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Presenting operational strategies for reducing drilling wastes as the first phase of waste management

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ABSTRACT

Considering the limitation of proper places for disposal of drilling waste, and negative effects of leaving the waste in the places on the public health and environment, a movement towards optimized management of wastes along with sustainable development is one of the major aims of developed and developing societies. The first step in optimized management of drilling waste is to reduce the waste during the drilling operation. In this article, first the management and operational strategies of reducing drilling waste in the drilling operations are presented. Then, the consequences of using any of management strategies in reducing of drilling waste are discussed and the solution for improvement of the structure of drilling waste management in the oil revolution of Iran is introduced to bethe privatization of drilling companies.

Key words: waste management, direction well, drilling fluid, drilling wastes.

INTRODUCTION

In common methods of drilling oil and gas wells, a twisting auger which is smoothed by mud or drilling fluids is used. This way, the auger excavates heavy stone layers of the earth and therefore we would have large accumulations of drilling wastes on the surface. In this phase, we should take some actions regarding reducing the volume of drilling wastes. Oil and gas wells are cemented by numerous pipe strings called casing pipes. Wells usually do not have the same diameter from the surface to the depth and with the increase of well's depth, the diameter decreases. Upper parts are drilled with a higher diameter. Currently available drilling augers dig wells with various diameters. For the upper parts, the well's diameter can be 20 inches or more and drilling in deeper parts continues with smaller diameters. After reaching a proper depth, the well is cemented by the casing pipes with a diameter less than the well's diameter and the cement is pumped into the space between the casing pipes and the well's wall. These surface pipes do the cementing from the surface to a depth more than the depth of surface drinking waters. Next, a well with lower depth is drilled and another cased string is guided into it and cemented. This process may be repeated several times.

Direction wells

In the mid 1970s, new technologies like in-well engines and drilling measurement tools were introduced which made vertical drilling possible. Drilling wells could now take angles towards any direction in order to reach an oil reservoir. This led to the increase of oil production. There are three types of directional drilling naming developed drilling wells, horizontal drilling, and multiple horizontal wells.

Developed drilling wells: This technology is used in areas in which drilling from the surface to the specified point is impossible or expensive. For example, marine drillings are more expensive than land drillings and if the structure is a couple of kilometers far from the land (inside the sea), directional drilling from the land towards the sea would be beneficial. Another option would be using a marine platform which multiple wells with different directions and depths can be drilled using it. Therefore the number of surface facilities decreases. An interesting example of this operation can be creation of four artificial islands in a bay near California coast which contains oil wells along with residential areas. Over 1200 wells are drilled from these artificial islands in order to reach the specified oil reservoirs. Over 60% of the drilled wells have an angle of 50 degrees or more. If we look at these wells from the top, they look like spider webs laying towards different directions in the island.

Horizontal drilling: some Hydrocarbon producing structures are not thick, but are continued in a horizontal fashion. Before emersion of directional drillings, excavation of such structures was impossible or drilling of multiple wells was required. The modern technology made the completion and exploitation of wells in a pretty thin horizontal layer possible. A vertical well is drilled from the surface to a specific depth and from that depth on, the drilling continues horizontally. A single horizontal well can have more contact area with the reservoir and decreases the environmental pollutions as well as increasing the productivity. Therefore it is used instead of multiple vertical wells.

Multiple horizontal wells: Some structures contain multiple small oil areas or zones in different depths. In order to exploit these sources using traditional vertical wells, multiple wells are required. Using the directional drilling technologies for drilling these types of wells, first a vertical well is drilled for reaching a specific point (the main well is single). Then multiple horizontal wells with lower diameters are drilled.

Drilling wells with smaller diameters

The amount of produced drilling waste is in a direct relationship with the diameter of drilled well. When multiple technologies are used simultaneously, wells with smaller diameters can be drilled. While drilling wells with small diameters, the tensional and pulling load of pipes decrease due to the small diameter of the drilling pipe and therefore in-well engines are utilized.

