1. **BACKGROUND**

- One of the major goals petroleum engineers have to achieve is to find the most efficient and beneficial way to extract oil and gas.
- A critical part of oil and gas production is the drilling process. In order to maximize the efficiency of the process, the problems associated with drilling have to be reduced.
- If left inside the well, these cuttings will:
  1. a reduction in rate of penetration
  2. formation fracturing, resulting in fluid loss
  3. premature bit wear
  4. lead to increased drill string torque and drag
- The process of transporting the cuttings from the bottom of the well to the surface is called wellbore cleaning, and the cuttings are transported using drilling fluids.
- The effectiveness of drilling fluids, either water-based or oil-based, depends on the combination of chemical and surfactants added, which was investigated in this project.

2. **GOALS & OBJECTIVES**

- To understand the concept of hole cleaning and how current cleaning processes in the industry can be improved.
- To investigate the efficiency of using different amounts of surfactant and caustic soda in sea water and drill water based muds, and find the optimal mixture that cleans the wellbore in the most effective way.
- To determine the most optimal conditions, either static or dynamic, of cleaning a wellbore based on inspection of the pipes.

3. **METHODS**

1. Formulated mud samples at 12 ppg to be used in the test.
2. The steel bars were cleaned with acetone.
3. The samples were labeled with their description, such as name, before and after ageing, drill water or seawater environment, etc.
4. The roller-oven was heated up to 230°F and applied with a pressure of 100 PSI in the cell wherein each steel pipe was placed filled with drilling fluid/mud, at 1/2 inch space empty from the top.
5. Sample was then aged for 72 hours (3 days).
6. After aging, the cell pressure was carefully discharged from the cell.
7. All the steel pipes were removed and pictures were taken for reference.
8. Cleaning solutions were prepared namely; 0.1%, 0.3% and 0.5% NaOH in seawater and drill water, 0.1%, 0.3% and 0.5% NaOH in seawater and drill water.
9. Each steel pipe was cleaned per solution prepared.
10. A magnetic stirring rod was used to stir the solution so as to clean the surface of steel pipes at 600 revolution per minute for 5 minutes, with three trials per solution (Fig. 1).
11. A picture of the bar was taken every minute of stirring to track the progress.

4. **RESULTS**

- **DRILL WATER**
  - **STATIC**
    - **NaOH**:
      - As the concentration of NaOH increased from 0 to 0.5, the amount of rusting increased on the cleaned drill pipe.
      - The amount of sludge and contaminations were decreased as well.
  - **Dynamic**
    - **SafeSurf**:
      - Less rust after cleaning but portrayed a greasier look.
      - As the concentration of SafeSurf increased, the amount of greasy look decreased and looked drier and rustier.

- **SEA WATER**
  - **STATIC**
    - **NaOH**:
      - As the concentration of NaOH in the static method was increased the rusting of the drill pipe also increased.
      - No contamination was observed on the upper circumference of the cylinder.
  - **Dynamic**
    - **SafeSurf**:
      - As for the SafeSurf, there was no correlation between the concentration and the rusting.
      - As the concentration of SafeSurf increased, the cleanliness of the sample generally increased.

5. **SIGNIFICANCE**

- Wellbore cleaning is a procedure essential for the safety associated during production. Several major accidents can occur in the drilling operation, especially if it is not taken care of in an appropriate manner.
- Current methods of cleaning the wellbore are time consuming and expensive, therefore more methods are being invented to increase the efficiency of production.
- Wellbore cleaning after each usage is critical to ensure well-maintained production. The results presented in this research underlines the most effective type of water, surfactant, and condition for wellbore cleaning.

6. **RECOMMENDATIONS & FUTURE PLANS**

- From the obtained results, it is recommended to experiment with other surfactants used in the drilling industry and attempt to optimize with respective concentrations.
- Presented in the Third European Association of Geoscientists and Engineers (EAGE) WIPIC Workshop—Doha, Qatar, 18-20 Nov. 2019.
- Article prepared and submitted for journal publication.
- Possible collaboration with the oil and gas industries.