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Research Article

Empirical Evaluation of Major Items in the Treatment of Drilling Waste Water Fluid

Behnam Rahimi[1], Farshad Farahbod[2*]
[1]Department of Chemical Engineering, Sirjan Branch, Islamic Azad University, Sirjan, Iran
[2]Department of Chemical Engineering, Firoozabad Branch, Islamic Azad University, Firoozabad, Iran

***Corresponding author**
Farshad Farahbod
Email: mf_fche@yahoo.com

Abstract: Drilling fluid -mud - is usually composed by water, clay, weighing material and a few chemicals. The drilling fluids are applied extensively in the upstream oil and gas industry, and are critical to ensuring a safe and productive oil or gas well. During drilling process, a large volume of drilling fluid is circulated in an open or semi enclosed system, at elevated temperatures, with agitation, preparing an important potential for chemical exposure and subsequent health effects. The role of the mud engineer or more properly Drilling Fluids Engineer is very critical to the entire drilling operation because even small problems with mud can stop the whole operations on rig.
Keywords: Environmental pollution; Nano; Coagulation; Treatment.

INTRODUCTION

Sometimes oil may be applied instead of water, or oil added to the water to give the mud certain desirable physical properties [1-2]. Drilling fluid is used to increase the cuttings made by the bit and lift them to the surface for disposal [3]. But equally important, it addition, provides a means of keeping underground pressures in check. The heavier or denser the mud, is the more pressure it exerts. Therefore, weighing materials - barite - are mixed to the mud to make it exert as much pressure as required to contain formation pressures [4]. The equipment in the circulating system consists of a large number of parameters [5]. Drilling fluids are applied extensively in the upstream oil and gas industry, and are critical to ensuring a safe and productive oil or gas well. During drilling process, a large volume of drilling fluid is circulated in an open or semi enclosed system, at elevated temperatures, with agitation, preparing an important potential for chemical exposure and subsequent health effects. When deciding on the type of drilling fluid system to use, operator well planners require conducting comprehensive risk assessments of drilling fluid systems, considering health aspects in addition to environmental and safety aspects, and strike a suitable balance between their potentially conflicting requirements [6]. The results of these risk assessments require to be made available to all employers whose workers may become exposed to the drilling fluid system. Despite the excellent track record demonstrated by invert emulsion fluids, operators continue searching for a water-based system that will give comparable performance [13-15]. Increasing concern is placed on environmental impact of operations, making water-based alternatives more attractive [16, 17 and 18]. Baroid has engineered high-performance water-based fluids that emulate the performance of an invert emulsion fluid. Each fluid system is customized to address specific drilling challenges [19-21].

MATERIALS AND METHODS

Waste drilling fluid with watery base in volume of 3000 cc is used in the tests. At each run coagulation, flocculation and sedimentation steps is performed. Different dosages (20, 40, 60, 100, 150 and 200 ppm) of nano ferric oxide with average diameter of 50 nm is added in the first reactor. The main parameters are measured from the supernatant above the sediments in the second reactor**.** Two reactors with volume of 4000 cc which are made of poly vinyl chloride are joined in series through pipelines. The second tank is in lower level from the first tank and the outlet fluid flows to the second one thoroughly. There is one globe valve which connects the two tanks.

RESULTS AND DISCUSSION

The experiments are held to qualify the pretreatment performance of drilling fluid in the proposed pilot scale two series reactors. Since the drilling fluid is in water base so the coagulation mechanism is chosen in pretreatment unit. Coagulation is handled by addition of nano mineral oxides to waste drilling fluid. Coagulation performs chemically and physically to agglomerate the dispersed colloids in waste drilling water to form flocs and improve the sedimentation. Measured parameters include total suspended solids, total organic compound, and amount of oil, chemical oxygen demands, pH, heavy metals, turbidity, chromium and total petroleum hydrocarbon. Variations in amounts of coagulant concentration, waste water initial pH and fast mixing rates are investigated and the effect of these parameters on the other mentioned specifications are considered and reported in forms of graphs. Below plots show the trends of changes in parameters and some correlations are presented to obtain the relation between parameters. Also, the trend varies with the changes in the amounts of independent variables or not.

