An improving Rheological Properties and Filter Loss of Water-Base Drilling Fluids Using Carboxymethyle Cellulose (CMC)

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Abstract

The aim of this study is to optimize the rheology and filter loss properties of Umm Ali clay to meet American Petroleum Institute (API) Specifications for drilling fluids.In This study, the effects of adding sodium carboxymethyle cellulose CMC to Umm Ali clay are shown in terms of filtration, plastic viscosity, viscometer dial reading600 rpm, gel strength, yield point, and shear rate and shear stress. A series of experimental tests carried out with different amount of CMC to determine the optimum value of CMC while monitoring filtration loss and rheological parameters.

KEYWORDS: Drilling, Sudan, Rheology, Filter loss, Water-base.

INTRODUCTION

Drilling fluids are most important components of the process of drilling wellsinto rotary drilling operations, depending on the properties enjoyed by the thing that makes it perform its mandated functions efficiently, such as cleaning the bottom hole of the well from the cutting, cooling and lubrication drilling bit, secure the hydrostatic pressure opposite to formation fluid pressure that keeps them in place, preventing the walls of the well from collapse and caving by creating a thin film from drilling fluids (mud cake).

An extensive classification of drilling fluids as pneumatic or liquid. The liquid drilling fluid types divided into two types that are: water based and oil based depending on continuous phase [1].

In drilling fluids engineering many types of polymers were used to improve drilling fluids properties and to avoid several compromised during drilling operations [2]. Sodium carboxymethyle cellulose CMC is type of polymer adsorbed in clay [3].

This study is focused on the optimization of Sudanese bentonite for drilling engineering applications in order to increase the national income by adding a natural resource and to decrease the cost and dependency on the import of bentonite from abroad.

MATERIALS AND METHODS

For this study purpose, four boreholes were drilled in different depths and coordinates. Samples were collected from the study area (Umm Ali site area) north of Khartoum, Capital of Sudan according to the standards procedures of sampling using auger drilling machine.

The samples were crushed and then prepared to suite drilling fluid tests purposes [2].Sodium carboxymethyl cellulose (CMC) was used to increase viscosity and to decrease filtration losses.

The filter loss measured using ZNS-4 Four –cups Mud Water Loss Instrument under pressure 0.69 Mpa, 30 minutes, filter loss area 45.6 and mud cup capacity 240 ml.To determine rheology of drilling fluids six speed rotational viscometer type (ZNN-D6). Depend on American Petroleum Institute (API) standardsall tests were carried out [4, 5, and 6]

EXPERIMENTAL RESULTS

Figures (1) to (12) show that the effect of adding sodium carboxymethyle cellulose CMC to Umm Ali bentonite.In figure (1) the filter loss decreases while the CMC concentration increasing. The reduction in water loss attributed to plating filming of clay particles by long-chain molecules, and wedging and plugging action of long-chain molecules [7].The Umm Ali bentonite reaches the API specification for filter loss at concentration of CMC equal 10% for all types.

As far as the effect on viscosity is concerned, figures (2) and (3) show that the increasing of CMC increases the viscometer dial reading at 600 r/min and plastic viscosity. This increase of viscosity in solution refers to adding polymer.

In addition, figure (2) shows that Umm Ali treated bentonite compared with other reaches API specification for viscometer dial reading at 600r/min at concentration of 10% CMC except for dark clay and grey clay at depth 3.0 m in borehole (1) and also for grey clay at depth 6.5 to 7.5 m in borehole (4) satisfy API specification for viscometer dial reading at 600r/min at concentration of 5% CMC.

As shown in figures (4) to (8) increasing of CMC concentration increases the Yield Point and Gel Strength and at low value of CMC concentration the local bentonite reaches API specification of YP/PV ratio.

Figures (9) to (12) show that the increase of CMC increases the shear stress. This increase of shear stress is attributed to the increase of drilling fluid viscosity.

Conclussions and Recommendations

The following conclusion could be drawn from the obtained results:

- The filter loss decreased with CMC increase.
- Viscometer dial reading 600rpm, plastic viscosity and yield point for water base drilling fluids prepared from Umm Ali treated bentonite increases with increase in CMCconcentration.
- Addition of 10% CMC concentration for the selected local bentonite, enhances rheological properties, filter loss and yield point as related to plastic viscosity ratio became within the range of API and OCMA specifications.

