UBD Technology in Petroleum Exploration

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ABSTRACT–

UBD technology is a revolution in the field of modern drilling techniques which uses the methodology of injecting non-condensable gases like nitrogen with circulatingsystem or air drilling system .This system has a lot of advantage like cost production evaluation, improve production rates , and reduced environmental impacts this system is already being used successfully in countries like Brazil, Canada etc. This paper depicts clearly theclassification this under balance drilling technology.

INTRODUCTION

Under balance drilling (UBD) is used when the effective down hole circulating pressure of the fluid system in contact with rock formation is lower than the existing formation pressure. USD has been utilised to minimize the formation damage due to invasion of mud solids and fluid filtrate into permeable and fractured formations. However if the drilling fluid does not have the adequate invasion properly, the severity of losses to the formation could increase if the under balanced conditions are not maintained at all times. Over balanced pulses may occur due to bit trips or mechanical problems that are common during the drilling process. Even though well productivity increases with under balance conditions, periods of over balance can ruin or reduce the advantages obtained after making the effort and expenses to drill the well under balanced. These days the oil industry is making effort to quantify more accurately the damages caused by these over balanced periods completely or properly design the properties of the drilling fluid to minimize the loss in productivity.

Under balance drilling technology is a valuable method for minimizing formation invasion related problems. Because the majority of hydrocarbons today are found in existing fields with depleting pressures, or in complex and low quality reservoirs, the economical use of USD becomes more and more popular. Most of under balance drilling applications today are conducted through the use of coiled tubing system. Under balance drilling can save the industry millions of dollars by increasing

the amount of recoverable oil within a shorter time frame.

FORMATION DAMAGE MECHANISM

A number of formation damage mechanisms do exist when drilling in under mode, which includes: Spontaneous counter current imbibition effects which allow the entrapment of potentially damaging aqueous fluid filtrate in the near well bore region;

- Problems arising from high fluid and solid losses to the formation
- Glazing and surface damage effects caused by the low heat capacity of circulating fluids and inadequate lubrication and turbulence to effectively remove the cuttings
- Change of rock wettability due to the presence of surfactants in the drilling fluid.

AREA OF APPLICATION

Under balance drilling has particular advantages in situations where the potential for severe fluid loss or lost circulation exists. This would include reservoir situations such as:-

- Highly fractured sand stone or carbonate formations where the majority of permeability is contained in the fracture system.
- Heterogeneous high permeability vagular carbonates.
- High permeability unconsolidated or consolidated sands.
- Formation exhibiting extreme sensitivity to chemically induced formation damage.

FLUID SYSTEMS

Air Drilling System:

Air drilling is the optimum circulating system, producing penetration rates 3 to 8 times faster than with a conventional mud system. The system can improve bit wear, drill a straighter hole, control lost circulation, and reduce pay zone damage.

Foam Drilling System:

Performed on the surface it acts like a drilling fluid yet has a superior hole cutting capabilities and penetration rates. Reduced air volume needed for implementation minimize equipment requirements and low annular velocities minimize erosion in unconsolidated formations.

Aerated Fluid Drilling System:

Air or gas is injected under pressure into water or conventional mud lowering the hydrostatic pressure. It substantially reduces low pressure lot circulation and is beneficial in severe loss zones. Nitrogen is added to fluid system where ever an inert gas system is required.

SURFACE EQUIPMENT

Compression and Nitrogen Generation System:

Compressor units and use of membrane nitrogen units that filter nitrogen particles from the air to produce continuous 95-99% nitrogen on site for a low cost, reliable alternative to cryogenic nitrogen.

Rotating Pressure Control Heads:

It is required to have continuous control of well even while rotating the drill string.

Separator:

It is skid mounted self-contained units designed to separate air from mud.

BOPs and Choke & Kill Manifold:

A complete set of annular, ram BOPs and choke & kill manifold is required.

DOWN HOLE TOOLS

Motors:

Positive displacement motors are available for drilling or clean out operations and can be used up to temperature of 600º F. It can be driven on nitrogen.

