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Full Length Research Paper

Effective techniques in drilling to improve the recovery process of hydrocarbons in oil and gas sector

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The purpose of this research is to use effective method of drilling to improve the recovery process of hydrocarbons in oil and gas sector. Hydrocarbons are present in large amount beneath the earth. By using exploration geo physics, the reservoir of hydrocarbons below the earth can be located with more precision and accuracy. The first step consists of the geological and the seismic survey to obtain the image of the beneath rocks. In the next, step drilling is performed to reach the desired depth. Depending on the types of rocks beneath the earth the drilling performed may be directional, vertical or horizontal. This paper will focus on "how multilateral/horizontal drilling can improve the recovery of low permeable hydrocarbons". Now a day's offshore drilling is also performed.

Key words: Hydrocarbons, seismic survey, multilateral drilling, offshore drilling.

INTRODUCTION

Hydrogen and carbon forms hydrocarbon which is an organic compound in which Crude oil is the most natural form of hydrocarbon (Clayden and Greeves, 2001). Hydrocarbon produces lot of energy when burnt and are the main source of electric energy and home heating. Hydrocarbons extracted may be either in liquid or gaseous form such as petroleum or natural gas. To gather economic values of petroleum, many important geological fundamentals and processes are needed (Magoon, 1994). Seismic methods are then used to find the structure of the layers beneath the earth. Then by using information from the structural layers, the point of drilling is defined. First oil well was drilled by Col. Edwin Drake in USA on August 26, 1859. The well depth was 21 m only and it took most of the summer to reach the desired depth. (Magoon and Beaumont, 1999)

To recover the hydrocarbons drilling is performed. But sometimes the usual drilling methods cannot be applied due to certain hurdles present beneath the Earth and different location of the reservoirs. The difficulty and cost associated becomes very high to reach the desire reservoirs by conventional methods. So further drilling cannot be performed by using the conventional drilling methods. Here technology comes to rescue. The effective techniques employ directional, horizontal, and multilateral drilling (Figure 1).

Oil drilling is the most common source of recovery of Petroleum. According to Guerriero (2011), "The step performed after the structural Geology is reservoir characterization (mainly in terms of porosity and permeable structures)". The main sources of Petroleum (fossil fuel) are fossilized organic zooplankton and algae (Kvenvolden, 2006). They were settled at the bottom of sea and lakes mixing with sediments under anoxic conditions.

When adequate thermal energy is passed on to the sedimentary organic matter to break chemical bonds, petroleum is produced from source rocks. The petroleum then starts to migrate along the fault zones. Certain numbers of traps are present in the layer of earth where petroleum starts to accumulate. They are called reservoir rocks. Further movement of petroleum is then prevented. These formations are located with the help of geological or seismic survey.

When a certain area of interest has been designated, a survey grid will be drawn up with enough detail to allow

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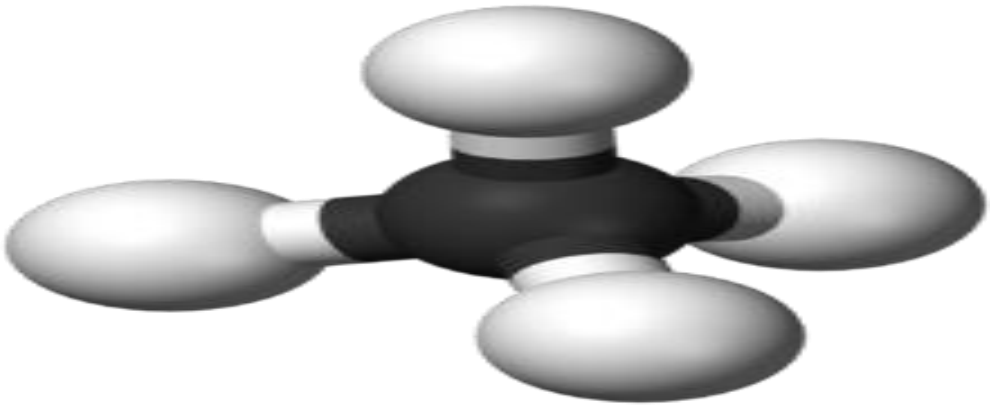

Figure 1. Structure of Methane. Source: (Bowling, 1986).

the interpretation team of geophysicists and geologists to map the subsurface strata. A survey ship, complete with navigation, recording and shooting equipment (and any other surveys which may be run simultaneously such as gravity and magnetic), will then follow this grid recording the seismic data on computer-compatible tapes for further processing.

Seismic methods use two phenomenon, reflection and refraction. They are based on Snell's law. The situation is directly analogous to optics, where series of shock waves move in the form of wave fronts from the point of energy release. When one of these wave fronts encounters an interface of two dissimilar materials a process of reflection and refraction takes place. From this survey, the point of drilling of an oil/gas well is located.

