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Abstract

With the emergence of horizontal wells, a new type of problems soon emerged; of which was of sand in the horizontal well bore. Sand has mostly been regarded as an evil in the production environment. Failures in the production due to sand plugging or excessive wear on production equipment have lead to many grey hairs for well owners when dealing with a problem that seemingly never stops. However, the sand might also be the very arteries and veins of the reservoir and thus be an asset to the production.

The positive/negative effects of sand in the production set-up can only be dealt with efficiently by incorporating a proactive contingency plan of action for mitigating the problems. [Welltec has over the years developed several solutions to abate different well issues such as setting and pulling plugs with the Well Stroker®, shifting the state of sliding sleeves with the Well Key® and milling out troublesome valves with the Well Miller® to name but a few of the tools developed by Welltec.

Welltec has adapted a practical approach to problem solution scenarios and tools are developed in tight collaboration in a close working relationship with well owners and other service providers to ensure that the solution sought will not only apply to the well in question, but also act as a built-on generic solution for solving a broader scope of challenges in the future. Måske skulle vi uddybe dette, hvis vores fremtidsplan er at komme med på tegnebrættet.

Sanding up

The real predicament is the fact that usually only limited sand production occurs, but the well owner needs to assess the well system to block off the zone that was the culprit in the sand production, meant in cleaning, assessing and alleviating the problem in a quick succession.

Having toyed ideas on sand bailing for some time Welltec has addressed this issue by establishing a development team, accessing a library of relevant information and developing a conceptual solution to the problem. The concept encompasses an operational scenario outlining all operational aspects of the sand bailing operation to avoid HSE issues/problems.

Introduction

With the emergence of horizontal wells, a new type of problems have come to the surface; of which being of sand in the horizontal well bore. Sand has mostly been regarded as an evil in the production environment. Failures in the production due to sand plugging or excessive wear on production equipment have lead to many grey hairs for well owners when dealing with a problem that seemingly never stops. However, the sand might also be the very arteries and veins of the reservoir and thus be an asset to the production.

The positive/negative effects of sand in the production set-up can only be dealt with efficiently by incorporating a proactive contingency plan of action for mitigating the problems. [Welltec has over the years developed several solutions to abate different well issues such as setting and pulling plugs with the Well Stroker®, shifting the state of sliding sleeves with the Well Key® and milling out troublesome valves with the Well Miller® to name but a few of the tools developed by Welltec.

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A solution by Welltec always implies a tool carried to the trouble zone quickly and with Måske skulle vi uddybe dette, hvis vores fremtidsplan er at komme med på tegnebrættet. the Well Tractor® as the tool conveyer. The

Well Tractor[®] system offers superior control of the tools compared to most other systems. The Well Tractor[®] has a number of read-outs allowing the tractor operator to adjust the speed and force to the application. Furthermore, the tractor provides an excellent weight-on-bit control and through an advanced feed control system, it can deliver accurately proportioned power to drive tools. In applications where the Well Tractor[®] acts in both conveyance and intervention mode the system can alleviate the sand build-ups, but also investigate the root of the problem cause. Welltec has a close working relationship with most oil field tool service companies – and these can be mounted on the Well Tractor[®] for surveying the reservoir conditions in depth.

Sanding up

A well owner contacted Welltec as he had a reoccurring sand problem. His production zones in a reservoir were constantly sanding up and he was spending thousands of Dollars in a never-ending battle to keep production levels up on the wells. The sanding problem was not a surprise since the reservoir engineers had warned him beforehand that sand would be a problem in the system. However, the production forecasts made the well owner disregard all concerns and start up the reservoir.

The real predicament in the system is the fact that usually only limited sand production occurs, but the well owner needs to assess the well system to block off the zone that was the culprit in the sand production, meant ingcleaning, assessing and alleviating the problem in a quick succession of each other.

Having toyed ideas on sand bailing for some time Welltec has addressed the sand issue by establishing a development team, accessing a library of relevant information and developing a conceptual solution to the problem. The concept encompasses an operational scenario outlining all operational aspects of the sand bailing operation to avoid HSE issues. This paper will present different designs for optimising the sand cleaning system.

