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Documenting water (fluid) from dewatering process as the most strategic product in drilling operations in order to make fluid and improve its rheological properties in line with environmental standards for reuse of wastewater

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ABSTRACT

Drilling operations, like any other industrial activity, at the end of the operation employed dumps waste, wastewater to the environment, and if there is no planning for treatment and their elimination, in long-term this can have adverse effects on the environment. Assessment and recognition of the effects of drilling fluids is an acceptable and logical method for making a suggestion to reduce the probable injuries and damages resulting from the disposal and the drilling to the environment. In addition, one of the most important factors in reducing the negative environmental effects of waste is correct management. So that sometimes the cost required for the removal of pollution or controlling emissions of waste significantly decreases with proper and innovative management, and all the waste caused by the washing of the reservoir, well reservoirs, adjacent area of pumps and equipment related to wells enter water run-off and after entering into the storage basin, the solid settles there and its liquid phase enters dewatering to do operations and water treatment units. Moreover, at a later stage to decide whether dewatering water is appropriate for dilution or making clay or not, depends on the results of rheological water mixture and drilling fluid (1). If the desired mixture had appropriate rheological properties after treatment, dewatering water can be used. (According to the environmental standards of water reuse and wastewater returned in accordance with the agenda of the Technical Office of the Executive Vice President of Strategic Planning and Monitoring, suitable Dewatering Water is the one that does not make rheological change properties more than 50% in the of the fluid). In this study, a number of drilling machines will be used in defined projects to the amount of waste in order to make use of the standards and to improve the rheological properties of the fluid examine (Islamic Republic of Iran Iran's vice president of strategic planning and monitoring, the Office of Strategic Technical Assistance Administration, 2010).

Keywords: *Dewatering, loss, rheological properties, fluid, waste*

Introduction

In various stages of drilling oil and gas wells, there are different designs according to the requirements of operations for the manufacture of drilling fluid, where basically using brine water-based mud, oil mud with special chemical additives are the agenda. In a general look, the main sources of pollution in the drilling operation mainly consists of residual drilling fluid circulating inside the wells, dug wells drilled by circulating mud mixed with drilling fluid (MI/SWACO,1998). And the fluid used for the separation in various operations and other types of waste fluids such as water used for washing equipment and oil rig, all of which are major environmental pollutants. The main material in drilling oil and gas wells is drilling mud (drilling fluid) that due to two types of formation, water-based mud and oil- based muds are used (Mousavi,2011). On average, each tank has more than 100 wells and for drilling each well more than a few hundred barrels of drilling mud is prepared and a lot of contaminant mud enters into the environment and this mud contains heavy metals, salt, and fuel and hydrocarbon that affect plants and animals and disrupt the natural balance of the ecosystem (Karimi *et al* ,2015 , Gunther,2010).

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Material and Methods

materials used in dewatering system include:

poly aluminum chloride (PAC)

This waste material (water and mud) is added to the Dewatering system causing agglomeration of small particles and creating larger colloidal particles. Surface water generally contains a variety of colloidal impurities that cause turbidity and somewhat color. To remove the colloidal particles colloids must come together and get larger in size. This can be done by using

chemicals. These materials would neutralize forces that cause the stability of the colloidal particles. This process of destabilizing colloidal particles is called chemical coagulation. The unstable particles while slowly stirred are given time to develop clots called flocculation. Finally, water moves from the settling basin and there coagulated solids are removed by settling. The most important factors in the coagulation process efficiency include: pH, ions in the aqueous solution (water ionic strength), the concentration of humic substances, water temperature and the type of contract (Mousavi,2011).

benefits of using poly aluminum chloride coagulant : Tests done on the PAC show that as its chemical oxygen demand (COD) is zero, using these materials as coagulant in water treatment process cannot add any amount of organic matter in water. About its benefits as coagulant, the sludge produced would be far less. In addition, time requirement of the sedimentation clots produced by this substance is less than other coagulants and this can have a positive effect in reducing the volume and cost of installation. Finally, as lower concentrations of PAC are used in comparison to other coagulants, it seems that the cost of coagulant materials used per cubic meter of treated water reduces(Mousavi,2011).