Vertical drilling

Vertical drilling is traditional type of drilling in oil and gas drilling industry. Drilling a Vertical well is usually cheaper than drilling a horizontal well. The production obtained from vertical wells is lesser as compared to the horizontal wells. The limitation of vertical well is that frequency of intersecting a large number of fractures is reduced so less production is obtained.

Horizontal drilling

Horizontal drilling is the same as vertical drilling until the “kickoff point” which is located just above the target oil or gas reservoir. From that point, the well is deviated from the vertical direction to horizontal. Some limitations of horizontal drilling are:

(a) Horizontal wells have a greater footprint compare to multilateral wells.
(b) When large number of pay zones are present, more than one horizontal well are required which is very costly.

Multilateral drilling

In this type of drilling, more than one branch emerge from a single mother wellbore. The branch may be horizontal, vertical or inclined depending upon the availability of the zones. More zones can be perforated through multi lateral drilling from a single mother well.

Directional drilling

It is an angle drilling. Drill pipe provides mechanical and hydraulic connection between drilling rig at surface and down hole directional steering system. Drill pipe provides axial load and disseminate the borehole by destroying the rocks. Drill pipe is then pumped with the mud fluid cool and lubricate the rock destruction process and to transport the rock cutting to the surface (Bowling, 1986).

Plasma channel drilling: According to Martin (1960), **“**Plasma channel drilling is a process in which sub micro second electrical breakdown of rocks is used for efficient fragmentation of rock Formations. This preferential electrical breakdown of rock is achieved by the use of a dielectric liquid (water for example) as the drilling fluid. The drilling fluid in the PCD process serves as a superior electrical insulator due to differences in the electrical properties between the rock and the dielectric liquid under impulse conditions. The peak power generated at the drill head is typically hundreds of MW. Such high powers enable pressures of several GPa to be developed in the breakdown channel (Figure 2). (Braun and Burnham, 1993).

METHODOLOGY

The aim of the study is to check how effective techniques in drilling can improve the recovery of hydrocarbons. The research is carried out to see whether multilateral drilling can help in the improvement or not. In order to carry out the survey, 10 to 15 persons working in oil and gas companies are selected including:

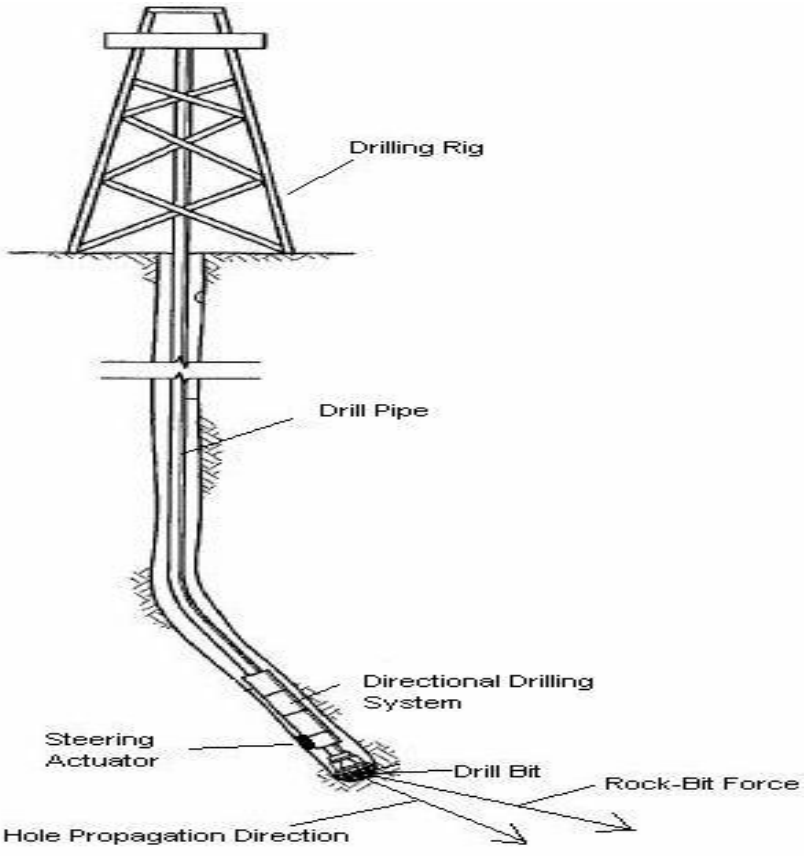

Figure 2. Drilling method Source: (Bowling, 1986).

1. General Manager drilling operations and services
2. Manager drilling
3. Senior drilling superintendent
4. Geological survey experts.