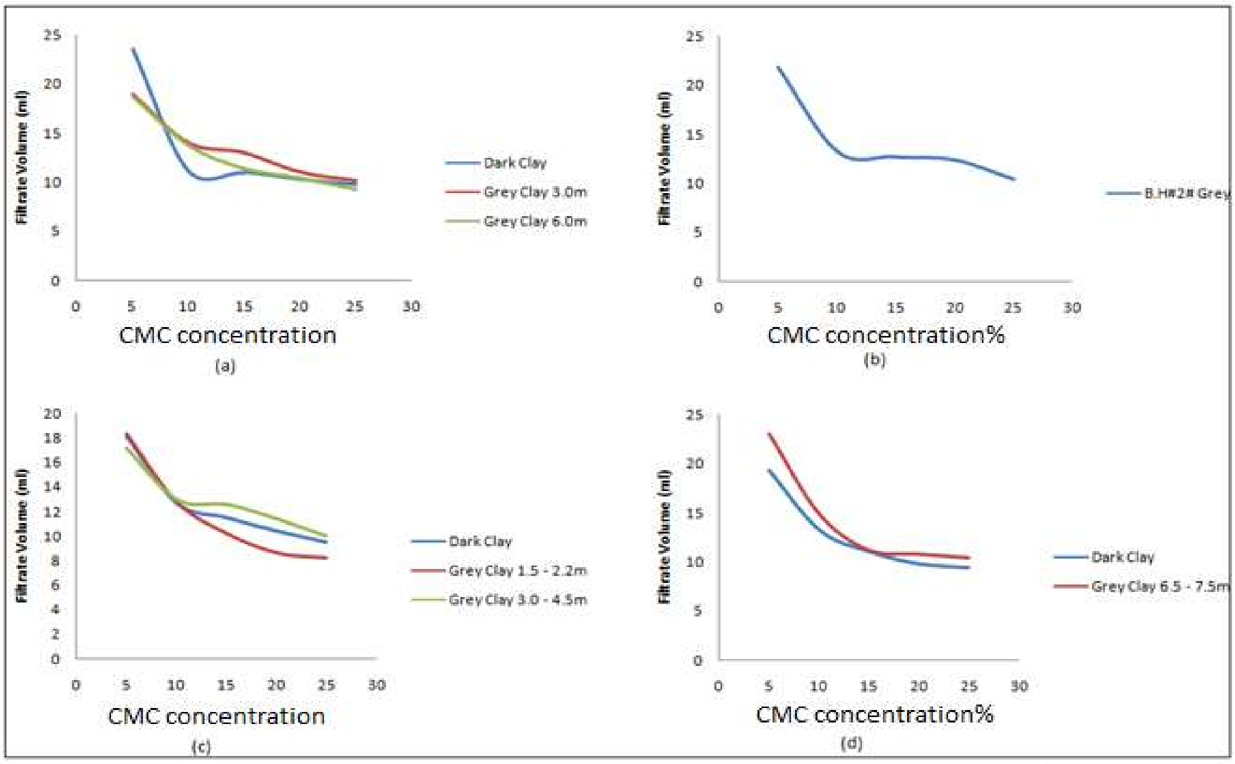

Figure (1) CMC Concentration vs Filtration Volume

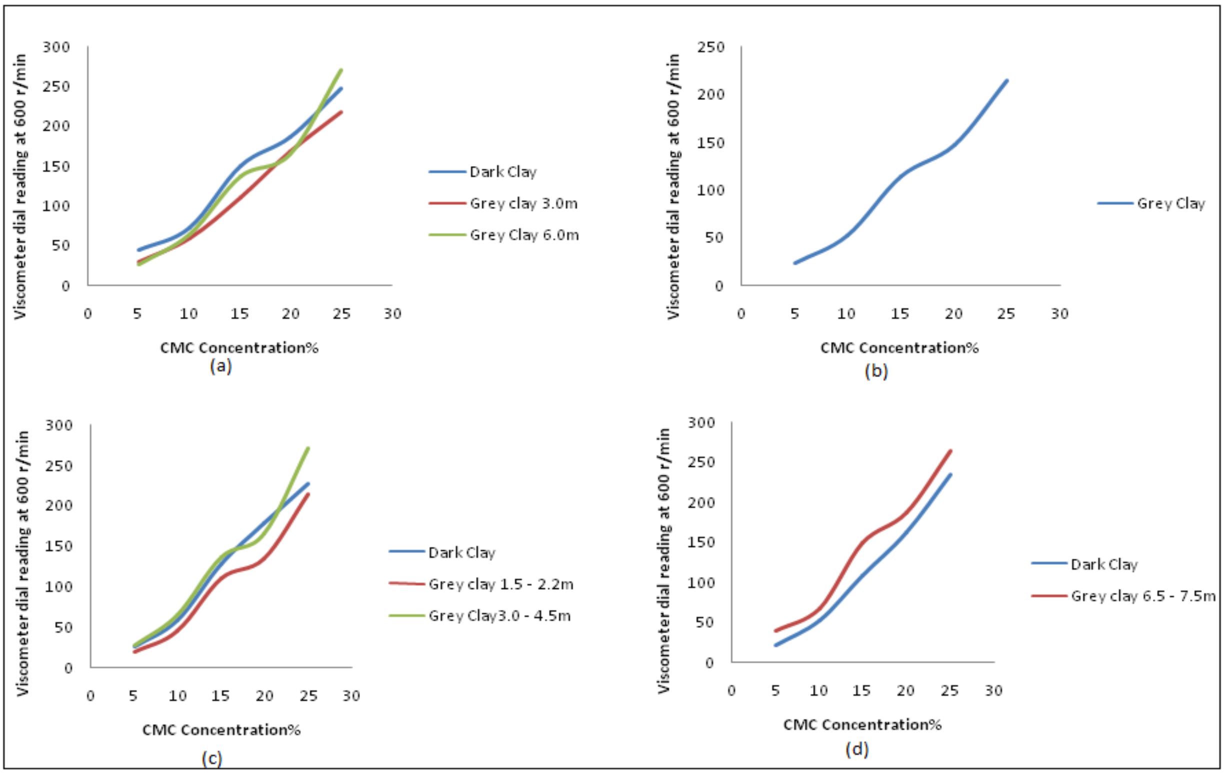

Figure (2) CMC Concentration vs