Polymer: This material is added to wastewater (water and mud) entering Dewatering system, causing the sticking together and forming packed particles and creating larger polymer chain (Karimi et al,2015).

3.Fluid storing reservoir:

Wastewater pumped from the wastewater pond enters into the tank and is ready for filtration and separation. The content of the reservoir enters the Dewatering tank system and a mixer for the isolation and purification of water by a single pump. Mixer is a section of dewatering unit used to mix wastewater with pack and polymer, polymer is added to wastewater using a single pump. In polymer tank, polymer powder should be poured into the cone-shaped tank of preparing polymer so that it mixes with water and produce a liquid called polymer or polyelectrolyte (Karimi et al,2015).

4. Re-consumption using dewatering:

If the concentration of solids within the wastewater is so much that settling is not effective, by adding polymer chemicals to the drilling waste to generate larger colloidal particles, we attempt to separate them. Dewatering is a physical and chemical process for separating solids from wastewater from drilling operations whose chemical process is flocculation and coagulation of the solid particles shown in Schematic Figure 1 of reaction of charged solid particles with Flocculants and coagulation material. The use of these materials is because the centrifuge device has the ability to separate the particles larger than 3 microns. Therefore, to be able to separate solids less than 3 microns from the water, coagulation process is used. In summary, these substances cause clotting and agglomeration of particles suspended in water and thus the first stage of separation of the solid phase from the liquid chemical in the process is done. The agglomeration of solid particles is stick together and form larger particles. After the process of flocculation and coagulation, colloidal particles with diameters greater than 3-5 microns, which have been clot are separated under mechanical operation inside the centrifuge device and removed from the water called solid modeling. (Mousavi,2011) and (Karimi et al,2015).

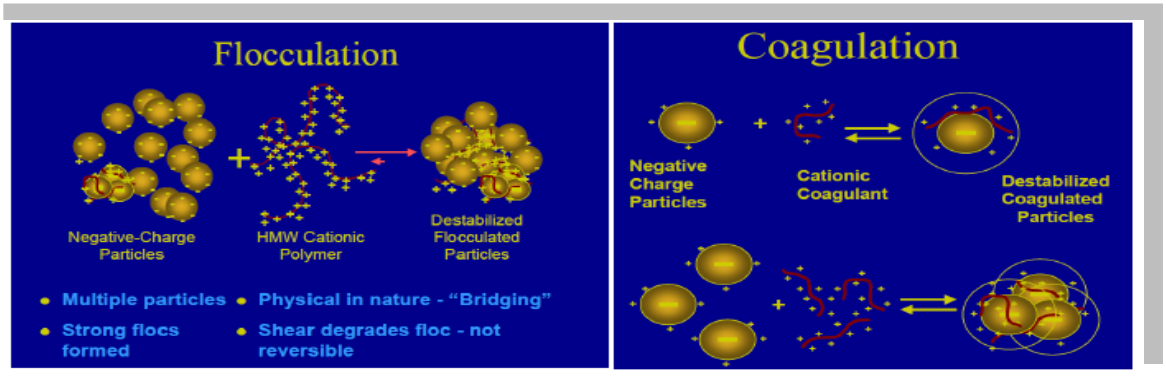


Figure 1: The chemical process of separation of particles from liquid (4)

5. Dewatering Centrifuge

This centrifuge is related to Dewatering unit used to separate solid from wastewater (mostly consisting of water and a small percentage of oil and gas oil) (Karimi et al,2015) and (Mousavi,2011).

