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Applied Investigation of Metal Nano Agent in Purification of Industrial Wastewater Stream

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Abstract

The drilling fluid is used in the upstream industries. Drilling fluid has basic roles in the heat transfer and transfer of cutting to the earth surface. The water based drilling fluid has minimum effect on the ecosystem shocks. The cutting of water based drilling fluid drained in the open and closed lagoons. This discharge can threat the sea and dry ecosystem. The treatment of cuttings of water based drilling fluid is studied in this paper. Tin oxide and Titanium oxide are used as nano coagulant in this research. The experiments were conducted to measure the important parameters in quality of treatment by addition of four different amounts of nano two metal oxides 1, 1.5, 2 and 2.5 gr. Experimental results show, the power of coagulant in elimination of component which makes turbidity. In addition, the increase from 1 gr to 2.5 gr of coagulant decreases this fraction from 0.19 to 0.14.

Keywords

Pre-treatment Reactor, Sea Ecosystem, Softening Process, Water Base Cutting Treatment, Nano Coagulants

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1. Introduction

The drilling fluid belongs to the slurry design, to ensure the best quality of cementing especially at high temperature environment such a HPDFS Silica Fume (SF) use as a cement slurry additive to reduce the density of cement [1]. SF increase slurry performance and control hydrostatic pressure during drilling cementing. This mixture used as primary source for a hydraulic seal in the well bore as secondary application is used for remedial operations including depleted zone closing, splits and leaks repair [2]. The function of SF is allows a well to reach full production potential besides producing a blocking effect in the oil well [3]. It is also responsible to prevent gas migration and highly effective for proper placement and decrease permeability for better control of weak zones [4]. Compressive strength of concrete containing SF is proved higher strength; as increase the concentration of silica fume it improves stress resistance in the early development and reduces the free water [5]. The mixing of silica fume into cement several optimum conditions are noticed [6]: A. It is nature to consume more water to prove as s function of extender and substitute for lightweight cements [7]. B. High water adsorption to increased pozzolanic reactivity promotes enhanced compressive strengths. C. The purity and solubility of the material makes it suitable for combating strength retrogression in cements at temperatures above 230°F (110°C). In addition, the thermo electric and also, the rheological properties of drilling fluid play important role to determine the workability of slurry, fineness [8]. The mixing process is very important parameters for thermal and rheological behaviour of drilling slurry, the criteria of designing slurry depends on formulation, thermal conductivity, density, plastic viscosity, shears tress, yield point and gel strength for enhance durability and toughness

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for drilling slurry grout is used for sealing geothermal wells for is olatezones drilling fluid operation [9]. The electrical and rheological behaviours of drilling slurry are important for the drilling process; it will be optimum to predict correctly about slurry placement [10]. Drilling slurry is concentrated suspensions of small and heavy particles so thermal and rheological measurements are suffering to the disruption of drilling operation [11]. The thermo electrical properties and the rheology of Oil Well drilling fluid (OWDF) should be considered when it applied on the originally and primarily casing drilling. Therefore, fundamental knowledge of OWDF slurry rheology is necessary to evaluate the ability to mix and pump grout, remove mud and slurry placement optimization and to predict the effect of temperature on the slurry pit [12]. Incomplete mud removal can result in poor drilling fluid bonding, zone communication and ineffective stimulation treatment. A rheology is study related to the flow of fluids and deformation of solids under stress and strain. In shear flows, fictitious parallel layers of liquid past each other in response to a shear stress to produce a velocity gradient, in term of shear rate, which is equivalent to the rate of increase of shear strain [13]. The property of drilling slurry is complex which has the appearance and interactions between the additives [14]. The chemical composition of drilling fluid, particle distribution, test in g methods, size shape, W/DF ratio, mixing time and temperature [15]. The drilling slurry is viscous plastic materials that exhibit yield stress and tension below the yield stress ultimately slurry behaves as a rigid and solid [16]. The Bingham plastic and power-law model is widely used to describe the rheological properties of drilling slurry measurements. Researchers that can be determined the properties of drilling fluid flow i.e., plastic is cosity, yield point, friction characteristics and gel strength [17]. The concentration and form of so lid particles has a significant impact on the thermo electrical rheological properties of the OWDF slurry to yield stress and plastic viscosity of drilling paste usually increase as the cement becomes finer and increases the stability of slurry. Equivalent Circulating Density (ECD) is important factor to understand the flow behaviour, flow rate, annular velocity and differential pressure; for that purpose number of computer simulation software is available to predict the ECD. The displacement efficiency is achieving the maximum mud displacement. A standoff value of the percentage of casing centralization in the wellbore, job operation time for proper thickening and Reynolds numbers base on laboratory methods is measuring rheological properties to understand flow behaviours. These parameters will be evaluating the drilling fluid pump-ability and drilling paste grout with strength correspond to behind the casing to increase efficiency and displacement. High flow rate may cause fracture the formation there should be investigated the current effective equivalent cement density [18].