A qualitative analysis was carried out to determine the cost effectiveness of the drilling techniques, the time efficiency and the limitations associated with them. It also put light on the difficulties and the specific requirements for the drilling techniques which are very effective but cannot be employed. The advantages of the latest technology over the conventional methods are also highlighted.

The analysis consisted of qualitative technique. The search will include the expert review and cognitive interviews. The result obtained from this search will be carried out to draw the final conclusions.

RESULTS

The purpose of this research was that multilateral drilling can improve the recovery of hydrocarbons. Views were taken from different persons working in different organizations. The results are subsequently.

Environmental effect

There are certain wastes associated with the drilling process. The waste includes the cuttings of the formations and the chemicals used in mud. In order to check the effect on environment, 15 persons were chosen to take their views. Out of which 10 were of the view of thought that multi lateral drilling has less impact on the environment, 3 said that it has no effect and 2 said that the waste is increased (Figure 3).

Time effectiveness

In order to analyze the time associated with the drilling process, different persons were chosen. Some were of the opinion that time is reduced because single foundation is required and dismantling time is also saved. However, few said that time taken during the drilling is greater because of the complexity. The results are shown in Figure 4.

Cost effectiveness

In order to check the cost effectiveness, 5 options were given to the persons from strongly agree to strongly disagree. A rating of 5 was given to highest level and 1 was given to the lowest. The results are then drawn from

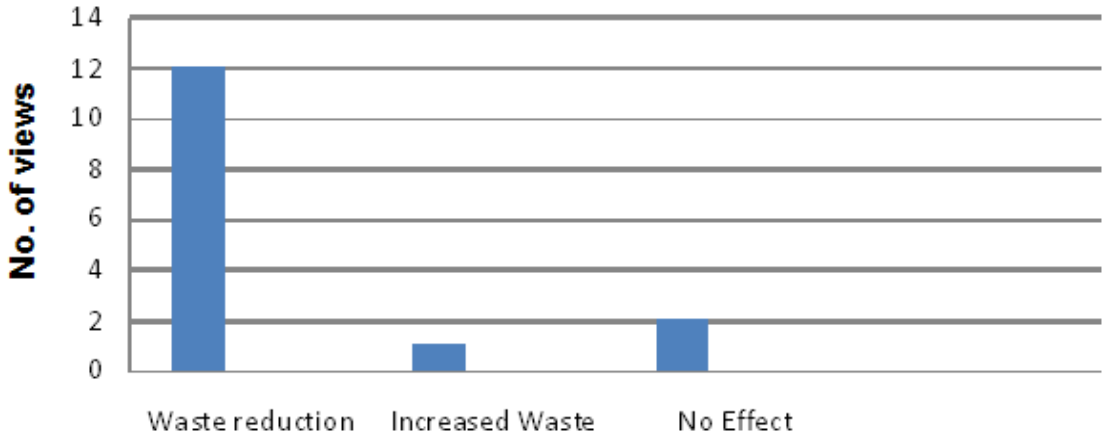

Figure 3. Effect of waste.

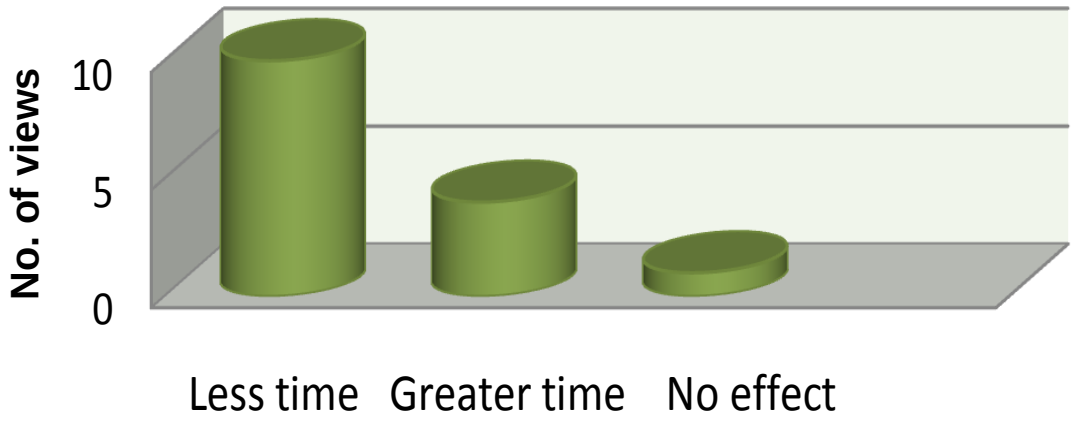

Figure 4. Time effectiveness.

the ratings (Figure 5).

