EFFECT OF MUD COMPOSITIONS ON THE RHEOLOGICAL BEHAVIOR

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ABSTRACT

The aim of this work is to study the effect of mud compositions on it's rheological behavior under high temperature conditions. Seventeen samples of five types of water base mud in which (fresh water bentonite mud. Lignosulphonate mud, gypsum mud, polymer mud, and salt saturated mud) were tested with different temperatures using the fann viscometer model 50-c. All the tested samples, except the fresh water bentonite mud, have the same trend of reduction in both plastic viscosity and yield point with increasing temperature. Six rheological models has been adapted: Bingham plastic, power law, modified power law, Casson, Robertson stiff and modified Robertson stiff. Both Robertson stiff and Casson model represent the laboratory data accurately.

INTRODUCTION

The composition of any drilling mud depends mainly on the requirement of the particular drilling operations. Economic, contamination, available make up water, pressure, temperature and any other factors are all significant in the choice of the drilling fluids [4, 5].

Water alone is sometimes an ideal drilling fluid and frequently used to drill areas where the trouble of low-pressure formation exists. When and where water is unable to perform the necessary functions of drilling fluid, it becomes necessary to add other ingredients to perform better or perhaps, even change the nature of fluid itself [1, 2, 3]. Water base mud, being the most widely used, had been evolved into many variation over the several years due to advancement in mud treating technology and improved additives for mud control. The main purpose of the experimental work that has been in this research is to study the effect of ingredients of water mud on it's rheological properties and thermal stability, Six rheological models have been adapted: Bingham plastic, power law, modified power law, Casson, Robertson stiff and modified Robertson stiff [6, 7, 8], various mathematical expression have been used to choose the correct model which fits the experimental data accurately.

EXPERIMENTAL

Seventeen samples of five types of water base mud were prepared with different concentrations of component to be tested with different temperatures using the fann viscometer model 50°C. The temperature which used in the tests were room temperature 100, 150, 200, 250,and 300°F.

The basic composition of the mud, which are considered the base, are given below:

1. For fresh water bentonite mud. The basic compositions which used are: 500 cc tab water + 30 ppb bentonite, weighted with barite to 8.72 ppg.
2. For lignosulphonate mud, the basic composition which used are: 500 cc tab water + 35 ppb bentonite + 2 ppb Qbroxine + 0.2 ppb NaoH + 2.1 ppb cmc, weighted with barite to 9.24 ppg.
3. For gypsum mud. the basic compositions which used are: 500 cc tab water + 35 ppb bentonite + 6 ppb Gypsum + 0.7 ppb NaOH + 3ppb Qbroxine +1ppb cmc, weighted with Barite to 9.55 ppg
4. For polymer mud, the basic compositions which used, are: 500 cc tab water +2 ppb xc + 4 ppb KCl +4 ppb Bentonite + 0.1 ppb KOH + 2 ppb cmc, weighted with Barite to 8.73 ppg.
5. For salt saturated mud, the basic compositions which used, are: 500 cc tab water + 8 ppb Bentonite + 120 ppb NaCl + 14 ppb zeogel + 2 ppbQbroxine to 9.82 ppg.

RESULTS AND DISCUSSION

Figs. (1) and (2) show the effect of 28ppb and 32ppb of bentonite on both the plastic viscosity and yield point of the fresh water bentonite mud. The results show that as the number of bentonite particles per unite volume of mud increases. The probability of two particles getting together increases. Thus, an increase in bentonite concentrations will increase the viscosity of the mud. The adverse effect is shown when decreasing the bentonite concentration to 28 ppb.

An interesting series of experiments are illustrated in Figs. (3) and (4). They shown that the additional of 1ppbQBroxine on the lignosulphonate mud would prevent flocculation of the clay particles by preventing them from coming enough to each other, thus prevent the Vander Waals attractive force to become acting, this leads to reduction in both plastic viscosity and yield point. Additional treatment with 3ppbQbroxine shows much lower values of viscosity until about 200 F° in which thermal flocculation process is occurred resulting an increase in both the plastic viscosity and yield point.

Figs. (5) and (6) are clear indication of the effect of 4 and 5ppbof Gypsum on the gypsum mud rheology. They shown that, as the concentration of Gypsum increases there is a slight increase in the rheological values. In fact there are two adverse effects in which the first is the base exchange of Na ions by the Ca ions, which result more liquid volume and lower viscosity, while the second effect is the soluble sodium sulphate which increases the number of particles and causes higher attractive and friction forces resulting higher viscosity. The result shown clearly that, the second effect is greater than the first. Thus, an increase in Gypsum content would increase the mud viscosity slightly.

