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Research Article

Analysis of drilling waste management process in one of the oil fields in southwestern Iran in order to protect the environment

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ABSTRACT

One of the environmental problems that oil industry encounters now a days is contaminations resulting from drilling wastes of gas and oil wells(due to drilling cuttings and productive drilling fluids). Available environmental rules in countries made firms and factories decrease negative environmental effects of these wastes. One of the most important factors in decreasing negative environmental effects of wastes is correct management of them. In a way that some occasions, needed costs in removal of contaminations of a waste collection or controlling its contamination spreading are considerably decreased with correct and initiative management. In this article has been tried to show with numerical results that using stabilization systems of drilling cuttings in a sample well (in Ahvaz field)is one of the most important and the simplest methods of controlling drilling waste in the world.

Key Words: Drilling, Waste management, Drill cuttings, stabilization, Environmental problems.

1. INTRODUCTION

In the last century, many gas and oil wells have been drilled in the world. During a drilling process, millions of barrel of drilling wastes are produced annually that these wastes mainly include such as drilling fluids and also produced drilling cuttings by a bit from a well. Nowadays, doing drilling projects in an international and national scale requires presentation of evaluations reports before and after drilling operations(Knez, D., et al.). Drilling operations of an oil well from the first to end leaves a lot of effects on its surrounding environment. The construction of pits next to rigs to keep waste and cuttings in them, drilling fluid penetration in the well formation while drilling process, discharge of waste and cuttings in the sea and some other samples are cases that cause the contamination of environment Most of the time, after finishing drilling process, this fluid and chemical are useless and they will and water sources. Increasing deployment of these mixtures made environment supporting organizations determine some rules order to decrease these materials and necessitate firms to its execution(Ghazi M., et al.).

2. MATERIALS AND METHOD

In respect to increasing deployment of exploration and development wells of oil and gas fields in the country and necessary access to hydrocarbon a great number of explorations, exploitation and delineation wells must be drilled in arid and sea zones. In this direction, depending on the drilling process of these wells, different drilling fluids are utilized for various purposes such as provide hydrostatic pressure, development suitable mud cake, drilling bit lubrication and so on. be released in the area around well and small volume of this fluid and chemicals are used again.

Consequently, after finishing a drilling process, huge volumes of these chemicals enter to environment (Baba Hamed S., et al). Where lacks of a special drilling process and engineering causes irreparable damages to the environment. In this study, wea re going to analyze and explain the significance a control method of drilling fluids waste using fixation and stabilization processes.

2.1. A review of literature in Iran

In this article, according to available statics and results considered and analyzed in wells No 11,14,15,18,20,6… in north Azadegan field and accomplished researches in the laboratory and with the operation condition, waste control process (fixation of cuttings) has been considered and analyzed practically in well No 458 in Ahwaz field.(Technical reports.) This data can be documented with a high accuracy in order to estimates cost control for cuttings fixation system in adjacent wells and similar fields.

3.Drilling cuttings Fixation and Stabilization Process Explanation

Separated formation cuttings from fluid by shale shaker might still be covered a great amount of mud. They aren't suitable for next use and transportation or work with it is hard. Cuttings compositor components or their covering fluid (metals, gasoline) may come out of it and they make it unsuitable for burring in disposal place. For this reason, many materials may be added for stabilizing and making their mud cuttings solid.

In principle, the solidification is a method that converts waste to stiff solid units with high integration in during it. These units may be a form of small waste particles (tiny capsule) or a big form or dishes containing waste (high capsules).The solid does not necessarily include a chemical reaction between waste and solid materials. But it may mechanically convert waste to forms of integrated units. As a result of this stage, contamination permeation will be limited with level to volume reduction or with putting wastes in internal impermeable capsules(Robinson, J.P.,at al.).

The stabilization involves the methods which decrease the potential of waste danger by means of converting impurities to a form with the least toxicity, mobility and solubility. The physical nature and waste properties do not necessarily change with. (Al-Ansary, M. S., et al.)

4.kindsof additives in order to fixation and stabilization processes

In the past, Cement, Wind ash, Lime and calcium oxide were used more for cuttings fixation and stabilization operations and other humid solids. Recently, seven new kinds of additive for cuttings stabilization and determining working their performance has been considered as cultivation environment for growing some plant. These materials including average soil with Mica based, fine Mica, three different commercial mixtures from recovered cellulose fibers, wall nut, and American wall nut plug. In order to waste control process in this well Portland cement, sodium silicate, polyaluminumchloride and polyelectrolyte have been used(Al-Ansary, M. S.,et al.). The final stabilized products obtained from this method used for road foundation work, filling and excavation operations and as construction materials (Morillon et al,2002) or other applications.