viscometer dial reading at 600

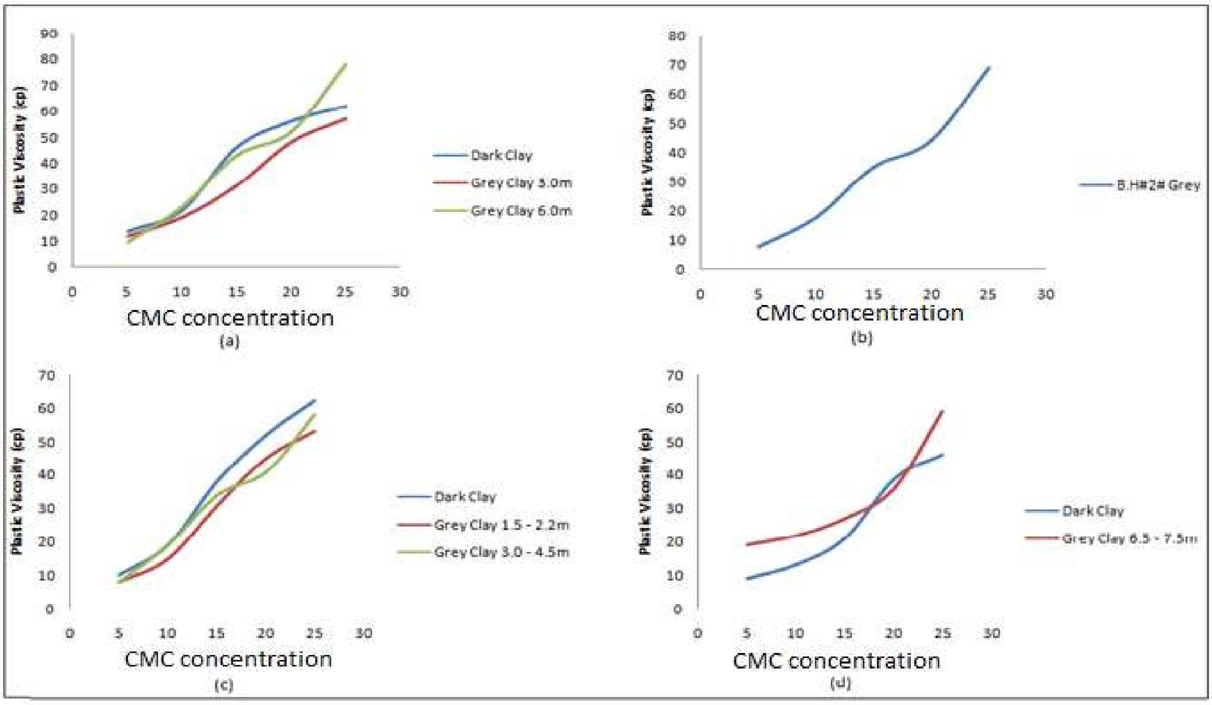

Figure (3) CMC Concentration vs plastic viscosity

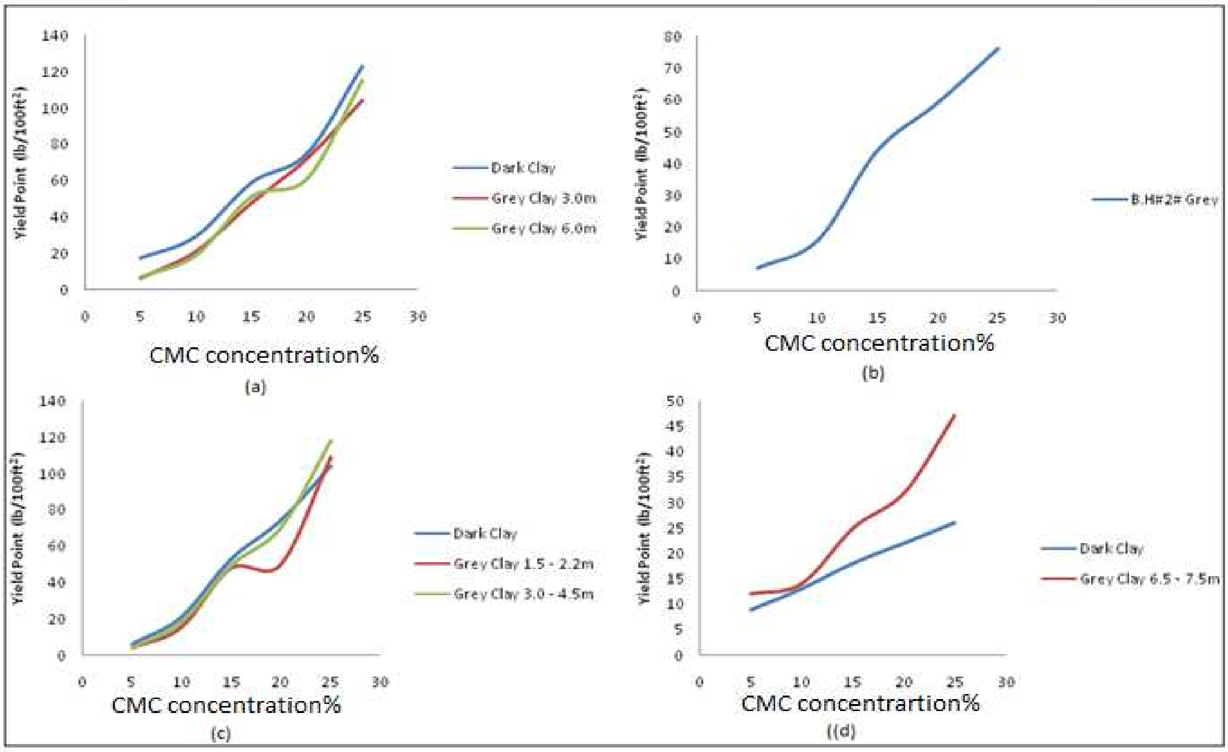