Casing strings having less distance due to diameter: the size and amount of wastes is a function of the type of drilling auger and the diameter of used casing pipe. In the past, casing augers and pipes were available in specific standards, so that any reduction affected the size of the well. In the last decade tough, the number and variety of available augers and casing pipes has dramatically increased and led to similar diameters in produced casing pipes.

Narrow cavity drilling: Narrow cavity wells are those in which about 90% of it is drilled using a 6 inch or less diameter auger. Although the narrow cavity technology was introduced in the mid 1950s, it was not applicable in that time, since for small diameter wells, simulation, production and other in-well operations were difficult. Modern technologies overcame the existing difficult situation.

Coiled tubing drilling: In this method, those parts of the drilling pipes wrapped around the pulley are not used. Instead, a continuous length of pipes are sent into the well and is controlled using a pulley. Coiled tubing has a smaller diameter compared to common drilling pipes and therefore produces a smaller amount of wastes. Also, because of its high technology, creating angles is done more precisely inside the well. Not only it reduces the volume of wastes, but also requires a smaller working surface and reduces the air pollution.

Drilling techniques for reducing required drilling fluids

Drilling fluids play an important role in well drilling. Also, they get polluted after contact with different structures and additives and they should be excreted or recycled after the drilling operation. In some wells, drilling can be performed with few or no drilling fluids.

Air pressure drilling: in some structures, wells can be drilled using the air or other gases as drilling fluid. There are four different types of air pressure drilling processes: air dust drilling, dust drilling, foam drilling, and air pressed mud drilling. In these methods wastes are carried to the surface using gas or a combination of gas and mud. Drilling with air pressure does not need considerable surface reservoirs compared to mud drilling. Therefore this technology can be used in environment critical situations.

CONCLUSION

• In areas in which hydrocarbon reservoirs are on an environmental spot (like forests, sea and residential areas) and there is a risk of environmental damages due to drilling operations, developed drilling wells can be helpful. On the

other hand, this methods allows multiple wells to be built on a single spot which prevents environmental damages like mud additives.

- In horizontal drilling method, since only one well is drilled in the distance between the surface and the production structure, fewer wastes exist compared to multiple vertical wells. Also, the possibility of clash between a well and underground water sources decreases and only one infrastructure is needed instead multiple ones which in turn reduces surface pollutions.
- In the multiple horizontal wells method, the total volume of produced drilling wastes is fewer than the time when multiple wells were drilled. Also, because of decrease in the number of surface infrastructures, surface pollutions are reduced.
- The smaller diameter we have for the well, the less wastes will be produced. Plus reducing wastes, narrow cavities require smaller infrastructure compared to common ones, but they require higher technology.
- In special cases, air pressure drilling can be used. In this method, there is little environmental pollution, since the air is not mixed with the material existing in the structure and there are fewer additives and the recycling of the drilling fluid is easier. That's why this method can be applied in environment critical areas.
- Due to high expenses of drilling waste management strategies, most governmental companies do not take them. Privatization and as a consequence proper management of projects are important factors which can assist us in preserving the environment. The government can force companies to obey the determined rules and obligations by privatizing oil companies and maintaining its controlling position on companies and projects and therefore reduce the expenses related to well drilling. On the other hand, lack of parallel environmental structures in oil companies is another reason of lack of attention to this important matter among companies. Having environmental structures in governmental companies has less application compared to when he government itself appears as an environment guard due to high expenses. Lack of standards and obligations for monitoring the performance of drilling companies has caused these companies to leave their wastes in situ after the end of their operations and take no action about recycling or disposal of them. The government or related organizations can offer the proper management strategies to these companies and obligate them to obey them.
- Drilling fluid systems which produce fewer wastes can help us preserve the environment. Selection of drilling fluid can be effective on the volume of total used mud and resulting waste. Synthetic-based fluid (SBM) cleans the well better than Water-based mud (WBM) due to smaller volume of produced wastes. SBM can be recycled, but WBM is disposed into the sea in marine conditions.

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