The addition of 4ppb KCl increases the of the polymer mud [Figs. (7) and (8)], This is due to the cross liking process between the mono valent K^+ cation and OH portion of the hydroxyl which result more number of bonding chains, more attractive forces and increase in the rheological properties. Through the addition of 8ppb KCl, much lower values of viscosity is obtained, this is a attributed to the presence of K^+ cation that acts as an inhibitor because of it's small size and low hydra table energy K^+ cation can penetrate the clay lattice and become tightly fixed by attractive forces which result in bonding of the clay sheets together and reduction in the tendency of the clay to swell, thus reducing it's viscosity.

The effect of 5 and 10ppb of zeogel on the salt saturated mud rheology are shown in figs. (9) and (10). It shown that the reduction in the zeogel con concentration to 10ppb results clear decrease in both plastic viscosity and yield point values, this attributed to the looseness of the cross linking particles which lead to slight brush head structure and lower viscosity values. Also much lower value of viscosity is obtained when the zeogel concentration decreased to 5 ppb.

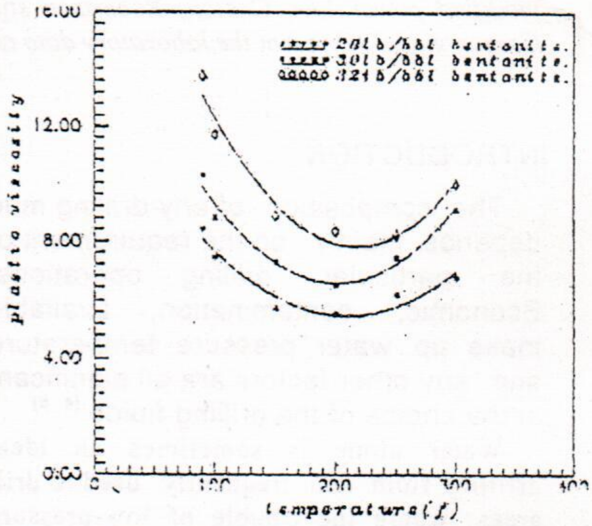

Fig. (1) Effect of Bentonite on spud mud rheology at different temperature

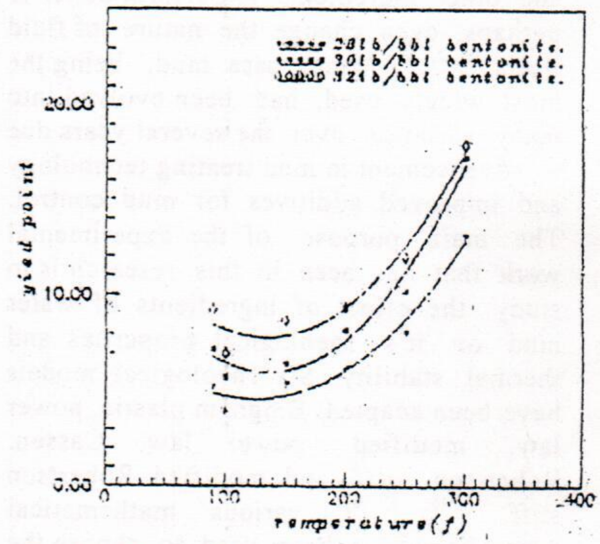

Fig. (2) Effect of Bentonite on spud mud rheology at different temperature

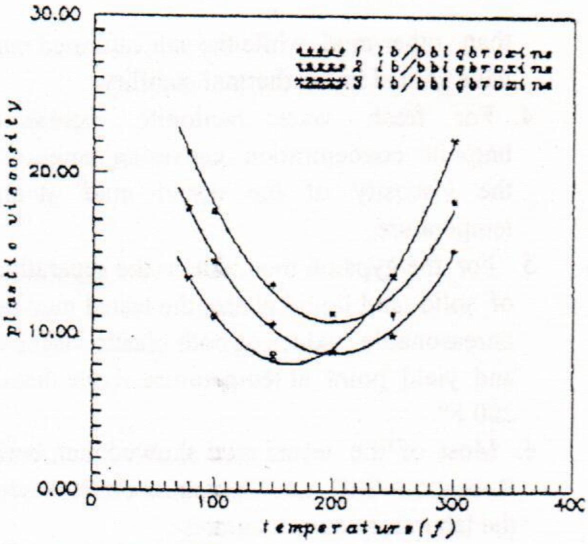

Fig. (3) Effect of QBroxine on lignosulphonate mud rheology at different temperature