Figure (4) CMC Concentration vs yield point

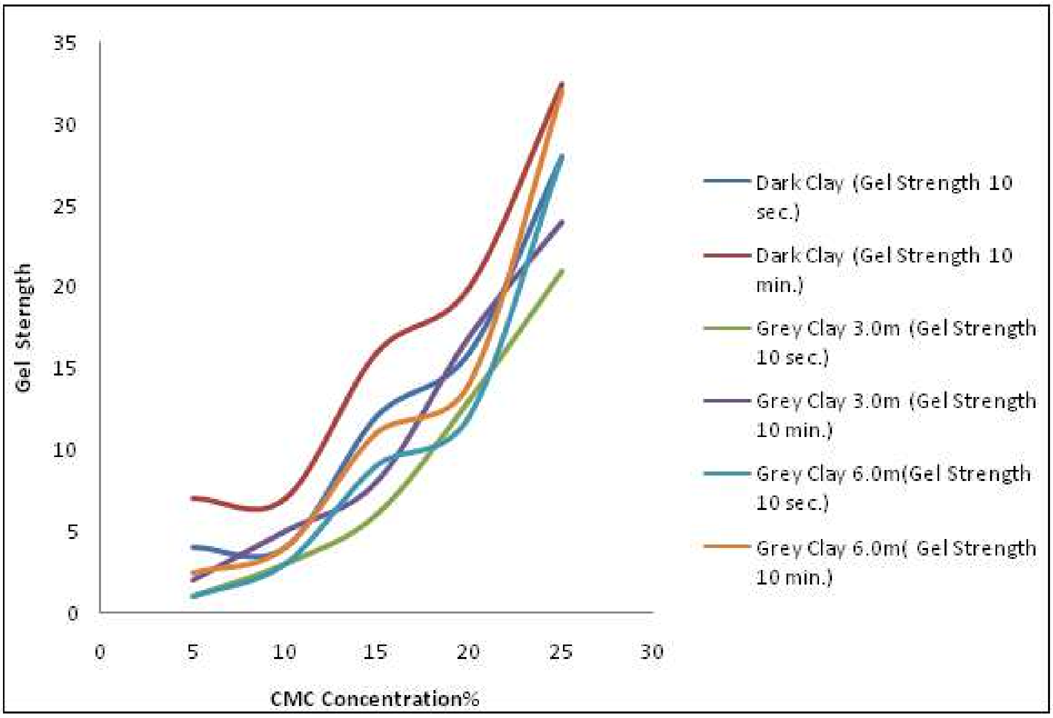

Figure (5) CMC Concentration vs Gel Strength B.H#1

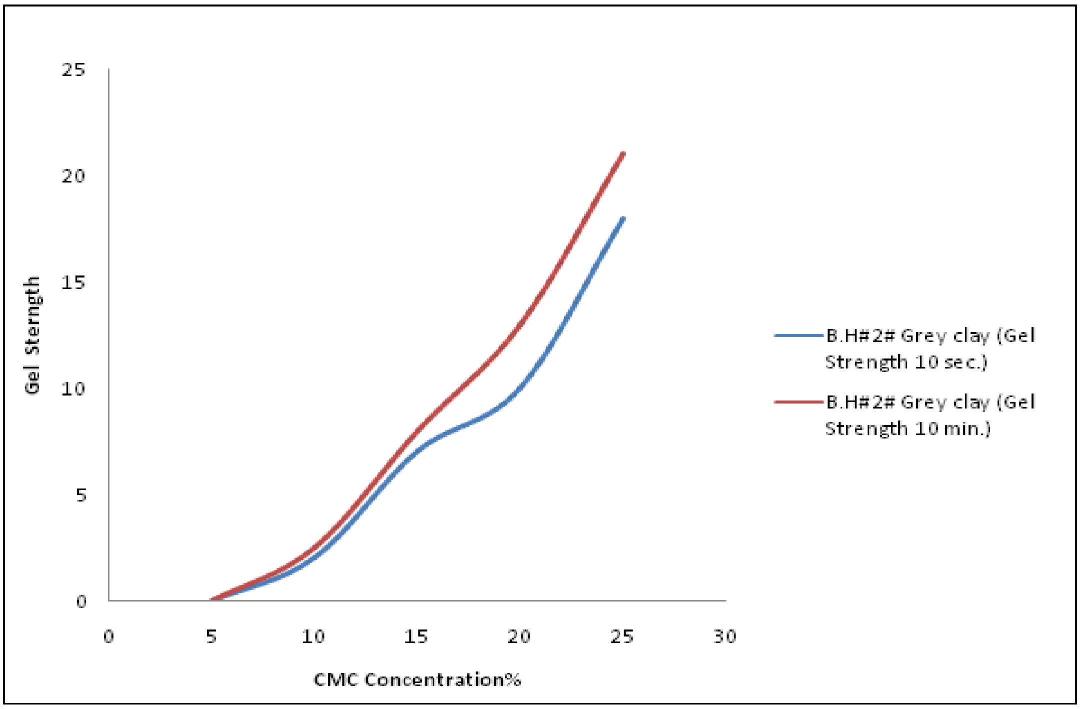