Maximum drilling fluid or colloids or emulsions as a non-Newtonian liquids in plastic or behave in such circumstances is that the gel analysis function of the intermolecular forces. The initial 10-sec and 10-min gel strength measurements gelation indications of the gel that will occur after the flow is stopped and the drilling fluid remain static. When circulating drilling mud and fluids during cementing operations abnormal results in bottom hole, which may cause challenge to the integrity and safety. Oil well drilling paste compositions are typically used for sealing subterranean zone at High Temperature and High Pressure (HTHP) such as the annular space in oil well between the surrounding formation and casing [19]. The slurry blend consists of cement class G with additives and water. The productivity of an oil well is significantly affected by the quality of drilling pasting between the well casing and the surrounding strata [17 and 19]. The drilling slurry flow ability and stability are major requirements for successful oil well cementing, because the drilling paste is the most active component of the slurry and usually has the greatest unit cost. Its selection and proper use are important in obtaining an effective, for long term integrity of the well [18 and 19]. Portland pastes can be used for cementing around the casing of oil and gas wells having deeper depth wells usually require special oil well drilling pastes [15 and 17]. There are currently eight classes of API Portland drilling pastes designated A through H that are arranged according to the depths to which they are placed at pressure and temperature to which they are exposed [16, 17 and 19]. In oil well drilling industry class G and H type well drilling pastes are well known for deep wells; because in addition other than calcium sulphate and water both shall be inter-ground or blended to the clinker during manufacturing of this oil well paste. Therefore with addition of ample quantity of additives such as retarders and dispersants can change their setting time to the cover wide range of well depths, pressure and temperature [11, 14 and 16].

In this study, the silica fume used as extender, as it is function to reducing slurry density also light slurry is used to control hydrostatic pressure during cementing operation. This slurry has greater strength to use in weak and unconsolidated formation.

2. Materials and Methods

2.1. Materials

Experiments are managed for the water based cutting which exits from well column. In softening process Sodium Carbonate and Sodium Hydroxide must be added to the water base cutting. The previous researches in this field are focused on finding the optimum ratio of Sodium Carbonate to coagulant and also Sodium Hydroxide to coagulant and these ratios are used in this work too. These proper values are 3 and 4, respectively.

Table 1. Specifications of concentrated brine wastewater.

Composition	Unit	Brine outlet line
Total hardness	ppm as $CaCO_3$	40839.1
Specific Gravity at 15 c		1.21
pH		8.6
Viscosity (Kinematic)	mm^2/s	0.85
Total Dissolved Solids	g/l	89.9

2.2. Experimental Apparatus

Experiments are held in two pre-treatment reactors. The capacity of each reactor is 8 litres and each of them equipped by a mixer. The speed of the mixers can be changed by a "control box".

2.3. Method

The purpose of this study is finding the best type of nano coagulant which results in the higher efficiency in the softening process. A sample of 3 liters of water base cutting is fed to the first pre-treatment reactor; the proper amounts of Sodium Carbonate and Sodium Hydroxide, and also one type of nano coagulant are added to the first pre-treatment reactor in each run..

3. Results and Discussion

Important parameters in pre-treatment of water base cutting to drain into the environment are investigated in this experimental work. So, different ranges of both nano tin and titanium oxide are used to find the proper operation conditions in pre-treatment of wastewater.

3.1. The Effect of Tin Oxide on BOD

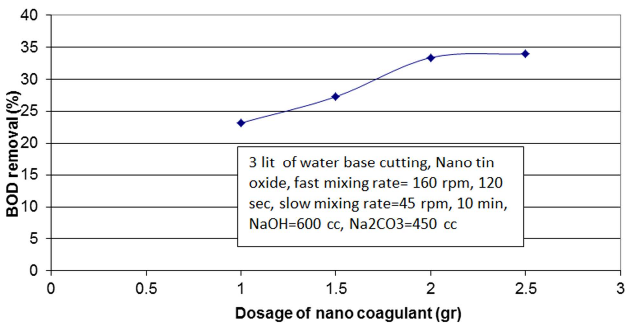

Figure 1. The effect of amount of nano tin oxide on BOD removal.

The amount of microorganisms in the water base cutting usually is determined by biological oxygen demands in the wastewater. The increase in the amount of nano tin oxide increases the amount of biological oxygen demands. Nano Tin oxide alters from 1 gr to 2.5 gr in the coagulation process. The removal percentage increases from 23% to 34%. The results of usage of nano coagulant show the positive relation in BOD removal. This may relate to the increase in the number of trapped microorganisms in the flocs. It seems that amount of 2 gr has the ultimate effect on BOD removal. The BOD removal percentage in 2.5 is approximately equal to that is obtained at value of 2. The Figure 1 shows this relation.

