.9. : Filtrate volume section 3

In the figure the right side is with chitosan and in the left side without chitosan. It was seen that the filtrate volume was reduced from 5.2 ml to 3.5 after chitosan was added, therefore the circulating material Loss function was proven. Based on its type Chitosan can be classified into a fibrous type so that it is suitable in formations that have small permeability because it can plug the pore properly.

For section 4 we add soltex because there is an issue Sloughing Limestone and is used as a lubricant, following the composition for section 4:

Product Name	Weight (ppb)
AQUA	319.80
NaCl (Natrium Chloride)	40.00
Biocide	0.20
Soda Ash (Sodium Carbonate/Na2CO3)	0.35
XCD Polymer	1.75
Soltex	2.00
PAC LV	1.50
PAC R	0.75
Polyamine	8.75
CaCO3 (Ultra fine)	45.00

Figure 1.10. Filtrate volume section 3

We used the addition of chitosan 2 ppb.
and this is the properties of mud section 4

Table 1.7.
Properties for section 4

Heat Aging Temp (°F)	250	250
Heat Aging Duration (hours)	16	16
Initial (I)/ Static (S)/ Rolling (R)	Rolling	Rolling
Mud Weight (ppg)	9.5	9.5
Plastic Viscosity (cP)	26.8	23.8
Yield Point (lbs/100 ft^2)	36	33.5
6 RPM	12.4	11.8
Gel Strength 10 secs (lbs/100 ft^2)	11.8	11.3
Gel Strength 10 mins (lbs/100 ft^2)	18.5	19
pH	9-10	9-10
API Filtrate (ml/30") LPLT/HPHT	6/11.6	4.8 /8.8
API Cake (mm)	1	1
Drill Solid (%volume)	≤3	≤3
MBT	<5	<5

Figure 1.11. : Filtrate volume section 4

the filtrate volume reduced from 6 ml to 4.8 ml , and the color of the filtrate becomes brighter because chitosan reduces the content of the hazardous substances contained in soltex.

Conclusions

Based on the result we can conclude that chitosan is succeeded become Lost circulation material, because volume of influx is lower after we adding chitosan. Chitosan in this case become Lost circulating material type vibrous, which is the best type of Lost Circulating Material.

The water influx become hazardous because the existence of soltex, soltex as we know for lubricity because the inclination of well is high, around 43˚. Chitosan can makes water influx become more brighten, as we can see in the figure 1.10, the color of water influx is indicate percent of chemical that hazardous in water influx is decrease.

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