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Investigating the Smart System Function of Injecting Fluid from Tanks to Well

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Abstract

Mud drilling is a combination of organic and inorganic chemicals made in the form of liquid and used in the drilling industry to move the piles to the surface, to control the pressure, to make unbonded walls, and to lubricate, etc. [1]. Developing the advanced digging, especially petroleum and gas wells, the drilling mud wealth has come so high that it is called *blood drilling*, and nowadays it is impossible to drill without mud, just like to live without water.

At the moment, injection of drilling fluids in petroleum and gas extraction derricks, such as *pile* (a high-viscosity drilling mud), should be executed in coordination with testers of the mud tanks, and line up the mud path, as well as the measurement of the level of the tanks using the meter, and This is done manually, which involves a lot of energy and time, as well as human errors in determining the level of tanks and the amount of mud in them.

The solution to address the problem mentioned above is the use of a smart system of fluid injection from tanks to the well. If the system is used in accordance with the necessity of the time, as well as the importance of the absence of human errors in the drilling industry, it is possible to highly minimize the time to perform fluid injection operations without human error.

It should be noted that the system mentioned above has a patent certificate with the number 92733 from the Industrial Property Organization of Iran.

Key Words: Injection system, Drilling derrick, Mud tanks

1. Introduction

The petroleum industry is one of the most effective and largest industries in the world, especially Iran. Petroleum, besides being the main source of energy in today's world, plays an important role in determining the national strength and international credibility of different countries. The petroleum sector in the Iranian economy has for many years been the main source of national income, and in fact, it represents the dominant role in the economy of the country. In this regard, the role of universities and industry is very significant in the production of crops that contribute to the advancement of this important industry.

Also, given that one of the objectives of the resistance economy is to use domestic power and to reduce the dependence on foreign production, operating the domestic economic cycles is possible only with the production of high-quality products and native labor. This goal is not possible without the use of the capacity of the elite and educators, and we must know that the productive and economical economy is reliant on the knowledge of the day, and students and craftsmen in this field can be the origin of many services and blessings in the economic, social and cultural spheres.

Meanwhile, drilling industry is the key to accessing petroleum tanks and petroleum industry infrastructure [2].

In the process of drilling operations, the mud with a high viscosity is always used for making non-mounted walls of wells, as well as for cleaning and cooling drills. Therefore, it is necessary to accurately calculate this required amount of mud and to be injected into the well in the shortest possible time, to guarantee the strength of the well wall, and to increase the drill life and drilling efficiency.

2. Theory and research background

In today's drills, to inject fluids from tanks to wells, the digger must announce the required amount of mud to the mud testers. After the tank workers measure the prepared mud, they closed the pump valves and line up the reserve tank towards the pump. They then announce the command of *switch-on* the pumps to the digger. The digger switches on the pump, and the injection operation continues until the mud tester issues a pump *switch-off* command. This happens while the tester controls the level of the tanks with a meter, which is subject to many errors.

The main reasons for these errors can be the effect of bad weather conditions on the worker, lack of experience of the digger or the tester, as well as delay in closing or opening the valves.

At present, the only way to inject fluid is to use hand-operated valves in a traditional method that does not operate the injection operations accurately and appropriately, and no specific system or device has been designed to do this.

The proposed solution to solve this problem is to use a smart fluid injection system from tanks to wells, in which the injection procedure is performed automatically and without interference, and consequently without error.

Obviously, the injection procedure is best operated in this way and is a new way to inject fluid from the tank of the well.

3. MATERIALS AND METHODS

Considering that so far no significant action has been taken in designing and manufacturing fluid injection systems and plants in drilling derricks, our study resources have been the traditional methods and experiences and evidences obtained from drilling derricks [3]. Figure (1) shows the traditional circulation system of the drilling mud on the derricks.

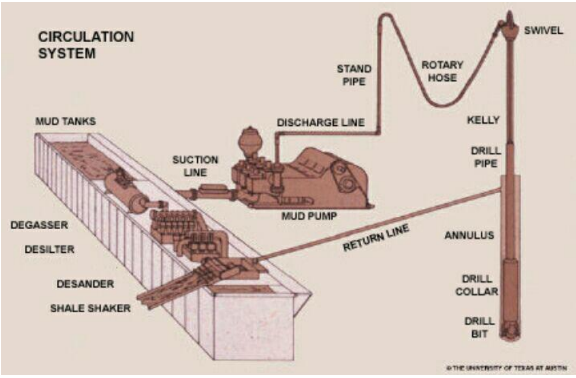

Figure 1: Traditional Mud Circulation System Drilling Drills

The smart system for fluid injection from tanks into a well consists of an electric valve and one touch panel & display and an ultrasonic sensor and a processor (s7-300 plc). First, the fluid level inside the tank is measured by the sensor, and it is displayed on a display based on barrel/digger.