Figure (5) CMC Concentration vs Gel Strength B.H#2

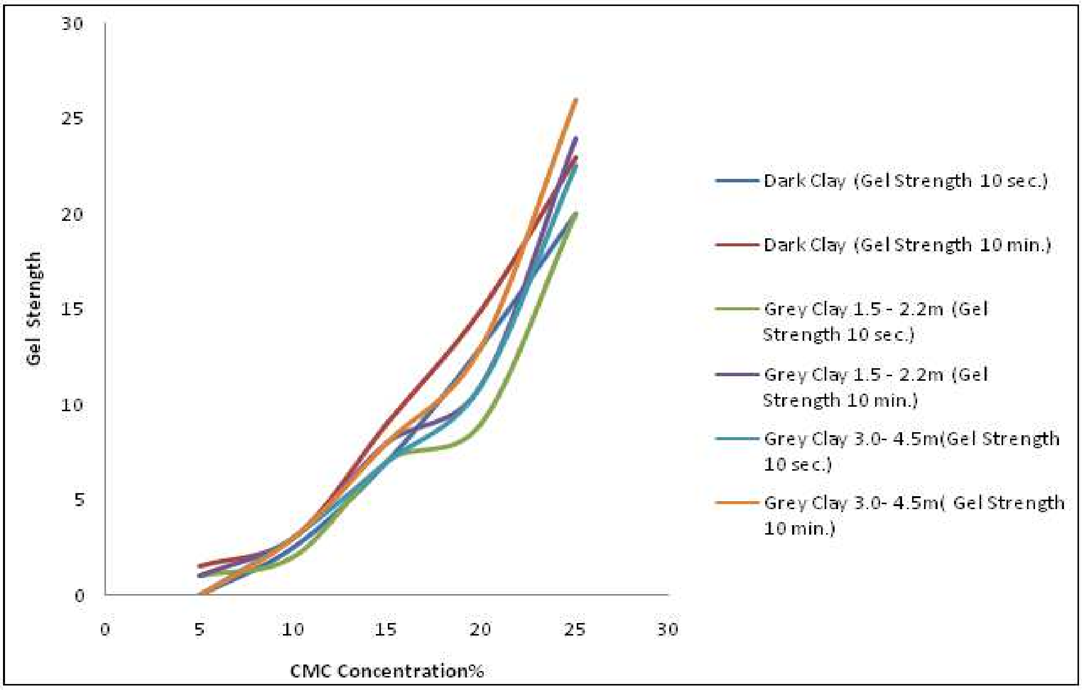

Figure (7) CMC Concentration vs Gel Strength B.H#3