6. Dewatering process method

1. Checking all equipment related to Dewatering according to the checklist and studying the chemical storage. We fill the suction tank or wastewater tank we want to dewater and fill it with a diaphragm pump (the tank can one of the buffered tanks).
2. Turn on the mixer in the buffer so that a uniform Dewatering fluid enters the unit.
3. Tests related to fluid waste like density and PH and solid particles percent are carried out and the results are recorded and if necessary the pH is adjusted.
4. The polymer level is investigated in the funnel like tank and filled if necessary. Running out of polymer in the tank should be avoided. Pack level is check out in its drum and the concentration is set according to the sample. The entry water is seen and ensured. Centrifuge is turned on and its parameters are set while feeding pump is still off. Dewatering unit is turned on. Feed pump is switched on. Polymer pump is turned on and set (to the extent necessary on the basis of sampling). If necessary, the pack pump is turned on and the solution is added to improve flocculation. The results of flocculation is checked with sampling valve.
5. If the test results are good (fast settling large clots separated solid and crystal clear water separated from the solid) and the output water of the centrifuge is still dirty, centrifuges is adjusted so that clear water is let out.
6. Output water is poured into suction tank to ensure the completion of the setting and clearing water, and after making sure it is directed to another tank. Clear water is directed by the three-way valve into clear water tank. At the end of Dewatering all the pumps are switched off. Round Bowl of centrifuge is reduced to 500. Differential is increased and flashed by water until clean water comes out and then the centrifuge is turned off. Dewatering unit is cleaned after use. The obtained solids are guided to coral to stabilize (Mousavi,2011) and (Karimi et al,2015).

7. The water discharged from the centrifuge during the mentioned processes has two applications:

1- Transferred into the storage tank water for dilution, it is used or transferred to the centrifuge set

2 - Can be returned to drilling mud system to be used for mud circulation. As mentioned clean water discharged from the centrifuges could be used to build new fluid. Before using this fluid, a test called compatibility test is done on it that checks the compatibility of this water with drilling fluid or any other use (Mousavi, 2011). Therefore, before compatibility test to check its favorability, tests related to water profile in accordance with the environmental standards of water and wastewater reuse and based on the agenda of the technical office of the executive of vice president of strategic planning and monitoring should be done (Islamic Republic of Iran Iran's vice president of strategic planning and monitoring, the Office of Strategic Technical Assistance Administration, 2010).

Table 1: Table of environmental standards of reuse of returned water and wastewater (2)

Item	PARAMETERS	Desired ranges	REMARKS
1	P.H	6.5-8.5	
2	Turbidity	50 ntu	
3	Color	75	
4	Nitrates	50mg/lit	
5	Hardnss	< 500 mg/lit	
6	Sulfates	< 500mg/lit	
7	Suspended solids	< 100mg/lit	

8.experiments related to water properties

In the following we refer to some of the tests.

Testing chloride: Platinum-cobalt standard method NCASI: 8025

Measurement of suspended soil:

8006 Photometric measuring, measurement range 5-750 mg/l

Nitrate test: This test is done using cadmium reduction method and using reactive powder package nitra ver5.

sulfate test: This test is done with powder reagent sulfa ver 4

9. Compatibility Test

To determine the compatibility of Dewatering water and water that is used for mudding, water rheological properties of the water should be tested. It should be noted that under ideal conditions, the polymer added to the process of Dewatering is exactly the same as the wastewater solids and after their reaction in the output polymer, there is no output polymer. But in the real situation, it is impossible, because in many cases the polymer used is more than the required amount and a considerable amount of polymer is left in the output (Mousavi,2011). In this paper, we will study our case on the intended devices in definition project (oil field) according to the following table. And will analyze the amount of material used for Dewatering process according to the indices and predictable amount of material.

Methods and Analysis:

To do this at first, we need to estimate statistics of consumables available (pack and polymer) for Dewatering process during a particular day in the existing devices in definition projects (oil fields) according to Table 2 and then gain predictable amount of material according to the standard index and the volume of water dewatered and according to the type of fluid (water and oil based). The purpose of this is to add enough and proper pack and polymer used so that its value does not exceeds the anticipated amount (Wonjtanowic et al,1991). (Karimi,2011) ,. (Yokoa ,199)

Table 2 - Statistics of consumables and Dewatering volume and predictable levels of standard materials (Karimi,2011)