The digger can enter the required amount, based on the barrel, by means of the touch panel. Consequently, the message is send to the plc processor, and then, after turning it into the machine language, the inlet valve is closed, and the fluid outlet valve is opened from the tank toward one of the pumps, and the fluid is transmitted to the well by a mud pump. As soon as the volume of the mud is reduced from the surface of the tanks, a message is sent from the sensor to the processor, and there, a command is issued to announce closing the electric valve of the tanks output and the pump switch-off.

A message is also sent to the digger displaying the completion of the mud transfer operation. Figure diagram A smart Intelligence Map displays fluid injections from tanks to wells.

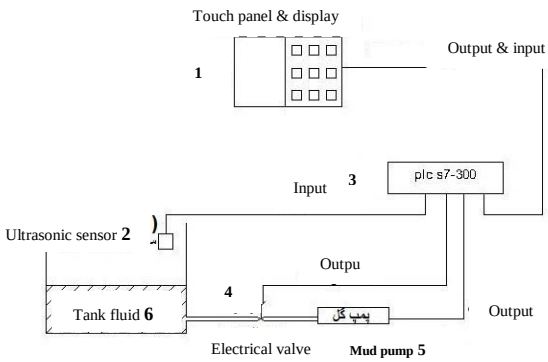

Figure 2: Diagrams and intrinsic components of the Smart Injection System from tanks to wells

4. Conclusion and Discussion

In the case of using a smart fluid injection system from tanks to wells, considering that the tank level is measured using the sensor, naturally, the human error rate is reduced. Due to the system's automaticity and the high speed of its operation can reduce a significant amount of costs and time.

Table 1 shows the comparison of the volume of the required and injected mud, in the traditional method of fluid injection. It presents the data obtained from high-viscosity fluid injection operations in drilling derricks.

Table 1: Comparison of the volume of the requested and the injected volume in the traditional method

Volume of Injected Mud (barrel)	Volume of required Mud (barrel)	Hour	Date
52	50	08:00	12/06/95
35	30	13:00	
38	40	19:00	
42	40	10:00	13/06/95
36	30	14:00	
43	40	19:00	
36	35	21:00	

As can be deduced from the above results, none of the requested volumes have been logged into the well precisely and without error. The main reasons for these errors coming from human errors can be caused by the delay in opening the gate valves on the tanks as well as the exhaustion of the worker. As seen, the greatest differences and errors in the hours are when the air temperature is high. It seems that one of the reasons for the evident differences in table is the warmth of the air and its effect on the performance of the mud tester.

It is, then, expected that if using the smart system to inject fluid from tanks to the well, these errors will be significantly reduced, due to its smart and hydraulic gates and the use of sensors instead of meters. Diagram 1 compares and reviews a traditional injection operation compared with smart injection operation.

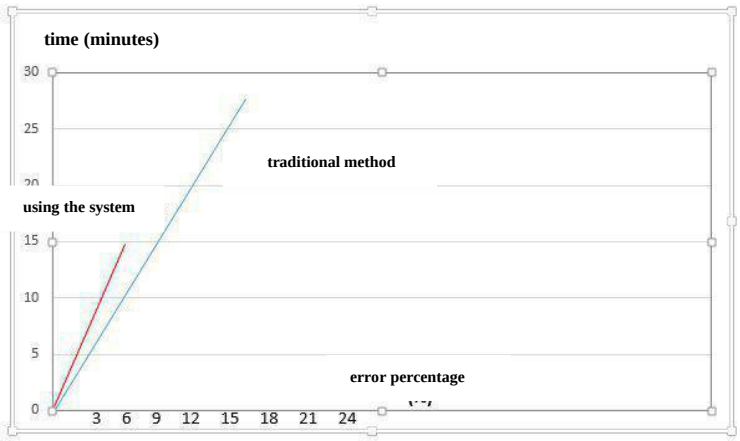

Figure 1: Comparing the time and error rates of a traditional injection method with smart injection

As can be seen, fluid injection has been carried out in the traditional method over a shorter time period and with a high error percentage (less than 5%).

5. Conclusions and suggestions

In comparison with the traditional and manual method, by using the Smart Injection System to inject fluid from the tank to the well, we can see a better and accurate fluid injection into the well. Using fewer workforces, instead of using numerous workforces for injecting operations, is another application of this system.

With this new injection method, and also considering the importance of the operation time in the drilling industry, and the quality of operations, this system can play an important role in reducing costs and time of operations.

6. Appreciation

At the end, I would like to appreciate the compassionate efforts of the Managing Director and staff of the Energy & Gas Exploration Company of Pars (PDX), especially, Mr. Manjesi M. and Mrs. Hamidifar M., who have always helped me in this way, and in registering the patent certificate of this system.

Reference

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