Case History

CleanDrill™ Reservoir Drill-in Fluid (RDF) Helps Overcome H_2S Issues and Fluid Losses in Challenging Formations to Achieve Unprecedented Natural Gas Production, Onshore Germany

A combination of Newpark's pro-active expertise, state-of-the-art fluids systems together with the targeted application of product additives, overcame all the many obstacles to successfully drill a challenging reservoir section.

CHALLENGE	SOLUTION	RESULT
• Risk of encountering H_2S and experiencing fluid losses • Wellbore stability issues • Strict fluids parameters specified by operator	• Newpark's extensive experience and fluids expertise • Pre-project planning and product availability • Rapid formulation changes to overcome drilling challenges • CleanDrill™ minimally damaging Reservoir Drill-in Fluid • Avagreenlube™ ester-based lubricant • ClearTrack™ hydraulics simulation software to manage fluid properties	• Wellbore stability maintained • ClearTrack™ software modelling enabled rapid & accurate decision-making • Losses kept to a minimum by Newpark specialists' rapid response time • Unprecedented natural gas production from completed well

OVERVIEW

The operator selected Newpark for the project because of extensive experience on successful wells in the region, and subsequently awarded a contract renewal as a result of the performance and service quality metrics achieved.

A Reservoir Drill-In Fluid (RDF) system was required by the operator to drill the reservoir section with minimal damage to the formation, while maintaining the high fluid densities specified to stabilize the wellbore and maximize hydrocarbon production.

CHALLENGE

Due to the wide range in the reservoir formations to be drilled (anhydrite, salt dome, copper shale and finally carbon, there was a high risk of encountering H_2S and experiencing fluid losses, as well as associated wellbore stability issues.

The parameters that needed to be achieved included drilling the 6" reservoir section from 4101m MD to 5377m MD.

The previous well drilled from the same pad showed the need in the reservoir for a higher density than originally expected, this would be a significant challenge as an RDF with calcium carbonate would not be enough to reach and maintain the high densities necessary.

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SOLUTION

Newpark fluids experts specified our CleanDrill™ minimally damaging monovalent brine-based reservoir drill-in fluid (RDF) and prepared a suite of product additives to pro-actively manage the anticipated well conditions.

The CleanDrill fluid system was delivered ready-mixed from Newpark liquid mud plant in Emmen, The Netherlands, 20km from the rig site.

The well section was started with the pre-mixed CleanDrill RDF at 1.31 SG, weighted first to saturation with KCl/NaCl and then to density with Mikhart 40 and 65 sized calcium carbonates.

With technical input from Newpark specialist, this formulation was selected by the operator to ensure minimal reservoir damage, despite the fact that a final liner would be cemented in place and perforated. The CleanDrill RDF met all of the stringent requirements set by the operator.

Mud Parameters	Unit	Planned Value	Actual Value
Density	SG	1,20 - 1,30	1,05 - 1,51
PV	cP	alap	7 - 33
YP	lb/100ft^2	15 - 35	17 - 49
6 rpm @ 50 °C	rpm	> 6	6 - 17
6 rpm @ 70 °C	rpm	-	-
API Filtrate	ml/30 min	< 4	2,0 - 6,9
pH	-	10,0 - 10,8	8,9 - 11,0
LGS (drilled solids)	% Vol	< 7	1,0 - 10,7
MBT	kg/m³	< 15	0 - 7,19
Sand	%	< 1	0 - 0,5
KCl	kg/m³	50	-

RESULTS

At 4,439m, drilling with the CleanDrill RDF, a standpipe pressure drop was observed, followed by losses (dynamic 8 m³/h; static 3 m³/h). As drilling continued, increasing losses made it it necessary to act quickly to pump two Lost Circulation Material (LCM) pills based on different size of Calcium Carbonate particles. Losses reduced to 2.5 m³/h dynamic, while drilling ahead losses reduced to zero.

After a roundtrip for BOP Test at 4206 m, reaming started with 10 mt resistance. Bottoms up showed varying mud weights between 1.26-1.34 SG and cavings. The mud weight was increased to 1.36 SG and 1.40 SG. Finally, the mud weight was increased to 1.51 SG to stabilize the borehole and reduce cavings by using barite as weighting agent.

At a depth of 4,500m, torque increased to 3100 daNm. Newpark engineers tested numerous products with the RDF, but the excessive torque could not be significantly reduced without compromising the density characteristics of the fluid.