Rig No.	Mud Type	Total Cutting Vol. (m^3)	Fixed Cutting Vol. (m^3)	Dewatered Water Vol. (m^3)	PAC Consumed (kg)	PAC Consumption Index	Polymer Consumed (kg)	Polymer Consumption Index
26	k.P.M	0	0	0	0	0	0	0
32	W.B.M	0	88	0	50	0	50	0
35	W.B.M	9	0	0	0	0	0	0
59	O.B.M	0	0	0	0	0	0	0
60	W.B.M	0	70	0	70	0	0	0
65	k.P.M	5	0	63	15	63	0	63
67	W.B.M	0	0	0	0	0	0	0
81	W.B.M	5	0	0	0	0	0	0
86	O.B.M	1.1	0	0	0	0	0	0
93	W.B.M	0	0	0	0	0	0	0

In analysis of daily report of the department of waste management, I have monitored and surveyed drilling machines in terms of using consumables and documenting water from Dewatering process and if the amount of material used is beyond the limit, it is identified in a report. In this project after estimating the amount of materials used, in comparison to foreseeable amount of observed are shown on the sets 32 and 60 and the consumable that is beyond the predictable limit, marked in the table above. As noted in the case of excessive use of consumables during Dewatering during operation, the fluid made by it will not have the appropriate properties, or may cause loss. In the following graph, the above mentioned issues are referred to (the amount of material used versus the predictable amount and standard are displayed) (Karimi ,2015).

Chart (1) Amount of consumables and predictable materials in 32 Fath Set (8)

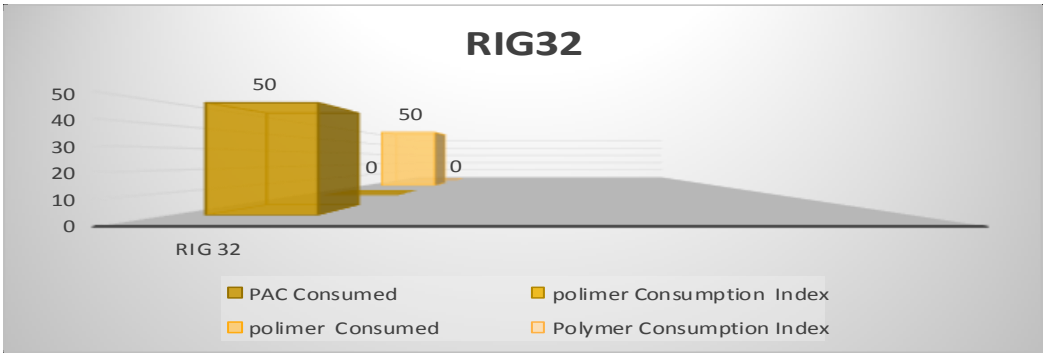
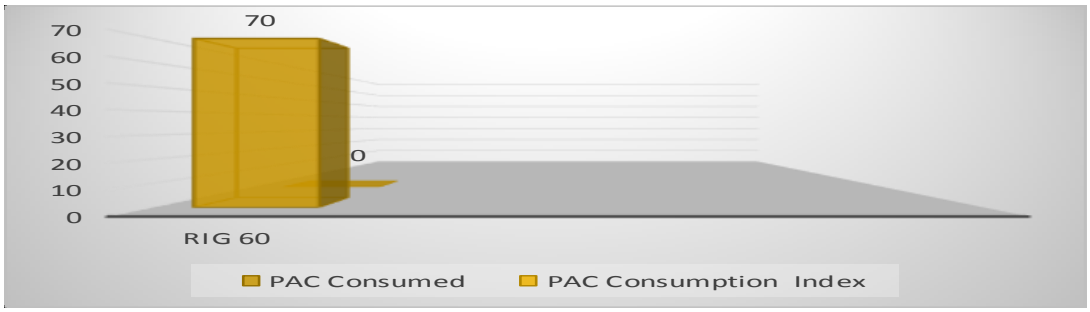


Chart (2) Amount of consumables and predictable materials in 60 Fath Set (8)



The purpose of analyzing consumables pack and polymer is the documentation of water from Dewatering process in accordance with environmental standards and studying the amount of materials used to improve the rheological properties of the fluid and deterring negative impact on the drilling fluid that ultimately stops fluid loss. Compatibility testing is done on a sample of recycled water (Dewatering) and a sample of drilling fluid that if they fail the test, the intended water must be treated by chemicals so that polymers that can lead to rheological problems can be found and eliminated. (Karimi,2015)

Compatibility test method

A. sampling from drilling fluid and conducting the tests related to rheological fluid as the index test.

B: 175 ml of dewatered water and 175 ml of drilling fluid are mixed for 15 minutes and then rheology tests are carried out and simultaneously appearance featured of the samples such as (being flocculated - or hardening or loosening) are recorded (Mousavi,2011).