5.The studied field

5.1.The study of waste management process (cuttings stabilization) in No458 well in Ahwaz oil field At first stage hole drilling in hole26" to depth of 60m investigated. This step produced about 28 m^3 drilling cuttings while 25 m^3 volume of this number was predicted by theoretical methods (Table1) and its 3 m^3 remainder was due to drilling fluid loss accompanied by drilling fluid. In the fixation method in waste management system, portland cement and sodium silicate have been used in stabilization and polyaluminum chloride (PAC)andpolyelectrolyte have been used for separating very small particles from drilling fluid (Tables1-9). According to table No8, with well drilling to depth 4391m in Ahwaz field

during 143 days computed theoretical cuttings volume is about 479 m^3. Other needed important parameters during complete drilling of this well are shown in table 8. As mentioned in table 8,chemical consumption rate for stabilization processes execution and very small particles separation process from drilling fluid is shown below. By using these data, the amount of chemical consumption can be estimated for other wells. Figure 1 shows a complete process of practical execution of cuttings stabilization method for applied waste management in oil fields of Iran. Beginning stage of this process starts from entering fluid from an extrusive pipe of drilling fluid from flow line and entering fluid to shale shaker and solid control instruments finally.

Table 1: The following table shows the properties of hole (26") of investigated well.

Section	Indicators									
26"	Meters	Days	Waste Water Processed (m^3)	Cutting Processed (m^3)	PAC (kg) by Vol treated (m^3)	Polymer (kg) by Vol treated (m^3)	Cement (kg) by Vol treated (m^3)	SILDRILL (lt) by Vol treated (m^3)	Hole Size (inch)	Theorical Hole m^3
	60	2	0	28	0.00	0.00	0.00	0.00	26	25

Table 2: The following table shows the properties of hole (17.5") of investigated well.

Section	Indicators									
17.5"	Meters	Days	Waste Water Processed (m^3)	Cutting Processed (m^3)	PAC (kg) by Vol treated (m^3)	Polymer (kg) by Vol treated (m^3)	Cement (kg) by Vol treated (m^3)	SILDRILL (lt) by Vol treated (m^3)	Hole Size (inch)	Theorical Hole m^3
	1,625	31	745	1240	0.00	0.07	28.23	0.97	17.5	303

Table3: The following table shows the properties of hole (12.25") of investigated well.

Section	Indicators									
12.25"	Meters	Days	Waste Water Processed (m^3)	Cutting Processed (m^3)	PAC (kg) by Vol treated (m^3)	Polymer (kg) by Vol treated (m^3)	Cement (kg) by Vol treated (m^3)	SILDRILL (lt) by Vol treated (m^3)	Hole Size (inch)	Theorical Hole m^3
	1,013	26	0	590	0.00	0.00	28.81	0.00	12.25	92

Table 4: The following table shows the properties of hole (8.5") of investigated well.

Section	Indicators									
8.5"	Meters	Days	Waste Water Processed (m^3)	Cutting Processed (m^3)	PAC (kg) by Vol treated (m^3)	Polymer (kg) by Vol treated (m^3)	Cement (kg) by Vol treated (m^3)	SILDRILL (lt) by Vol treated (m^3)	Hole Size (inch)	Theorical Hole m^3
	998	48	0	710	0.00	0.00	101.41	0.00	8.5	44

Table 5: The following table shows the properties of hole (6.125") of investigated well.

Indicators									
Meters	Days	Waste Water Processed (m^3)	Cutting Processed (m^3)	PAC (kg) by Vol treated (m^3)	Polymer (kg) by Vol treated (m^3)	Cement (kg) by Vol treated (m^3)	SILDRILL (lt) by Vol treated (m^3)	Hole Size (inch)	Theatrical Hole m^3
695	32	0.00	379	0.00	0.00	337.73	0.00	6.125	16

Table6: The following table shows well completion stage.

Section	**Indicators**									
Clean up	Meters	Days	Waste Water Processed (m^3)	Cutting Processed (m^3)	PAC (kg) by Vol treated (m^3)	Polymer (kg) by Vol treated (m^3)	Cement (kg) by Vol treated (m^3)	SILDRILL (lt) by Vol treated (m^3)	Hole Size (inch)	Theatrical Hole m^3
	0	0	0.00	0.00	0.00	0.00	0.00	0.00	Clean up	0

Table7: The following table includes terminal well stage

Section	**Indicators**									
Clean up	Meters	Days	Waste Water Processed (m^3)	Cutting Processed (m^3)	PAC (kg) by Vol treated (m^3)	Polymer (kg) by Vol treated (m^3)	Cement (kg) by Vol treated (m^3)	SILDRILL (lt) by Vol treated (m^3)	Hole Size (inch)	Theatrical Hole m^3
	0	0	0.00	0.00	0.00	0.00	0.00	0.00	Clean up	0

Table8. Determines meter/ cube particulars of production materials and consumed chemical.

Ahvaz 458	Indicators									
	Meters	Days	Waste Water Processed (m^3)	Cutting Processed (m^3)	PAC (kg) by Vol treated (m^3)	Polymer (kg) by Vol treated (m^3)	Cement (kg) by Vol treated (m^3)	SILDRILL (lt) by Vol treated (m^3)	Hole Size (inch)	Theatrical Hole m^3
	4,391	143	745	3002	0.00	0.07	90.61	0.40		479

Table 9. Determines meter/ cube particulars of production materials and consumed chemical.

