Cement Integrity Assurance and Evaluation

Course Description:

In an oil or gas well, the cement sheath behind the casing is the first barrier between the reservoir and the surface. Any failure, either during the placement or in the first hours following the cement job, can lead to catastrophic consequences related to safety and costs related to safety and environment. The cement sheath integrity is also a key factor controlling the life of the well. The development of fluid migration paths in the annulus or fractures can dramatically shorten the life of the well and reduce its value. Therefore, it is extremely important to understand and control drilling, cementing, and well completion parameters, all of which can affect the integrity of the cement sheath for the entire life of the well.

Various techniques exist to evaluate the cement integrity, either directly or indirectly. All of these techniques (hydraulic pressure signature, material balance, LOT/FIT, injection tests, and cased hole logs) have their advantages and limitations in the assessment of the cement sheath. An integrated approach towards cement evaluation can result in improved barrier evaluation.

The use of these methods, either individually or through an integrated approach requires an understanding of the data acquisition techniques, including the factors that affect the quality of the measurements.

Course participants will take part in a detailed review of the cementing processes, cement sheath evaluation, and discussion of various measurement methods and interpretation techniques. Remedial cementing theory and practical application of squeeze methods will be covered so that if the primary cement job is not successful the participants will understand how to repair or correct a cement integrity failure.

This course includes

- A detailed review of the cementing processes and parameters that would ensure the integrity of the cement sheath during the life of the well.
- A comprehensive cement sheath evaluation section discussing the various measurements and interpretation techniques as well as the factors that affect the quality of the measurement and interpretation.

The course includes classroom sessions on cementing practices and log interpretation. For classes scheduled in Aberdeen there is the opportunity to visit our Schlumberger facility where attendees have the opportunity to review cement evaluation technologies.

The participants will be encouraged to come with their own examples that include all associated information, such as well construction details, cementing and log data. The participants will hence be willing to share their data and discuss their experience.
**Audience:**
This course will be most useful to drilling, production, and completion engineers.

**Prerequisites:**
Participants should have a basic knowledge of cementing and logging operations.

### Course Agenda

#### DAY 1
**Cementing Objectives and Importance of Mud Removal**
- Introduction to cementing
- Cement rheology
- Mud displacement

Participants will start off day one with a general introduction to cementing. This will set the stage for understanding the importance of effective cement placement and performance. The day will proceed to include the topics of fluid rheology, friction concepts, density hierarchy, centralization, pipe movement, spacers, and washes. Learning about these will help participants to better understanding of the impact these factors have on efficient mud removal.

#### DAY 2
**Importance of Temperature for Proper Design Plus Cement Evaluation**
- Temperature determination
- Temperature simulation
- Cement evaluation – logging tools and interpretation

On the second day participants will learn about the importance of accurate temperature determination and the effects high temperature have on set cement. Simulation methods for estimating circulating and static temperature will be taught. The second half of the day will be spent learning how cement evaluation tools work, how they are used, and how to interpret different cement evaluation logs. Evaluation logs will be used to illustrate how cement type, centralization and quality control affect log interpretation.

#### DAY 3
**Annular Fluid Migration and Cement Defects**
- Consequences of gas migration
- Paths for gas migration
- Cement slurry to solid transition effects
- Migration prevention
- Flow path effects

Day three will focus on the consequences of gas migration behind the pipe. Participants will get to learn what types of paths might form, how these paths might be prevented, and what happens as the cement slurry goes from a fluid state to a solid state. During this transition phase it is important to understand what happens and how this can be countered. Techniques and materials which can be employed to prevent gas migration will be covered. To drive this day’s learning home the participants will calculate potential flow capacity of cement sheath defects.

#### DAY 4
**Mechanical Properties of Set Cement, Lab Testing, and Use of Ultrasonic Imaging Tool**
- Overview of mechanical properties of Solids
- Laboratory testing of cement
- Important properties for long term Integrity
- Ultrasonic imaging tool (USIT)

Day four will include a short review of mechanical properties of cement, steel, and formation. Participants will learn how lab testing is performed and what the implications of test results have on the performance of the cement sheath. Some “rules of thumb” for target mechanical properties will be discussed. Remedial cement properties and material selection for long term well integrity will also be covered. Ultrasonic imaging tools will be discussed so that the participants will better understand the usefulness of this tool and how it is used to evaluate behind pipe cement performance.

#### DAY 5
**Remedial Cementing**
- Squeeze cementing theory and objectives
- Running vs. hesitation squeezes
- Well preparation
- Recommended practices and misconceptions

The last day will cover possible remedial actions taken to fix a possible lack of integrity of the cement sheath. Remedial or squeeze cementing objectives and applications will be explained, as well as some suggested methods of performing squeeze jobs on different types of problems. The day will conclude with a review of what has been learned throughout the duration of the course.