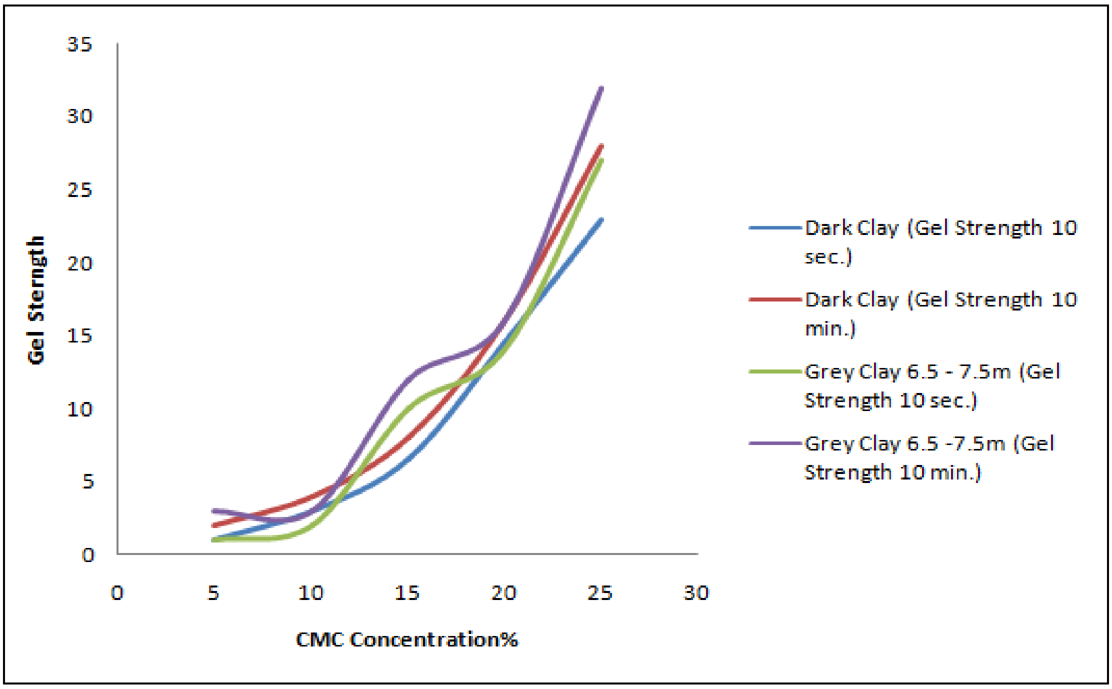

Figure (8) CMC Concentration vs Gel Strength B.H#4

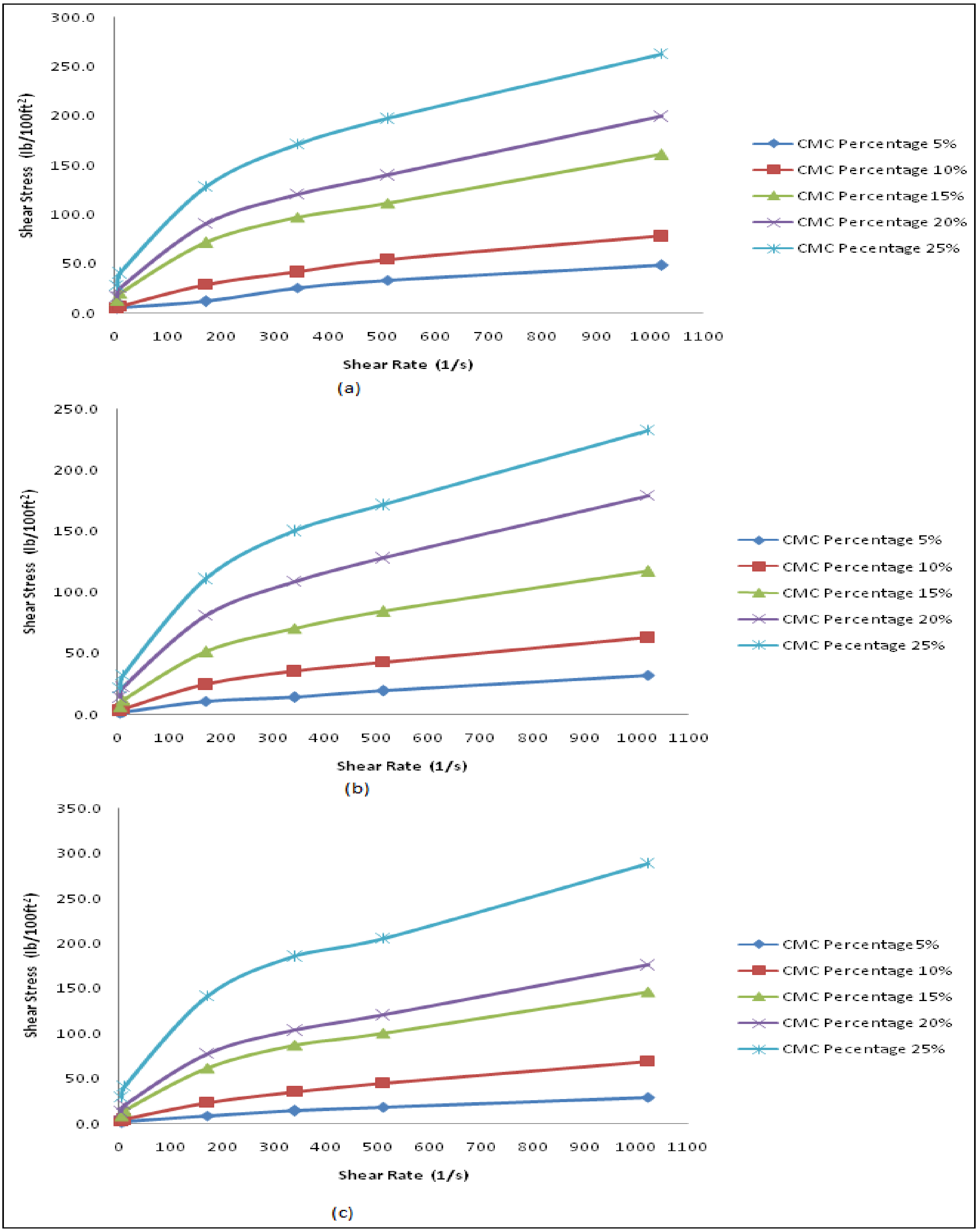

Figure (9) Shear rate vs Shear stress B.H#1