Sanding down

At Welltec the design process is always practical as well as iterative; the creative team keeps on testing and designing until the best possible solution is at hand. The result of their work in relations to sand is the Well Sand Bailer System with the specific product name: Well Cleaner[®].

During the evolutionary development of the Sand Bailer, Welltec addressed a series of issues in order to establish a generic library of knowledge. First a crude model of a production system was developed, which would provide the team series of questions, each addressing a specific part of the tool. Secondly, they went on to refining the system with respect to sanding as well as the production of sand by using relevant published material to determine the situations.

One of the biggest issues in the development was the fact that despite similarities in well design, each well is unique and therefore has its own characteristics. This implies that each jobs requires a unique research and investigation process.

To alleviate any well-site surprises, Welltec has developed a simulation system can accurately describe the well trajectory, well conditions and using the input from the operator can compute the tool solutions for efficient operations.

However, despite Welltec's best efforts to mathematically model the problem, it was soon realised that the complexities, as described, had an exponential growth effect in terms of related issues. Welltec has therefore a continuous on-going program to further enhance the simulation system.

Welltec has entered into a 3-year research program with the aim of developing a plug-in style application can be attached to the simulation program. When certain conditions are encountered the plug-in will be enabled and ask a series of additional questions to describe the well situation and create a phased work program for the at-well-site operations. The research program is a combination of an industrial PhD and a close working relationship of an esteemed university.

In the development of the Sand Bailer system, the next step in the process was to analyse the consistency of sand as sand is not just sand. Grain size, porosity and chemical mixture of the sand vary considerably from well to well, from production zone to production zone, which puts the engineering in a dilemma when it comes to filter design in the Sand Bailer. Due a procedural development it was possible to evaluate the effects that different types of sand have on the filter or sand trap in the Sand Bailer System. These tests and analyses lead to the question of how to optimise the flow speed depending on different grain sizes and compositions.

Final step concerned impeller design. The flow creation in the Sand Bailer is based on an optimised impeller, and a significant amount of working hours were spent on the design so it would withstand being exposed to a mixture of sand and brine.

During development Welltec realised that one tool would not do everything and at least two product families were needed, each consisting of several configuration possibilities.

Liquid

The Sand Bailer working in a liquid environment uses flow as the main driver to propel the bailing of sand. The tool can be tractor conveyed (for long horizontal traverses) or used as a stand-alone application (in more vertical well sections).

Whether on Well Tractor® or wireline the tool consists of a basic rotational unit (BRU) consisting of electronics, compensator and motor sections. The BRU drives an impeller – the impeller gets the flow to circulate through the tool and ‘drags’ sand to the bottom of the tool where it will deposit in the sand trap chamber. Depending on the configuration of the tool a different number of sand trap section can be mounted on the tool – typically between 2 – 6 sections are used. Each section has a capacity to hold approximately 5 litres.

A drive shaft runs through the sand trap section upon which a brush tool is mounted. The brush helps getting flow circulation going especially in environments with heavy type sand that are not easily suspended in the flow.



Figure 1: Sand Trap Chambers

Welltec has different types of revolving bull nose paddles (not illustrated) and brushes each designed to a range of operations.