Criteria:

The decision on whether Dewatering water is appropriate for dilution or for mudding depends on the results of rheological change of mixture of water and fluid Table 3. If the desired mixture, after treatment, has appropriate rheological properties, Dewatering water can be used (suitable Dewatering water is the water that does not create more than 50% change in the rheological properties of the fluid). To record sample items, we use 1 and 2 facades, respectively (Mousavi,2011).

Table 3 - Criteria in water and fluid (4)

DrillingDrilling Fluids	Dewater Mixtuer And Drilling Fluids
VIS 1	VIS 2
PV 1	PV 2
YP 1	YP 2
GEL 1	GEL 2

If the test is failed:

With the addition of (0.5-1) of unit in citric acid per barrel (depending on the drilling fluid PH), we get mixed PH to 4 or 5 and then use sodium perborate (0.25 – 0.35) (Mousavi,2011).

Results

In Dewatering process we will have the reduction of the volume of waste water generated in the process of drilling (Reduction), return of a large amount of drilling waste produced to the wells (Recycling) and the conversion of all the waste generated into solid waste (due to easy separation, disposal and more economical of solid waste compared to liquid (Residue). Dewatering process is appropriate in Remote Location situations of the rigs, where there are no facilities for treatment of waste resulting from drilling mud. Dewatering process is appropriate in situations where the water (Fresh Water) is not available for the use and construction of drilling mud w. Dewatering process reduces the volume of drilling mud deposited into the Reserve Pit. The purpose of analyzing consumables pack and polymer is the documentation of water from Dewatering process in accordance with environmental standards and studying the amount of materials used to improve the rheological properties of the fluid and deterring negative impact on the drilling fluid that ultimately stops fluid loss.

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References

Islamic Republic of Iran Iran's vice president of strategic planning and monitoring, the Office of Strategic Technical Assistance Administration, 2010. *Department of Energy, Office of engineering and technical standards for water and ABFA, environmental regulations, reuse water and wastewater return*, Publication No. 535 ,

MI/SWACO . 1998. *Drilling fluids engineering manual*.chapter 23.

Mousavi, S.2011. *Evaluating the efficiency of waste management system by zero discharge procedure for the removal and reduction of pollution caused by drilling gas wells (Case Study Kish Island),* MSc thesis, Islamic Azad University, Science and Research Branch of Ahvaz. 135 pages.

Gunther, et al. 2010 .*Effects of ryegrass on biodegradation of hydrocarbons in soil*.Chemosphere,33:203-215.

Karimi S, Saffarian SH. 2015. .*Investigating phytoremediation potential of Brasica nigra in removal of nickel,zinc and arsenic from contaminated soils*. Journal of Indian chem.soc.Vol.92 . 2015 .,pp 1-6.

Karimi, S. Asakereh, Kolahkaj, A. 2015. *Monitoring and reducing the environmental impacts caused by the fluid and lags resulting from the operation of oil and gas wells in the process of zero drainage system for sustainable development, an international conference with a focus on agricultural development, environment and tourism* . Iran / Tabriz, September 2015. 8 pages.

Karimi, S. 2015. *Report of assessing of oil field project performance in oil fields of Azadegan and Yaran May and June. Drilling Fluids Management Service. Waste Control Office National Iranian Drilling Company* .

Wonjtanowic AK , Ye Y. 1991. *Environmental control of drilling mud discharges through dewatering in cold weather climates: effect of ambient temperature.Proceeding of international arctic technology* , Alaska, Jun11-15, pp:711-719.

Yokoa. 1999. *Minimizing the environmental effects of drilling operations*. Proceeding of 5th International Conference on waste management. California, USA, march 8-10, pp: 174-185.