These various challenges and well parameters were modelled using Newpark's proprietary ClearTrack™ hydraulics simulation software, allowing the Newpark fluids specialists a complete understanding of fluid downhole behaviour, as can be seen in the screenshot below:

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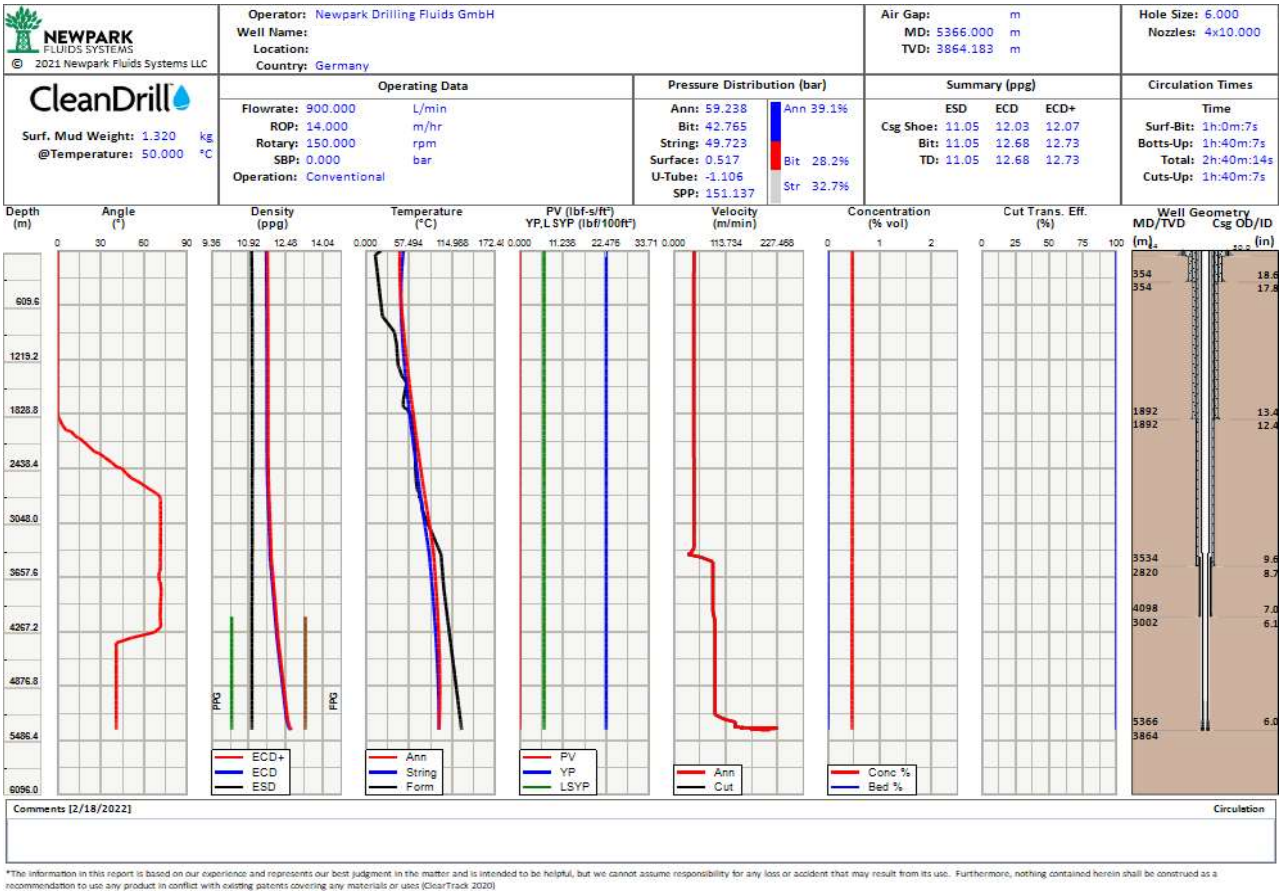

*The information in this report is based on our experience and represents our best judgment in the matter and is intended to be helpful, but we cannot assume responsibility for any loss or accident that may result from its use. Furthermore, nothing contained herein shall be construed as a recommendation to use any product in conflict with existing patents covering any materials or uses (ClearTrack 2020)

As a result of Newpark's comprehensive tests, the decision was taken to change the drilling fluid to a salt-saturated fluid weighted with barite, formulated with 2% of Newpark's proprietary Avagreenlube™ ester-based lubricant.

After cementing the liner and perforating, the well began producing gas at unprecedented rates, with more natural gas produced than all the previous wells in the field.

The successful drilling and completion operations and unexpectedly high natural gas production rates has allowed the operator to plan a campaign of three additional wells.

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