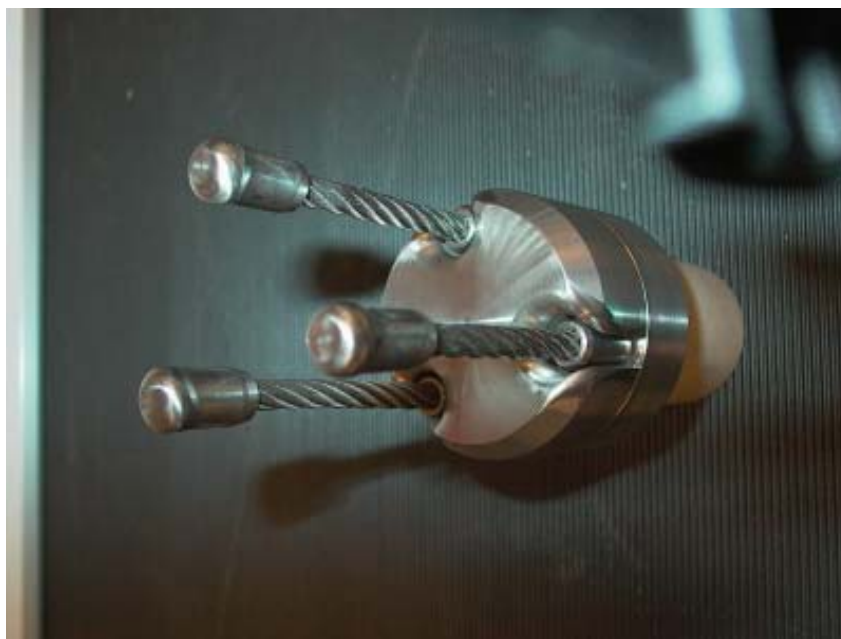


Figure 2: Flare Brush

The Sand Bailer for liquid environments is able to pick up debris ranging from 0,02” to 0,6” in grain size.

Dry

The Sand Bailer for dry environments cannot use fluid to suspend and drag material into the sand trap chambers. Again the same BRU as for liquid bailers are used. In addition, an inner helix drags the sand into the sand trap chamber. A scraper device is mounted at the tip; this is designed to loosen the sand for the transport into the tool. The bottom of the tool has an inner housing, which prevents the sand from falling out, after being retrieved. Similar to the Sand Bailer for Liquid environments the sand trap section has a capacity to hold approximately 5 litres and is able to pick up debris ranging from 0,02” to 0,6” in grain size.



Figure 3: Revolving paddle



Figure 4: Brush w/ plate



Figure 5: Brush for harder debris and scales

Figures 4 and 5 are new additions to the application, issued in spring 2006. These new additions are special since the rotational force pushes the tool to the side of the casing and the tool starts scraping away.

Case story

Welltec had a successful bailing operation with BP in the spring of 2005. After a successful wireline conveyed milling operation using the Well Miller[®] it was found that a large portion of the production zones was obstructed with a layer of sand and scale.

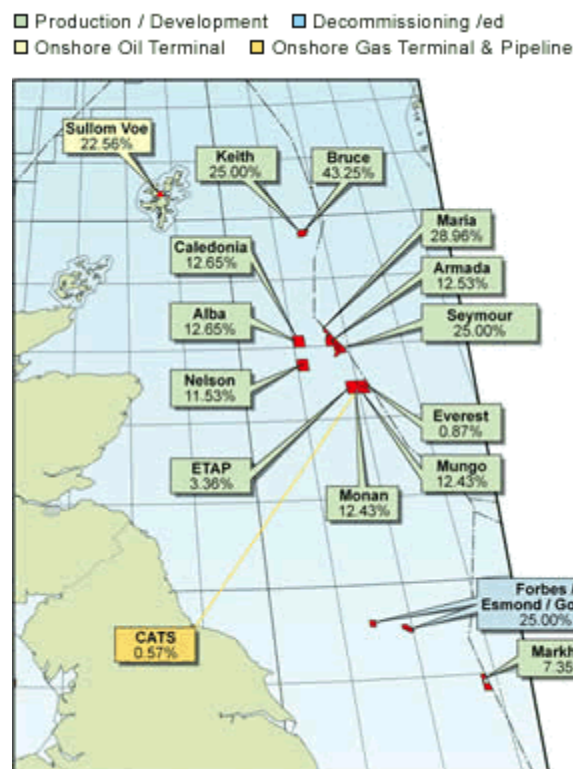


Figure 6: Everest Field

Welltec was given the project and was able to successfully extract the sand in the production zone. In total 69 ft of production zone was regained and considerable time was saved in comparison with the second option for a sand bail i.e. coil tubing.

Afterwards BP estimated that the cost savings where approximately £0,5 mill with 50% lesser offshore days and 50% fewer crew for the total operation incl. Welltec field crew, BP and service company field crews.

Conclusion

So – that leaves the question is sand friend or foe? To Welltec it is a challenge with each individual operation – and a welcome challenge because with each operation Welltec is able to add operational knowledge to the tool packages to the benefit of well owners worldwide.

There isn't just one answer to the question – but since sand is used in injection purposes as well, there is a duality about sand that makes it the material of dreams and nightmares.