Conclusion

From the views of different persons working in different organizations, the following conclusions can be deducted:

(1) In multilateral wells, higher production is obtained as compared to conventional wells. Conventional wells (Vertical Wells) yield smaller contact with the reservoir when smaller pools are considered, however when several branches are laid down from the single mother bore, greater contact with the reservoir is achieved. Hence high production is obtained.
(2) Multilateral wells are time and cost effective. For multilateral wells, single foundation for the rig is required. Conventional wells require separate foundation at every place. So the time and cost involved in the dismantling, shifting, joining of the rig and the preparation of the foundation on the next place is saved. Up to the kick off point a single mother well is drilled, it also saves lot of cost.
(3) Environmental impacts are decreased in multilateral wells. Different fluids used in drilling process carry out the cuttings of drilling. The value of cuttings is reduced in multilateral wells so as the drilling fluids. Drilling fluids are made up of different chemicals. So when the cuttings and fluids are reduced the impact on the environment is also reduced. This is a big advantage of multilateral drilling.
(4) Quick recovery through multilateral wells. Maximum number of reservoirs is in contact with multilateral drilling, so quick recovery of hydrocarbons is obtained as compared to conventional wells. So payback period is also smaller.
(5) Less effect on water underneath the earth surface. In multilateral wells, only a single mother bore well is drilled. However in conventional drilling method more number of wells are drilled. Since mud is used for the cleaning of hole continuously. It is made up of different chemicals so

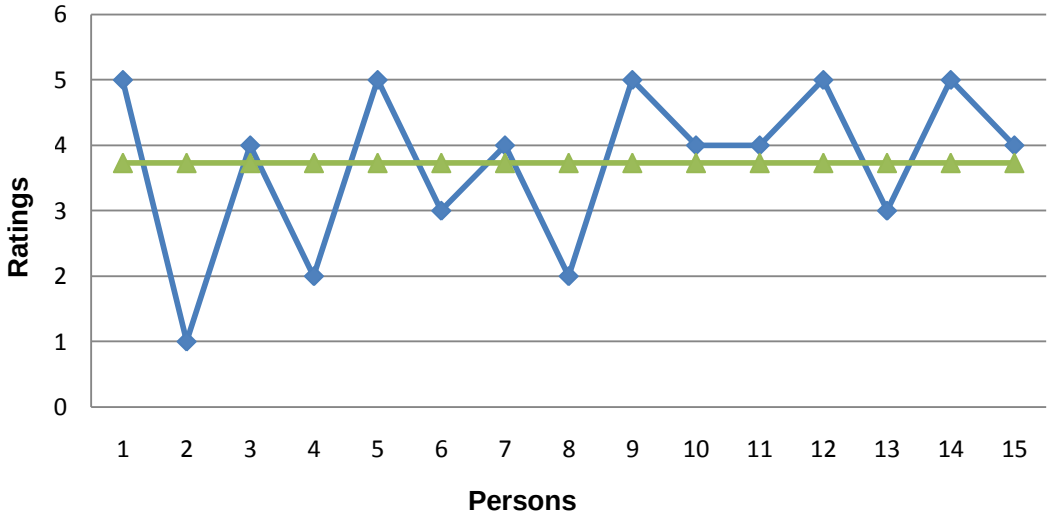

Figure 5. Cost effectiveness.

the effect of multilateral wells on the water beneath the earth is reduced.
(6) It also improves the recovery of low permeable gases which cannot be recovered through conventional methods.

LIMITATIONS AND RECOMMENDATIONS

There are certain limitations associated with multilateral drilling. However, certain recommendations will be made to enhance the usage of multilateral drilling.

(1) Multilateral wells are very complex. They are difficult to drill. To cope with the complexity, companies must employ learning of their workers. Proper training should be given to them by hiring experts in that field.
(2) In multilateral wells, casing is performed only of mother bore well, however the branches are open. Controlling of the formations is difficult. So drilling should be performed only for the developmental wells not for the exploratory wells.
(3) The equipment used for the multilateral drilling is very costly. At first glance, this technology looks to be very expensive. However, the overall advantage should be considered which is much greater when production is obtained.
(4) Well control becomes very difficult when production from different branches is obtained. However, by using Christmas tree (equipment having separate well heads), the problem can be overcome. The production coming from branches will go to separate heads.

In summary, the conventional drilling is not much complex to perform and that is why it is popular in Pakistan. But the production obtained is not in greater quantity. On the other hand, multilateral wells are difficult to drill and the equipment is expensive but the advantage becomes greater when production is obtained. So this should be preferred. In Pakistan, no company has performed multilateral drilling yet but work is going on for the adaptation of this technology. It has bright future in Pakistan provided that government of Pakistan emphasizes its use and invests heavily in this technology.

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