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Effect of Salinity on Polymers Performance

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Abstract

Drilling industry is driving toward improving the performance of the drilling process in an economical and environmental attractive way. Recently, drilling development techniques faced greater challenges in terms of wellbore stability as polymers with different salt concentrations, have major effect on the drilling mud properties. The rheological behavior of several polymers used effect on common types of mud with different salt concentrations, that change normal mud properties (plastic viscosity, yield point, gel strength, API filtration). Exposing to different concentrations require utilizing polymers additives in order to avoid high cost and nonproductive time. The present work tested the effect of three different salt concentrations on mud polymers during drilling operations.

Keywords: Salt, polymers, drilling mud, concentration, properties.

Introduction

A polymer can be defined as a very large molecule made up of repeating chains called monomers. Polymers have high molecular weight and when added in low concentrations increase the viscosity of water and results in fluids ability to suspend particles (Belkin, et al. 2005; Manal, and Ibrahim, 2008).

The common polymers mud is those in which anionic polymers are used as the main additives. Since 1970, this kind of drilling mud has been widely applied to the vertical and deep well drilling in most oil fields. (Manal, B., Ibrahim B, 2008). Polymers have been used in drilling fluids for different purposes. They are used as lubricants, emulsifiers, reduce filtration, stabilize clays, flocculate driller solids, increase carrying capacity and reduce drag among other functions (Brookey, T. 1998; Cobianco et al., 2001; Li, et al., 2005). However, polymer fluids generally contain only minor amount of bentonite to build viscosity and the inhibitive character of these polymer mud often conflict with their performance.

Materials and Methods

The test was conducted in Halliburton Oil Service Company Laboratory, where three types of polymers with different concentrations were used. In order to understand the effect of sodium chloride on polymers performance, the lab work tested mud polymer (rheology at 10000 mg/l, 15000mg/l, and 35000 mg/l respectively) was used before mixing chemicals with water in the titration.

Results

The relationship between concentrations of salt versus yield point (YP) in case of premix mud has direct impact on Carboxy Methyl Cellulose (CMC) low and high viscous, and decreasing in yield point values. Moreover, time and temperature while mixing usually affect CMC. In case of Polyanionic Cellulose (PAC R), YP is gradually influenced by salinity concentration, due to the complexity of installed element where test was done at room temperature and time no more than 10 minutes. In case of Starch, the YP effected with salinity using four types of polymers ((PAC R, CMC Low viscous, CMC High Viscous, and starch) (Fig. 1)

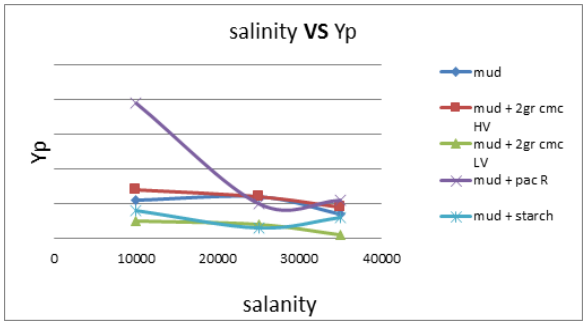

Fig. 1: Salinity Concentration vs. YP for Four Types of Polymers.

The effect of salt concentration on mud plastic viscosity in case of CMC, having low and high viscosity, are shown in Fig. (2) and Tables (1 - 3). It is noticed that, mud properties improved with different concentrations of KCL. Mud properties such as gel strength and plastic viscosity are greatly affected even by adding KCL at different concentrations. All polymers used have good thermal stability up to 250 F°. As the temperature increases the stability decreases. However, it is recommended using bentonite shale to extend the polymers thermal stability at similar lab test analysis and also during drilling operations.