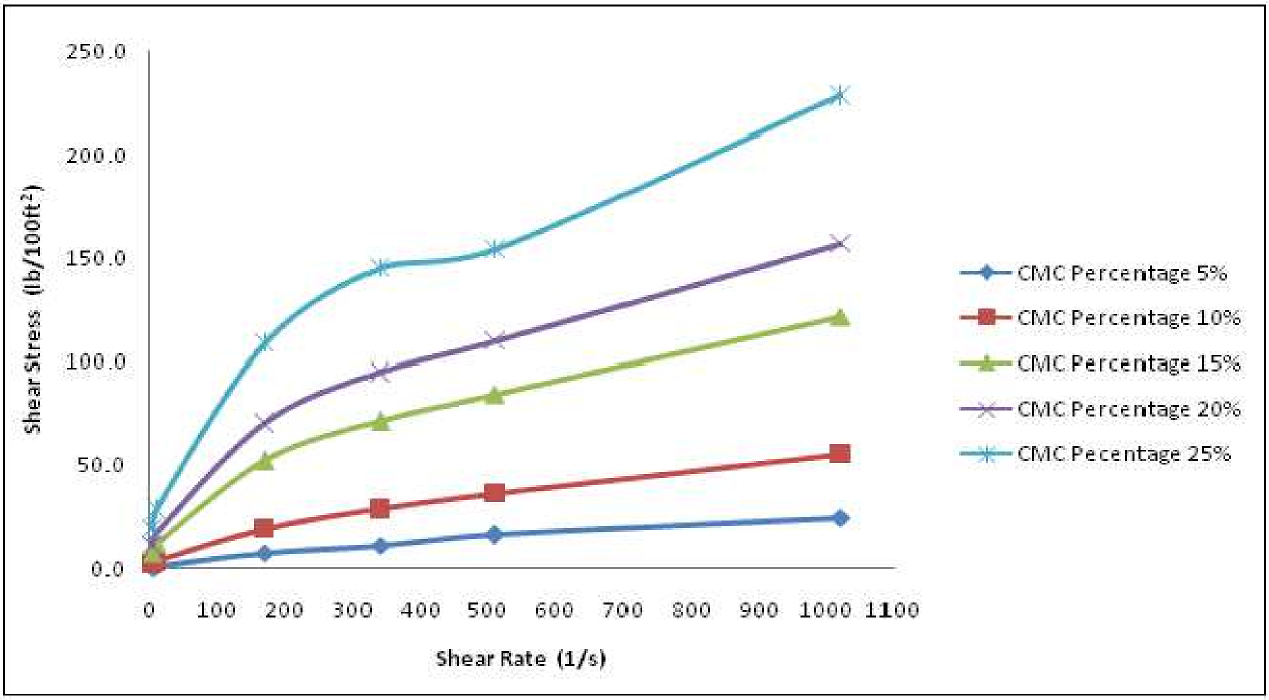

Figure (10) Shear rate vs Shear stress B.H#2

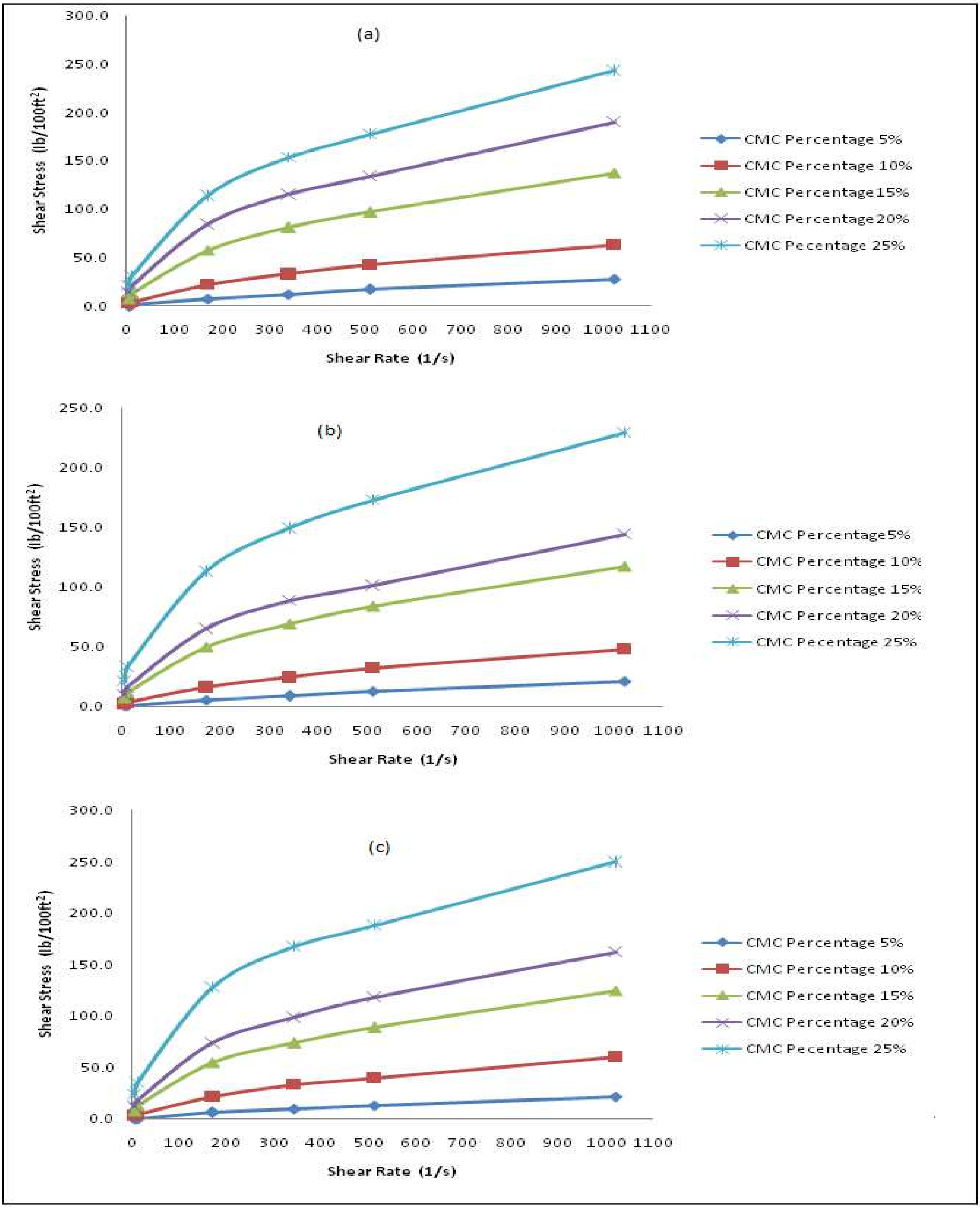

