TETRA TECH RPS ENERGY | TRAINING

N689: Drilling Fluids

Instructor(s): Kevin Gray

Format and Duration
Classroom - 5 Days

Summary

This course will deliver an advanced understanding of modern drilling fluids and their selection for maximum operational efficiency. The course looks at both the fundamental aspect of both water based and oil based fluid systems and details the key aspects that are used to make the most appropriate choices of both base fluids and system additives.

This is very much an operationally focused course which looks to deliver a detailed understanding of not just the narrow field of the mud engineers work, but all the associated areas of risk that can result from the formulations, chemical additives as well as the testing techniques and procedures that they may use. The knowledge from this course can be directly applied to ongoing drilling operations or future well planning and will have a dramatic impact on drilling performance. All the topics are placed in their operational context and an understanding of how each topic is interrelated with the other subject areas in the course is developed throughout the week. Throughout the course areas in which the drilling fluids system can adversely impact the well cost or increase the well risk are detailed and the mitigations for these risks are discussed.

This course is delivered in partnership with Black Reiver Consulting Ltd.

Learning Outcomes

Participants will learn how to:

1. Understand the selection criteria for each mud type.
2. Describe and understand the functions of mud systems.
3. Understand the key additives and their effects on the physical and chemical properties of the mud system.
4. Be able to describe and understand the key tests that are used in testing drilling fluid and be able to interpret changes in the key properties of that fluid.
5. Be able to communicate clearly with the fluids engineering team both in the office and at the Rigsite.

Training Method

This is a classroom course comprising a mixture of lectures, discussion, case studies, and practical exercises.

- Practical demonstrations of all the key principles using models and simulations in the classroom.
- Mixed instructor led delivery of theoretical content with blend of PowerPoint overview, whiteboard explanations of detail and class interactive exercises.
- A narrative that runs through the course where each topic is interrelated and build on the previous learnings.
- Extensive allowance for class led questioning within the course delivery.

N689: Drilling Fluids

Instructor(s): Kevin Gray

Format and Duration
Classroom - 5 Days

Who Should Attend

This course is ideal for drilling engineers, well site supervisors, tool pushers, rig managers and field support personnel. Geoscientists or reservoir engineers looking to get better value from your interactions with the drilling team. Anyone involved with improving drilling performance and cutting drilling costs.

Course Content

1. Introduction to Drilling Fluids

- Overview of drilling fluid functions, including cooling, lubrication, and cuttings transport.
- Types of drilling fluids: Water Based Mud (WBM), Oil Based Mud (OBM), and Synthetic Based Mud (SBM).
- Selection criteria for drilling fluid types based on well conditions and operational needs.

2. Hydraulics Design from Pump Back to Pits

- Understanding drilling fluid circulation systems, including surface and downhole components.
- Pressure loss calculations across the circulating system to optimize hydraulic efficiency.
- Impact of fluid viscosity, flow rate, and wellbore geometry on hydraulic performance.

3. Drilling Fluid Properties – Basic Designs

- Key drilling fluid properties: density, viscosity, gel strength, pH, and filtration control.
- Importance of fluid property control in wellbore stability and hole cleaning.
- API and industry standards for fluid property measurement and quality control.

4. Wellbore Stability Issues and Drilling Fluid Design

- Causes of wellbore instability, including mechanical failure, chemical interaction, and differential sticking.
- Role of drilling fluid selection in maintaining wellbore integrity.
- Use of inhibitive fluids, additives, and bridging agents to improve stability.

5. Water Based Mud (WBM) and Rheology

- Principles of Rheology
- Fundamentals of fluid flow behaviour in drilling operations.
- Understanding plastic viscosity, yield point, and gel strength and their impact on hole cleaning.
- Effects of temperature and pressure on rheological properties.

6. The Chemistry of Clays

- Types of clays in drilling fluids (e.g., bentonite, attapulgite) and their impact on viscosity and gelation.

- Clay hydration and dispersion: How water chemistry affects fluid properties.
- Additives used to control clay swelling and improve fluid performance.

7. Basic Water Based Mud (WBM) Systems

- Composition and properties of freshwater, saltwater, and polymer based WBMs.
- Advantages and limitations of WBMs in different drilling environments.
- Common additives for rheology control, filtration reduction, and shale inhibition.

8. Non Aqueous Fluids (NAF) and Solids Control

- Non Aqueous Fluid (NAF) and Synthetic Based Mud (SBM) Systems
- Composition and differences between oil based and synthetic based muds.
- Advantages of NAFs and SBMs: Improved lubrication, thermal stability, and wellbore stability.
- Environmental regulations and cuttings disposal considerations for NAFs and SBMs.

9. Solids Control Systems and Techniques

- Importance of solids control in drilling fluid performance and cost management.
- Use of shale shakers, desanders, desilters, centrifuges, and hydrocyclones in solids removal.
- Effects of poor solids control on fluid properties, equipment wear, and wellbore stability.

10. Lost Circulation Material (LCM) in Drilling Fluids

- Causes of lost circulation and its impact on drilling operations.
- Types of LCM additives: Fibrous, granular, and flake-based materials.
- Selection and application of LCM to mitigate different loss zones.

11. Wellbore Stability and Stuck Pipe Prevention

- Basics of geomechanics and wellbore stability
- Stuck Pipe – Causes and Prevention
- Types of stuck pipe incidents: Differential sticking, mechanical sticking, and wellbore collapse.
- Role of mud weight and rheology in preventing stuck pipe situations.
- Techniques for freeing stuck pipe, including jarring, rotation, and chemical spotting.

12. Wellbore Strengthening Techniques

- Methods to improve wellbore integrity and prevent fracture propagation.
- Application of sealing agents, bridging materials, and wellbore stress management.

13. Mud Lab Operations

- Basic lab equipment, functionality and use

- Importance of regular fluid testing and Realtime monitoring.
- Standard API/ISO laboratory procedures for measuring drilling fluid properties.
- How lab data is used to optimize drilling fluid formulations.

14. Advanced Applications and Assessment

- Reservoir Damage and drilling fluids
- Understanding formation damage mechanisms, including fluid invasion, fines migration, and permeability impairment.
- Drilling fluid formulations designed to minimize reservoir damage.
- Use of bridging agents, polymers, and cleanup treatments to protect the reservoir.
- Considerations for HPHT and Geothermal Wells
- Unique challenges in High Pressure High Temperature (HPHT) and geothermal drilling.
- Selection of temperature stable drilling fluids and additives.
- Pressure management techniques to handle extreme wellbore conditions. (MPD)

15. Drilling Fluids for Cementing Operations

- Role of drilling fluids in effective cement placement.
- Fluid compatibility and displacement efficiency considerations.
- How pre-flushes, spacers, and fluid loss control agents improve cementing success.

This detailed training curriculum provides a structured learning path covering: Drilling fluid fundamentals and advanced applications. Hydraulics, rheology, and wellbore stability considerations. Solids control, stuck pipe prevention, and HPHT drilling challenges.