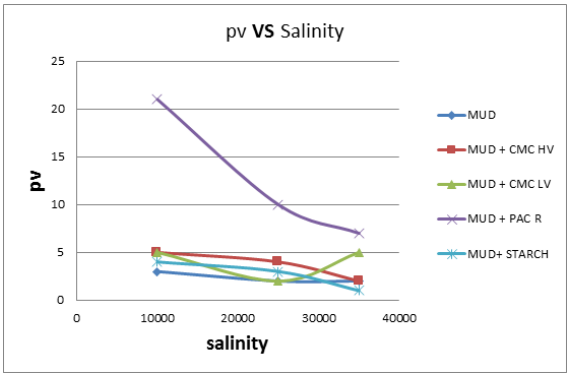

Fig. 2: Salinity concentration vs. PV for four types of polymers.

Table 1: Rheology Values at Concentration 10,000 mg /L.
* Mud mixing Time is 10 minutes at Room Temperature (F°)

Mud parameters	Pre_ mix mud	Mud+2gr cmc HV	Mud+2gr cmc LV	Mud+2gr Pac R	Mud+2gr Starch
Mud wt	8.4	8.4	8.4	8.4	8.4
Cl mg / 1	10,000	10,000	10,000	10,000	10,000
Ca++ mg / 1	120	120	120	120	120
fann 600	17	24	15	81	16
fann 300	14	19	10	60	12
fann 200	11	14	7	52	11
fann 100	10	11	5	40	7
fann 6	9	8	3	17	3
fann 3	6	6	2	16	2
Pv	3	5	5	21	4
Yp	11	14	5	39	8
Gels 10 / 10	5/8	6/10	2/3	14/22	2/3
N	0.765	0.669	0.836	0.48	0.458

K	0.48	0.175	0.041	2.656	0.649
FL	NOT CONTROL	9.2 ML	8.4 ML	8 ML	NOT CONTROL

Table 2: Rheology Values at Concentration 15,000 mg /L.

Mud parameters	Pre_mix mud	Mud+2gr cmc HV	Mud+2gr cmc LV	Mud+2gr Pac R	Mud+2gr Starch
Mud wt	8.7	8.7	8.7	8.7	8.7
Cl mg / 1	25000	25000	25000	25000	25000
Ca++ mg / 1	120	120	120	120	120
Teta 600	16	20	8	30	9
Teta 300	14	16	6	20	6
Teta 200	12	13	4	15	5
Teta 100	11	11	3	10	4
Teta 6	6	6	2	4	3
Teta 3	4	4	1	3	2
Pv	2	4	2	10	3
Yp	12	12	4	10	3
Gels 10 / 10	5/6	3/5	2/3	2/3	¾
N	0.194	0.49	0.699	0.709	0.89
K	4.419		0.055	0.21	0.014
FL	NOT CONTROL	10 ML	9 ML	10 ML	NOT CONTROL

Table 3: Rheology Values at Concentration 35,000 mg /L.

Mud parameters	Pre_ mix mud	Mud+2gr cmc HV	Mud+2gr cmc LV	Mud+2gr Pac R	Mud+2gr Starch
Mud wt	8.9	8.9	8.9	8.9	8.9
Cl mg / 1	35,000	35,000	35,000	35,000	35,000
Ca++ mg / 1	120	120	120	120	120
Teta 600	11	13	11	25	8
Teta 300	9	11	6	18	7
Teta 200	8	10	5	14	6
Teta 100	5	7	3	11	4
Teta 6	3	5	2	4	3
Teta 3	1	2	1	3	2
Pv	2	2	5	7	1
Yp	7	9	1	11	6
Gels 10 / 10	2/3	3/5	2/3	3/5	¾
N	0.292	0.281	1.033	0.58	0.378
K	1.539	1.855	0.008	0.532	0.483
FL	NOT CONTROL	12 ML	14 ML	11 ML	NOT CONTROL

Conclusions

From the obtained experimental results we came to the following conclusions

- Mud yield is improving with different concentrations of KCL.
- Some of the mud properties such as gel strength and plastic viscosity are greatly affected by adding KCL at different concentrations.
- The tested viscosifier polymers have good rheological behavior stability at normal temperature.
- All polymers used have good thermal stability up to 250 F°, as the temperature increases the stability decreases.
- It is recommend using Bentonite to extend the polymers thermal stability at similar lab test analysis and even at drilling practices.

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