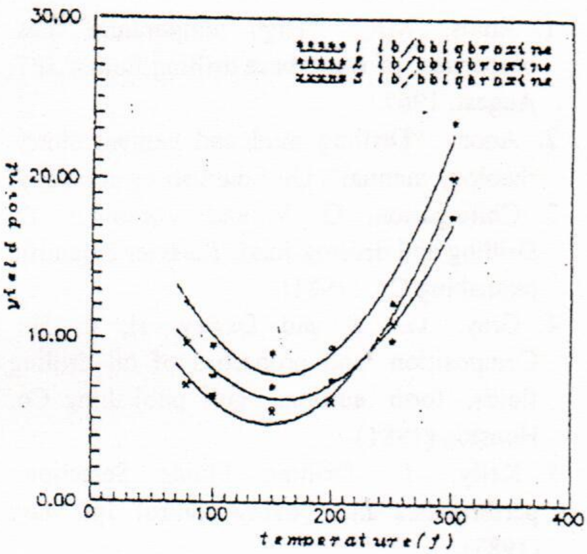

Fig. (4) Effect of QBroxine on lignosulphonate mud rheology at different temperature

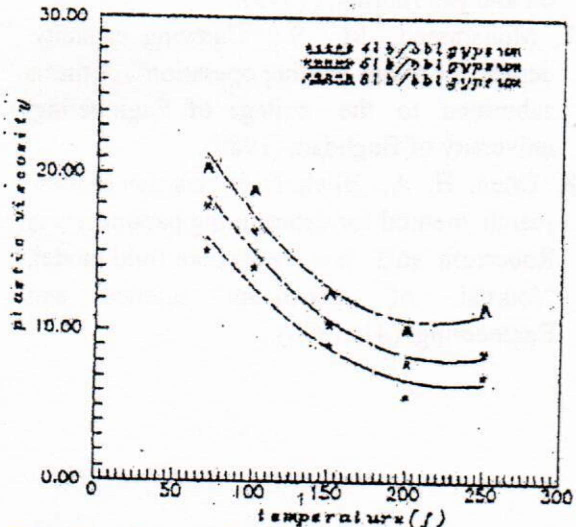

Fig. (5) Effect of Gypsom on gypson rheology at different temperature

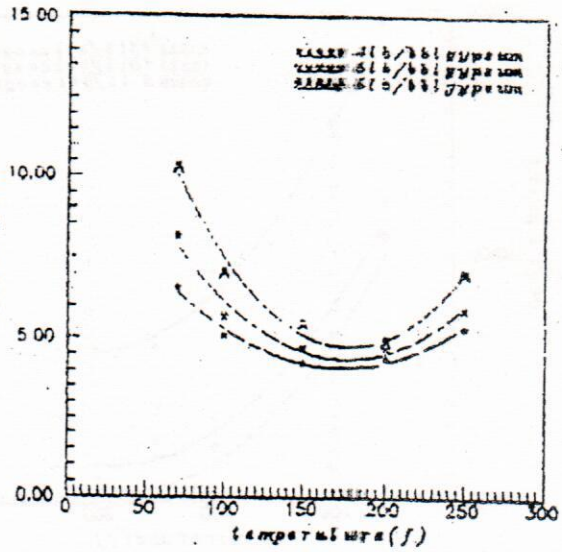

Fig. (6) Effect of Gypsum on gypsum mud rheology at different temperature

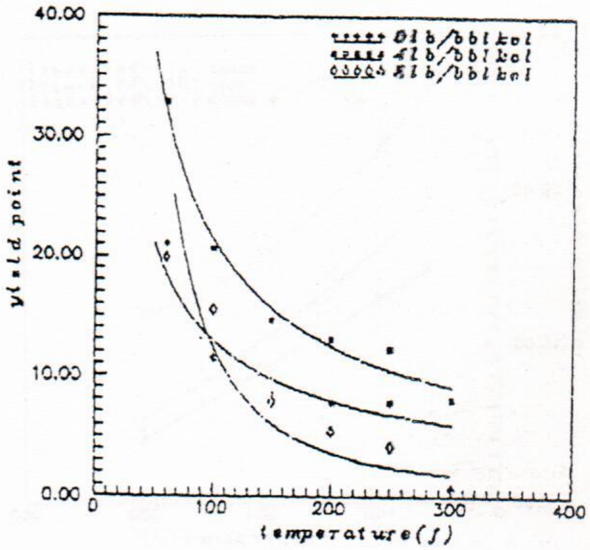

Fig. (7) Effect of KCl on polymer mud rheology at different temperature

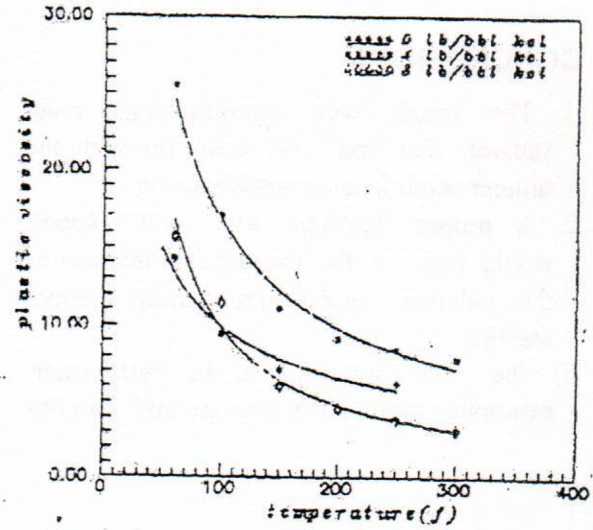

Fig. (8) Effect of KCl polymer mud rheology at different temperature

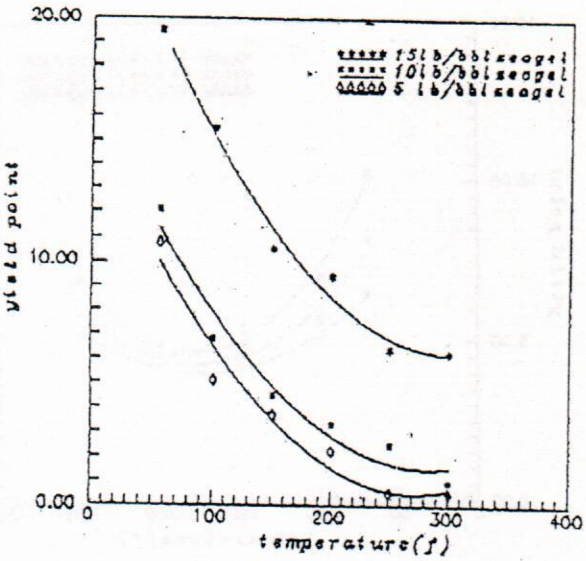

Fig. (9) Effect of Zeogel on salt saturation mud rheology at different temperature

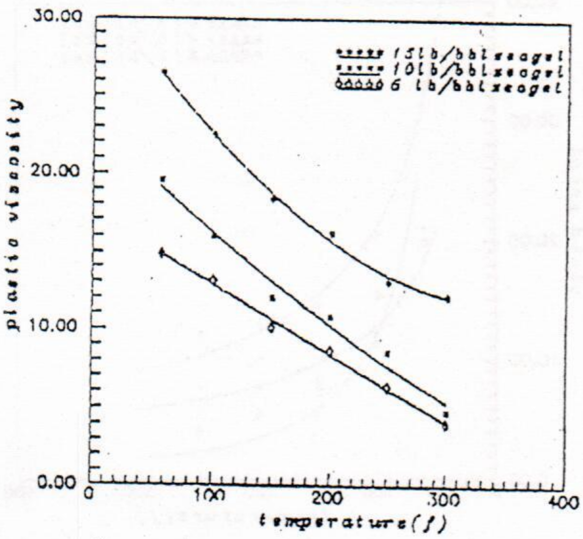

Fig. (10) Effect of Zeogel on salt saturated mud rheology at different temperature

CONCLUSIONS

1. The result with lignosulphonate mud showed that the over treatment with the thinner result in an reversible action.
2. A proper treatment with KCl (8ppb) would improve the rheological behavior of the polymer mud resulting much thermal stability.
3. The result showed that, the fresh water bentonite mud have less thermal stability than other mud, while the salt saturated mud have gained much thermal stability.
4. For fresh water bentonite, increasing bntonite concentration causes an increase in the viscosity of the tested mud at any temperature.
5. For the gypsum mud, due to the separation of solid and liquid phase, the tested mud get unreasonable values of both plastic viscosity and yield point at temperature above that of 200 F°.
6. Most of the tested mud showed that, both Robertson Stiff and Casson model represent the laboratory data accurately.

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