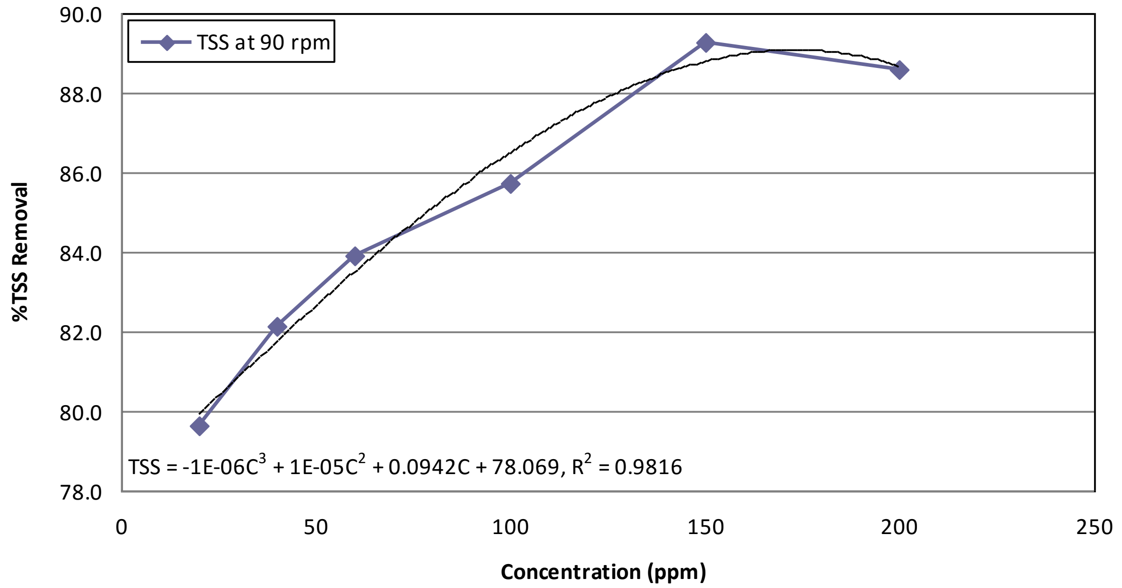

Fig-1: TSS versus concentration at 90 rpm of fast mixing rate

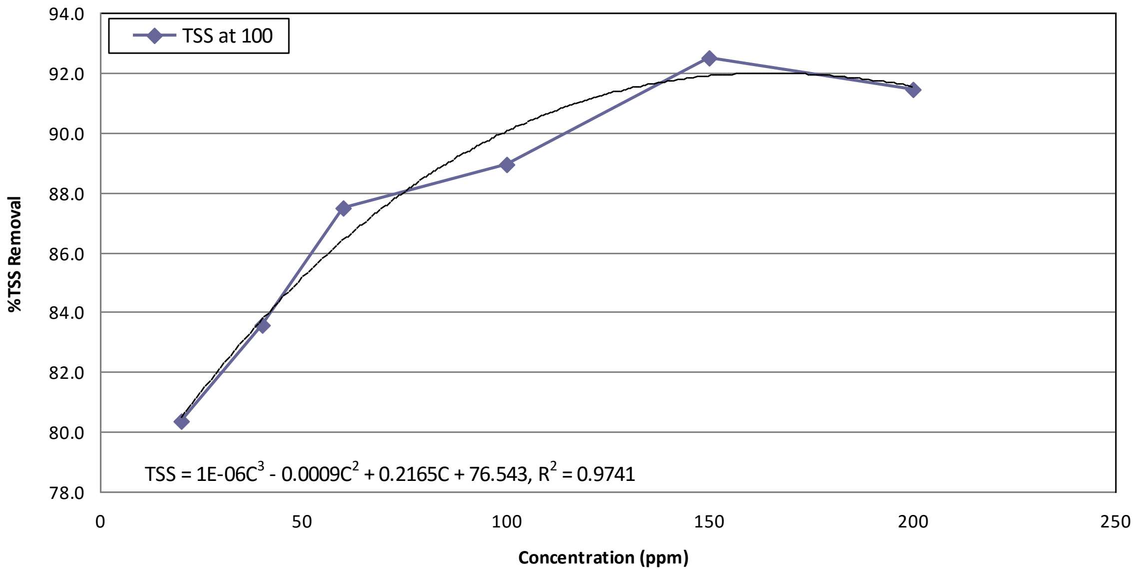

Fig-2: TSS versus concentration at 100 rpm of fast mixing rate

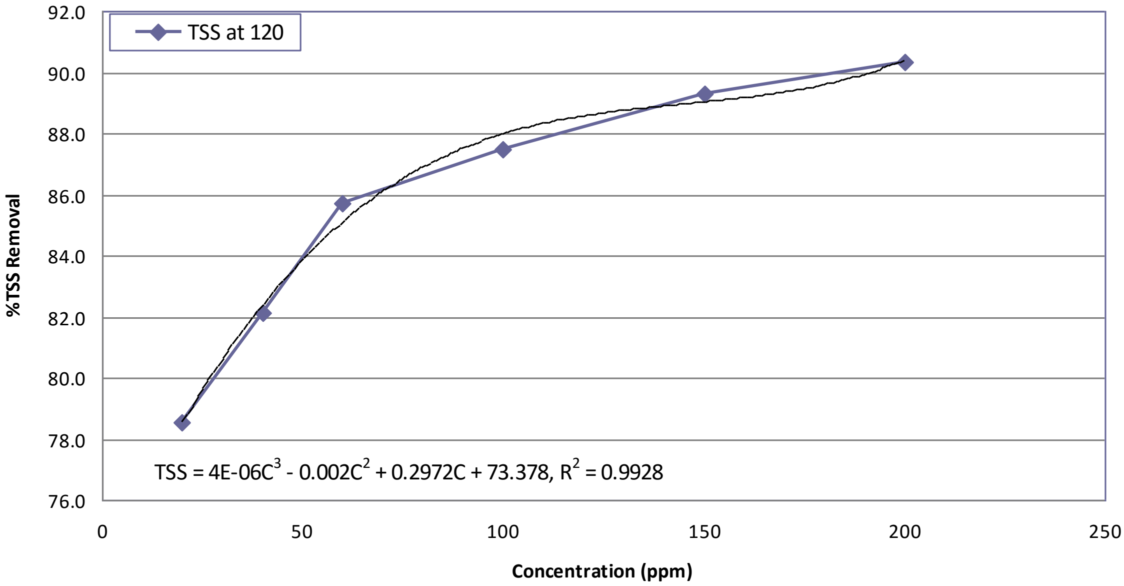

Fig-3: TSS versus concentration at 120 rpm of fast mixing rate

All values of TSS removal percentages are higher using fast mixing rate of 100 rpm than ones are obtained when using the other experimental values of fast mixing rates of 90, 120 and 140 rpm. Correlations are presented to predict the pretreatment performance for TSS removal in different values of fast mixing rates versus amount of concentartions. Three degree polynomial is examined for all values of fast mixing rate. This shows the proper enough validation with amount of mean least error of higher than 0.97. Related coefficients of the correlations are presented in Table 1.

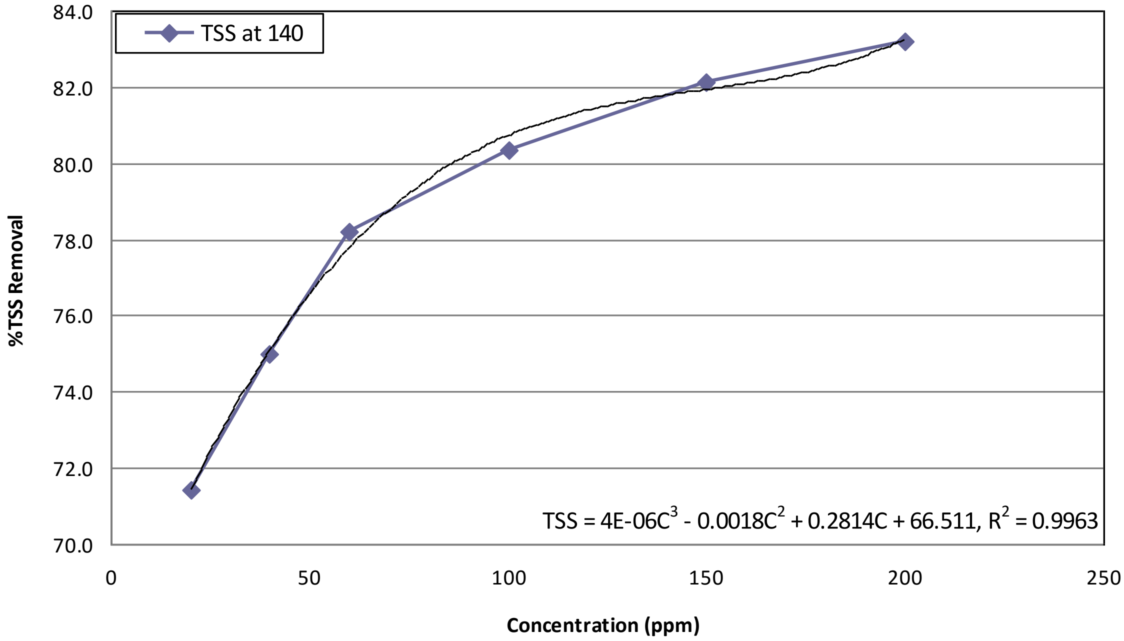

Fig-4: TSS versus concentration at 140 rpm of fast mixing rate

Figure 1, Figure 2, Figure 3 and Figure 4 shows the above mentioned trends in percentage removal of total suspended solids. The Table 1 shows the constansts of poly nomial correlations wiche are prdicted for total suspended solids removal. Theses correlation are 4^{th} order and are determined in the below chart.

Table 1: cefficients of obtained correlation for TSS removal% vs. concentration values.$y=ax^3+bx^2+cx+d$.

Fast mixing rate(rpm)	a	b	c	d	R^2
90	1E-06	1E-05	0.0942	78.069	0.9816
100	1E-06	0.0009	0.2165	76.543	0.9741
120	4E-06	0.002	0.2972	73.378	0.9928
140	4E-06	0.0018	0.2814	66.511	0.9963

CONCLUSION

Detailed investigation of experimental study about the usage of nano ferric oxide in pretreatment of waste drilling fluid is reported in this survey. Contaminant removal from waste drilling fluid by coagulation- flocculation- sedimentation mechanisms is considered here. The effect of coagulant concentration on total suspended solids is investigated. Some correlations are presented to predict the relation between the pretreatment condition and pretreatment results. The coefficients of the proposed correlations and amount of root mean square error are presented in some tables. Some principles in pretreatment process are illustrated in results as below; the concentration values of coagulant affects the performance of treatment. The increase in amount of ferric oxide from 20 to 150 ppm may increase the neutralization of the colloids and makes more sedimentation or may be extra than that is required for coagulation. Coagulation mechanism depends on physical trapped contaminants in flocs and also on chemical bonds between contaminant and coagulant.

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