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MUD SOLIDS CONTROL FOR MINIMUM LIQUID DISCHARGE DEMONSTRATED ON WYOMING WELL -- A POSSIBLE APPLICATION FOR GEOTHERMAL DRILLING

Don Vesely

NL Baroid

ABSTRACT

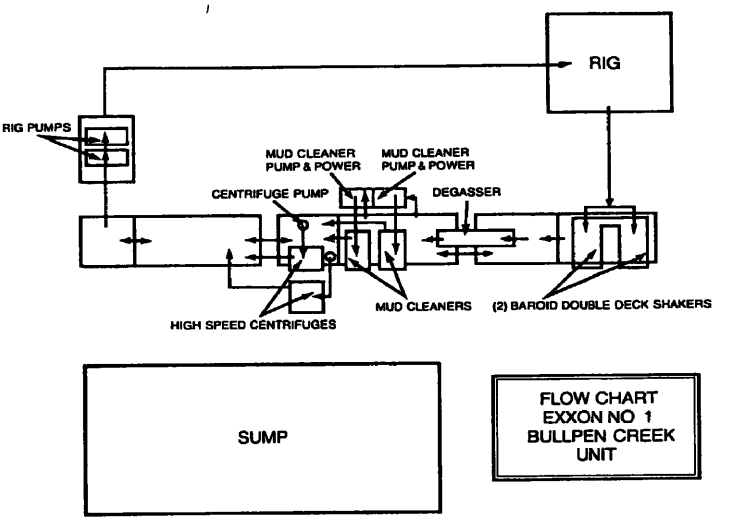
A 12,500 foot well was drilled in Wyoming with virtually no liquid discharge (jetting). This article explains how the solids control equipment was configured to achieve this objective and gives technical information regarding the percent solids removed by each piece of equipment.

Exxon Company, U.S.A. has completed its Bullpen Creek Unit #1 in Lincoln County, Wyoming. In March 1976 Exxon invited several service companies to submit drilling mud and solids processing programs for a wildcat well in southwestern Wyoming. Baroid was awarded the drilling mud, solids control equipment, and mud logging services on this project, which successfully utilized a closed mud system to a total depth of 12,500 feet. The Bullpen Creek unit was drilled by Parker Drilling Company's Rig 116 which was designated a special Bicentennial rig.

The mud processing equipment specification was a joint effort of Exxon Company, U.S.A., Exxon Production Research Company, and Baroid personnel in Denver and Houston. The unique design objective of the solids processing system was to minimize liquid discharge and, ultimately, to develop a closed mud system with dry solids discharge. Field research on this wildcat was conducted to provide insight and technology to handle ecological problems, reduce expense of reserve pit clean-up, and reduce water consumption and mud cost. The closed mud system used on the Bullpen Creek well would have application in areas such as the Beaufort Sea, the North Sea, or any other location where stringent regulations prohibit the discharge of solids and liquids, and where transporation of these materials from the rig site is very costly.

The Bullpen Creek solids control system utilized two specially manifolded BAROID DOUBLE DECK SHAKERS equipped with 50 mesh over 100 mesh screens to effect primary solids removal. Two BAROID MUD CLEANERS were utilized as an intermediate step in the control process. These mud cleaners which incorporate desilting and shaking operations, were equipped with 150 mesh screens to allow discarded fluid to be reclaimed and added back to the mud system.

The final solid-liquid separation stage was accomplished by the use of two high speed cylindrical



contour shaped centrifuges operating at 2500-3000 RPM. This equipment combined with the DOUBLE DECK SHAKERS and MUD CLEANERS comprised the entire solids removal system.

Discarded solids from each piece of equipment were collected in specially prepared steel bins and transported to the reserve pit with a forklift.

A series of special tests and measurements was performed daily to monitor such variables as flow rate and density into and out of the equipment, weight of solids discarded per minute, and percentage of liquid associated with the discarded solids. Water and chemical additions were monitored to obtain a material balance. Table I shows the results of these field tests.

TABLE I

Time Interval	60 days
Depth Interval	1,044 to 9,212 feet
Calc. lb of drill solids (theoretical)	1,130,000
Solids removed by Shakers, lb	563,000(47%)
Solids removed by Mud Cleaners, lb	292,000(24%)
Solids removed by Centrifuges, lb	334,000(29%)
Total solids removed, lb	1,189,000
Estimated 60,000 lb bentonite equivalent removed by centrifuges (based on the Methylene Blue Test)	
Water addition	800 bbl

The percentage of solids removed from each piece of equipment did not vary appreciably during the complete test. Between May 20 and May 31, 1976, it is estimated that 5,800 barrels of mud would have been jetted to the sump to remove the same amount of solids discarded by the mud cleaners and centrifuges. To maintain the mud density of 8.8 ppg during this time interval, approximately 470 bbl of mud would have been built each day.

The mud system used on the Bullpen Creek unit included AQUAGEL Bentonite and CARBONOX^{R} Mud Thinner Mud properties at 12,383 feet were good in spite of the fact that no mud was jetted and the reserve pit was dry. Table II illustrates these properties.

TABLE II

Mud Weight, ppg	8.8
Funnel viscosity, sec	35
Plastic viscosity, cp	5
Yield point, lb/100 sq ft	4
Gels, lb/100 sq ft	6/16
Filtrate, ML/30 min	26
Cake, 32nd in	2
Solids, 0/0	3.7
Water, 0/0	96.3
Clay content, ppb	13.5

The effective use of solids control equipment is a means whereby an operator can reduce costs of mud, water, transportation and reserve pit clean-up, while obtaining a good low solids mud system. This technique is applicable for Geothermal, oilfield, mining, and other rotary drilling operations. It is essential to the success of such a system to have conscientious, able personnel present to supervise the operation. Such personnel were responsible to a great degree for the effectiveness of the closed mud system at Bullpen Creek.

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THE AUTHOR

Don Vesely is Regional Technical Services Manager for NL Baroid's Western Region. He graduated from the University of Texas in 1965 with a degree in Mathematics. Vesely worked as a Sales Engineer on the Texas Gulf Coast and has been a Regional Engineer in Midland and Denver. Also, he was District Manager in Vernal, Utah.