Improved methods, technology & best practices create savings in composite plug milling operations



William Handy – Applications Engineering Manager, Baker Hughes October 24th, 2013

© 2011 BAKER HUGHES INCORPORATED, ALL RIGHTS RESERVED. TERMS AND CONDITIONS OF USE: BY ACCEPTING THIS DOCUMENT, THE RECIPIENT AGREES THAT THE DOCUMENT TOGETHER WITH ALL INFORMATION INCLUDED THEREIN IS THE CONFIDENTIAL AND PROPRIETARY PROPERTY OF BAKER HUGHES INCORPORATED AND INCLUDES VALUABLE TRADE SECRETS AND/OR PROPRIETARY INFORMATION OF BAKER HUGHES (COLLECTIVELY "INFORMATION"). BAKER HUGHES RETAINS ALL RIGHTS UNDER COPYRIGHT LAWS AND TRADE SECRET LAWS OF THE UNITED STATES OF AMERICA AND OTHER CONTRIES. THE RECIPIENT FURTHER AGREES THAT THE DOCUMENT MAY NOT BE USED INFOLTUDE, COPIED OR REPRODUCED IN WHOLE OR IN PART BY ANY MEANS, ELECTRONIC, MECHANICAL, OR OTHERWISE, WITHOUT THE EXPRESS PRIOR WRITTEN CONSENT OF BAKER HUGHES, AND MAY NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO BAKER HUGHES.



- Stuck Coil
 - Large Debris
 - Low Annular Velocity
- Slow Progress
 - Washing Sand
 - Slow Mill Times
- Extra Trips
 - Short Trips
 - Hole Cleaning
 - Long Trips
 - BHA replacement
 - Cutting Coil





- Stuck Coil
 - Large Debris
 - Low Annular Velocity
- Slow Progress
 - Washing Sand
 - Slow Mill Times
- Extra Trips
 - Short Trips
 - Hole Cleaning
 - Long Trips
 - BHA replacement
 - Cutting Coil

- Stuck Coil
 - Large Debris
 - Low Annular Velocity
- Slow Progress
 - Washing Sand
 - Slow Mill Times
- Extra Trips
 - Short Trips
 - Hole Cleaning
 - Long Trips
 - BHA replacement
 - Cutting Coil

Solutions

- Stuck Coil
 - Large Debris
 - Low Annular Velocity
- Slow Progress
 - Washing Sand
 - Slow Mill Times
- Extra Trips
 - Short Trips
 - Hole Cleaning
 - Long Trips
 - BHA replacement
 - Cutting Coil

- Mill Design
- Application Specific Carbide

- Stuck Coil
 - Large Debris
 - Low Annular Velocity
- Slow Progress
 - Washing Sand
 - Slow Mill Times
- Extra Trips
 - Short Trips
 - Hole Cleaning
 - Long Trips
 - BHA replacement
 - Cutting Coil

- Mill Design
- Application Specific Carbide
- High Flow Motors

- Stuck Coil
 - Large Debris
 - Low Annular Velocity
- Slow Progress
 - Washing Sand
 - Slow Mill Times
- Extra Trips
 - Short Trips
 - Hole Cleaning
 - Long Trips
 - BHA replacement
 - Cutting Coil

- Mill Design
- Application Specific Carbide
- High Flow Motors
- Milling Parameters

- Stuck Coil
 - Large Debris
 - Low Annular Velocity
- Slow Progress
 - Washing Sand
 - Slow Mill Times
- Extra Trips
 - Short Trips
 - Hole Cleaning
 - Long Trips
 - BHA replacement
 - Cutting Coil

Solutions

- Mill Design
- Application Specific Carbide
- High Flow Motors
- Milling Parameters

Plug Design

Section 1 MILL DESIGN











Circulation





Section 2

APPLICATION SPECIFIC CARBIDE

Application Specific Carbide

- Optimizing Metallurgy & Form Factor Yields:
 - Increased Durability
 - Increased Rate of Penetration
 - Decreased Cuttings Size



Carbide Metallurgy



Case History

• 79 plugs milled with one mill

- Two wells
- Williston, ND
 - Bakken Formation
- 3-3/4" Mill
- 2-7/8" Motor



mill after drilling out 43 composite plugs



mill after drilling out 79 composite plugs

Section 3

OTHER CONSIDERATIONS

Workover Motors

- High Flow Rate 2-7/8" Motors
 - Higher Annular Velocities
 - More Power
 - Decreased Durability
- 3"+ Motors
 - Higher Annular Velocities
 - More Power
 - Increased Durability & Strength
 - Transportation and Handling Issues



Milling Parameters

Cuttings Size Milling Speed

Plug Design

- Hidden Slip Features
- All Cast Iron is NOT Created Equal
 - Cast Iron Type A: 1 min./in³
 - Cast Iron Type B: 7 min./in³

- Ceramic Buttons
 - Very Little Material
 - Very High Hardness
- Aluminum







QUESTIONS

THANK YOU