Figure (11) Shear rate vs Shear stress B.H#3

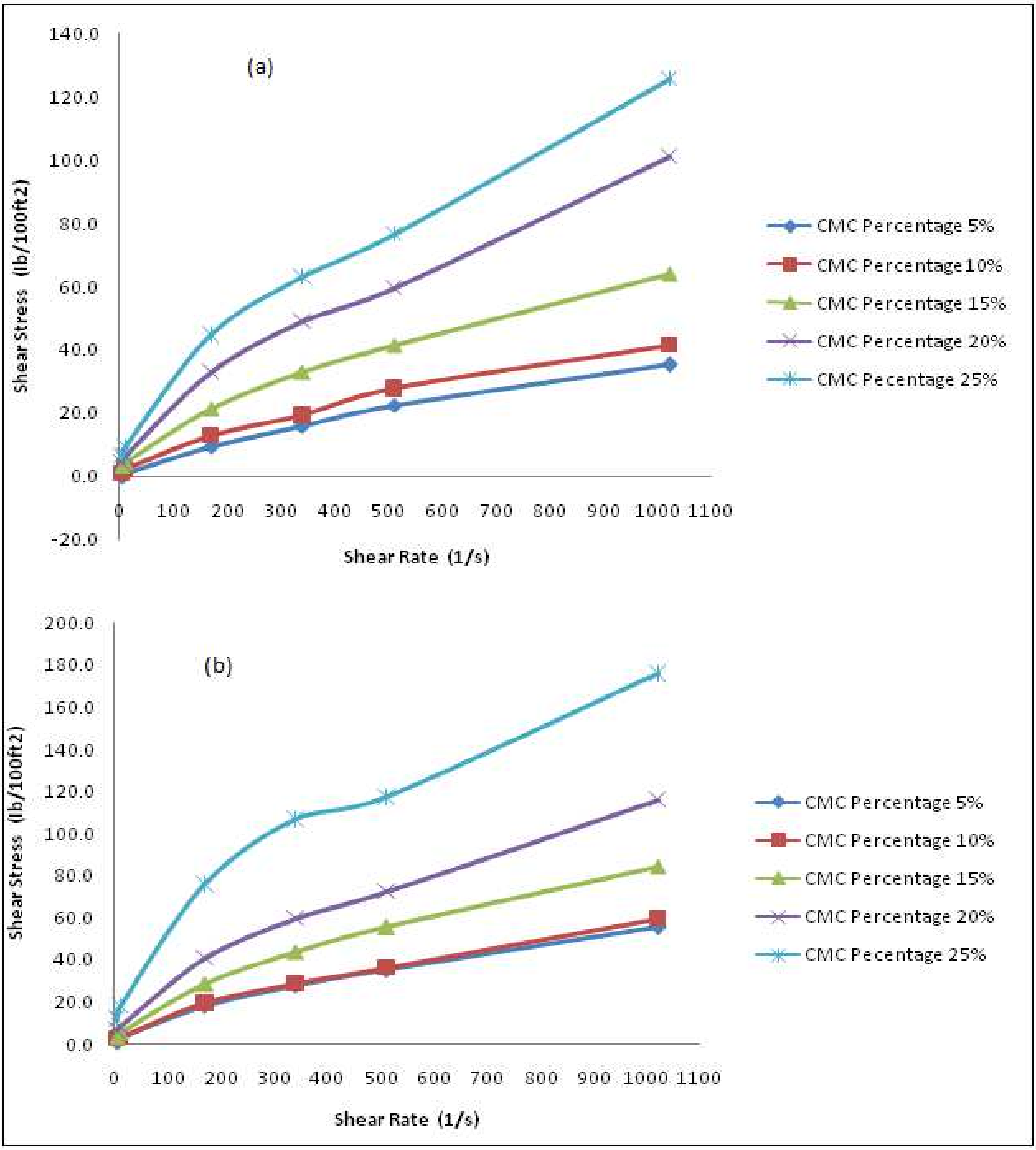

Figure (12) Shear rate vs Shear stress B.H#4

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