Percussion:

Air rotary hammer drills are used in extremely hard and abrasive formations to provide maximum penetration rates. They are designed to work with air but can also be used with foam techniques.

BENEFITS AND LIMITATIONS OF UNDER BALANCE DRILLING

BENEFITS

- Pressure maintained by wellbore below the reservoir pressure allows reservoir fluids to enter the wellbore, which avoids formation damage. By avoiding significant formation damage, the stimulation requirements during the purpose of well completion are also reduced, which leads to considerable savings.
- Potential hydrocarbon zones are detected by the help of under balance drilling, and also for identifying the zones that would have been bypassed with conventional drilling methods.
- During under balance drilling there is no physical mechanism to force drilling fluid into the formation drilled. Therefore, lost circulation is kept to a minimum when fractured or high permeability zones are encountered.
- Due to the decreased pressure at the bit head, UBD operations demonstrate superior penetration rates compared to conventional drilling techniques. Along with reduced drilling times, an increase in bit life is typically reported.
- Since there is no filter cake around the well bore wall, the chances of differential sticking are also reduced.
- Since conventional drilling fluids are not used in under balanced drilling applications, there is no need to worry about disposing potentially hazardous drilling mud.

LIMITATIONS

- Under balance drilling also has disadvantages that can prove detrimental to the outcome of the drilling process.
- There is a higher risk of blow out, fire or explosion.

- Under balance drilling is still an expensive technology. Depending on the drilling fluid used, the cost can be significant, particularly for extended reach horizontal wells.
- It is not always possible to maintain a continuously under balanced condition. Since there is not a filter cake around the wellbore, any instantaneous pulse of overbalance might cause severe damage to the unprotected formation.
- UBD has its own unique damage mechanisms, such as surface damage of the formation due the lack of heat condition capacity of underbalance drilling fluids.
- It is more complicated to model and predict the behaviour of compressible drilling fluids.

HOLES CLEANING CONSIDERATIONS

Decreased bottom hole pressure typically causes higher penetration rates. However, higher penetration rates can increase the circulating bottom hole pressure and bring the well back to overbalanced conditions. Moreover, due to the annular fluid segregation, there is an increased risk that the wellbore will be packed-off resulting in stuck pipe. In this situation, gas tends to rise while the liquid settles to the bottom of the hole. This is a major cause of increased bottom hole pressures because of the increased fluid density at the sand face.

Large cutting volumes generated by high penetration rates are also difficult to remove. Therefore, penetration rates should be carefully adjusted to ensure sufficient hole cleaning and slug removal.

Inadequate liquid flow rates can cause sticky-hole conditions that result in differential sticking. A decrease in ROP would therefore be needed for the cutting to be transferred to the surface. A viscosified aqueous phase is an important factor in achieving better ROP.

LIMITING TECHNICAL FACTORS

- Reduced wellbore pressure gradients can cause hole stability problems.
- Formation of mud rings can block air flow, leading down hole fires.
- Water causes cuttings to accumulate, thus causing the drill string to stick. If aerated mud is used rather than air, differential under balance can be reduced.
- HC's and air often mix to achieve a flammable range. With a small spark, which can be generated by the contact between the drill string and hard minerals, the risk of fire increases.
- Stable foam condition is not easy to achieve.

SAFETY IN UNDER BALANCE DRILLING

The presence of hydrogen sulphide in produced hydrocarbons poses an extreme danger to the rig personal. Hydrogen sulphide is extremely

poisonous and can be fatal even at very low concentrations. If the presence of hydrogen sulphide is anticipated during drilling, the operator must provide:

- Necessary notice of the proposed operations and hazards
- Special training
- An emergency contingency plan
- Hydrogen sulphide resistive material

CONCLUSION-

The UBD technology had a lot of positive impacts like faster drilling and higher productive rates which gas a great advantage in the field of petroleum exploration, .moreover it also extends the life of the drill bit which contribute towards ultimate cost reduction.

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