Chemical Usage	**Product**	**Chemical Usage per Section**									
		26	**17.5**	**12.25**	**8.5**	**6.125**	**Completion**	**Clean up**			**TOTAL**
	Poly Aluminum Chloride - PAC (kg)	0	0	0	0	0	0	0	0	0	0
	Polyelectrolyte (kg)	0	50	0	0	0	0	0	0	0	50
	Portland Cement (kg)	0	35,000	17,000	72,000	128,000	20,000	0	0	0	272,000
	Sodium Silicate - SILDRILL - (lt)	0	1,200	0	0	0	0	0	0	0	1,200

In table 9.Consumed chemical collection computed and state in different well hole drilling.

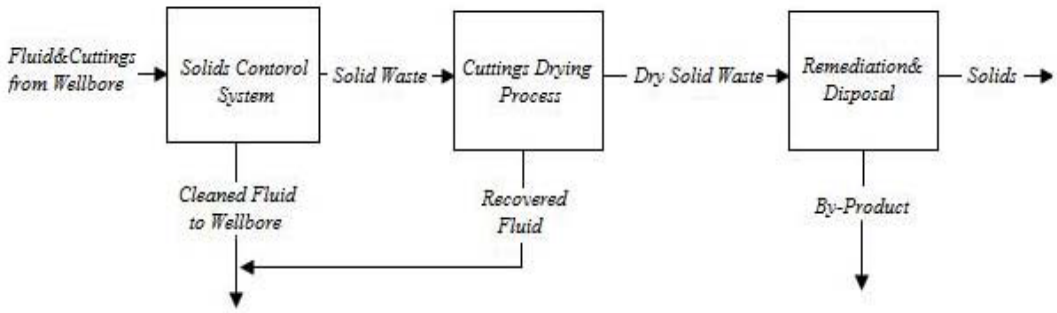

Fig 1.Total diagram of drilling fluids and waste management system(drilling cuttings stabilization

Many stabilization systems establish high pH and high alkalinity conditions. Principal disturbance has been about long stability of applied methods .In fact, this anxiety exists that additives can not prevent from releasing waste components in long term or made matrix suddenly falls down due to these additives that placed total waste components in it and these components will be released in environment. No information is available in this regard because this technology has only 20 years old (Yao, L.,et al.).

Although a Chevron Texaco company tested about eight different commercial products from this point of view and all of them have been rejected in this test(Fleming 2000).

As tiff waste is a shapeless solid with minimum rate of water. This production includes one or more a solid phase, entrapped air in form of pore spaces and a liquid stage and all of them are in chemical balance or close to it. When drilling solid is placed in leaching condition, this balance is stroked. In leaching mechanisms (Latex production) chemical reactions do not happened (except solid constituent components analysis).

Although this sample may be correct in laboratory, butin reality environment cannot be documented. Generally, as above mentioned above many additives materials include high pH. If stabilized as waste used directly in soil or as complementary soil, it will create some problems.

In this regard, in south-eastern Loeizyanai University (Reference), researchers found that cuttings stabilization in a silicatenet includes higherpH than 11. This system was applied for growing plants in wet land and they found that the plants cannot grow in stabilized condition .Because of needed space and equipment for stabilization, this method is not applicable in off shore drilling rigs. This method is applicable in land drilling rigs and off shore drilling rigs where their waste carry is carried to land.

5.2. Solid control equipment and used waste drilling fluids:

a) Shale shaker: Shale shaker accomplishes at the first stage of drilling fluid refinement.

b) Auger: transfer Cuttings from shale shakers toward dryer shale shaker.

c) Dryer shale: This shale shaker is set in a down section of main shales, and is covered mesh nets smaller than main shale nets with which we promote fluid transmissivity capability increase through it. In fact, this shale shaker takes available cuttings liquid and this fluid is turned to active fluid system through a pump. Extrusive cuttings finally evacuate of this shaker to coral.

d) Mixer: generally mixers cause mixing chemicals and cuttings.

e) Reserve and terrestrial Reservoirs (buffers): Reserve and terrestrial reservoirs are generally used for keep cuttings to transfer in future or to do required experiments.

f) Reserve Pits: According to the zone and environment conditions and drilled well depth, generally special reserve reservoirs are placed and since these reservoirs are used in different fluid

storage, they should be isolated so that prevent fluid leakage to inner land.

5.3. The use limitations from the method of cuttings stabilization

There are limitations in the application of stabilizing and stiffing system. For instance cement piller systems are not efficient in the following cases:

a) The rate of organic materials is higher than45%.

b) Desired waste has less than 15% solid materials.

c) Additional values of tiny particles exist.

d) Very large value of coarse particles exists in given waste (Pal skale).

Proposal

*Using advanced technologies that we can produce minimum rate of fluid and drilling cuttings after finishing drilling process.

*Using up to date solid control equipment that they can produce minimum waste.

6. Conclusion

Equipping gas and oil drilling rigs and using new drilling fluid waste control technologies in the direction waste control of these wells will be a worthy help to environment protection with increasing growth of population growth and having a clean environment for future generations. This seems essential point that the cost for contaminate of a agriculture land can not be estimated. Therefore, the result of uses drilling fluid waste control system or waste management in gas and oil wells in a country and in the world will help to protect environment and human life and animals.

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