3.2. The Effect of Tin Oxide on COD

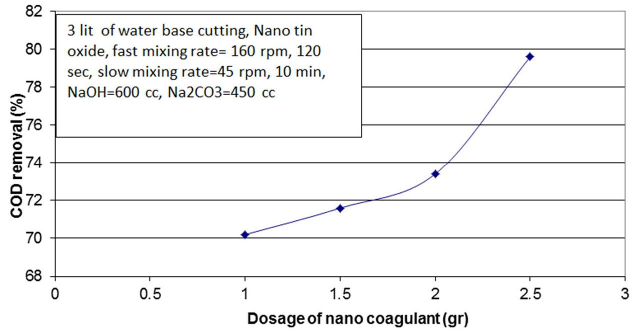

Figure 2. The effect of amount of nano tin oxide on COD removal.

The Figure 2 shows the relation between nano coagulant dosage and chemical oxygen demand. The usage of nano tin oxide in the values of 1 gr to 2.5 gr on the amount of chemical oxygen demands is shown in Figure 3. The increase in the amount of nano tin oxide increases the amount of COD removal percentage in the wastewater. This shows the positive effect of nano tin oxide as coagulant which leads to the removal percentage from 70% to 79%. The amount of chemical component trapped in the flocs and also bonded with flocs increases with the amount of coagulant. However this increase is not so significant.

3.3. The Effect of Tin Oxide on Color

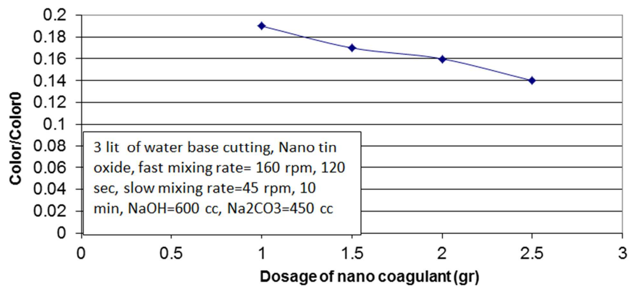

Figure 3. The effect of amount of nano tin oxide on value of color/color0.

Figure 3 shows the effect of usage of nano tin oxide on the fraction of color/color0. This is one factor to show the quality of clearance of wastewater. The increase in the coagulant dosage decreases this value. This shows the power of coagulant in elimination of component which makes turbidity. The increase from 1 gr to 2.5 gr of coagulant decreases this fraction from 0.19 to 0.14.

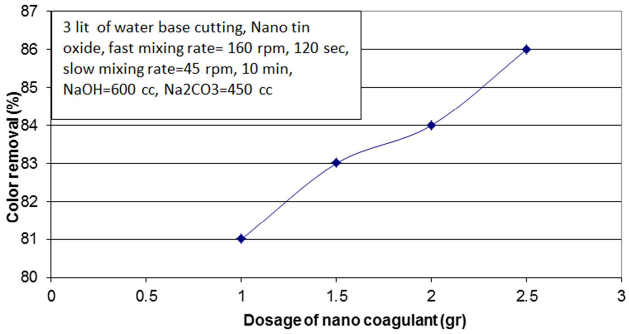

Figure 4. The effect of nano coagulant tin oxide on color removal percentage.

The increase in the amount of nano tin oxide increases the amount of color removal percentage. The Figure 4 shows this effect and indicates on the results in the previous experiments. The color removal percentage decreases from 81% to 86%. This depends on the amounts of all factors of turbidity. These factors are examined in the following results.

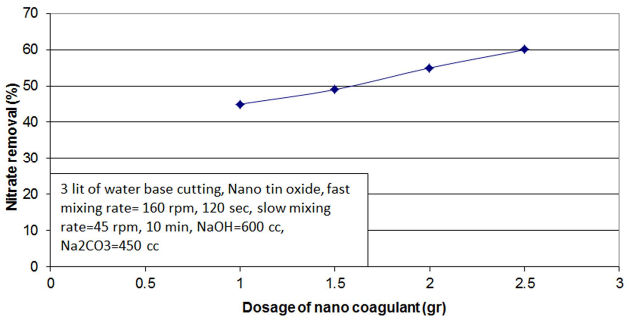

Figure 5. The effect of nano coagulant tin oxide on nitrate removal percentage.

The amount of nano coagulant changes from 1 gr to 2.5 gr and the effect of nano tin oxide augmentation on the removal percentage of nitrate. The nitrate removal percentage increases from 45% to 60%. The nitrate compounds can bond with coagulant or trapped in the flocs. The Figure 5 shows values of nitrate removal in different nano coagulant amounts.

4. Conclusion

The performance of two nano coagulant in pre-treatment of water base cutting is presented in this experimental work. The results of usage of nano coagulant show the positive relation in BOD removal. Also, the increase in the amount of nano tin oxide increases the amount of COD removal percentage in the wastewater. This subject shows the positive effect of nano tin oxide as coagulant which leads to the removal percentage from 70% to 79%. This topic also shows the power of coagulant in elimination of component which makes turbidity. In addition, the increase from 1 gr to 2.5 gr of coagulant decreases this fraction from 0.19 to 0.14.

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