World Journal of Advanced Engineering Technology and Sciences
eISSN: 2582-8266
Cross Ref DOI: 10.30574/wjaets
Journal homepage: https://wjaets.com/

(REVIEW ARTICLE)

Check for updates

Implementation of selective flocculation process in drilling operations to optimize per-flex fluid volume consumption and reduce the carbon footprint

Muhammad Ahsan [1,*] and Daniela Serrano [2]

[1] *Baker Hughes, Energy Transition and Decarbonization, Houston, United States of America.*
[2] *Baker Hughes, Drilling and Completion Fluids, Bagota, Colombia.*

World Journal of Advanced Engineering Technology and Sciences, 2024, 12(02), 950–952

Publication history: Received on 12 July 2024; revised on 25 July 2024; accepted on 07 August 2024

Article DOI: https://doi.org/10.30574/wjaets.2024.12.2.0357

Abstract

One of the significant challenges faced by the oil and gas industry is the reduction of the carbon footprint associated with drilling operations. This paper presents a case study on the implementation of a selective flocculation process to optimize the consumption of PER-FLEX fluid, a high-performance water-based mud (WBM), during drilling operations. Conducted in a Colombian oil field, this study demonstrates how the adjustment of polymer concentration and injection rates in the flocculation process can reduce the need for fluid dilution, thereby decreasing water and chemical consumption, waste production, and CO_2 equivalent (CO_2 eq.) emissions. The findings highlight the effectiveness of selective flocculation in enhancing drilling fluid performance and contributing to sustainability goals.

Keywords: Drilling Fluids; WBM; HPWBM; Selective Flocculation; Optimization

1. Introduction

The global drive towards sustainability has necessitated the adoption of measures to reduce carbon emissions across various industries. The oil and gas sector, in particular, faces the challenge of minimizing its carbon footprint while maintaining operational efficiency. Drilling operations, a critical component of oil and gas extraction, contribute significantly to CO_2 eq. emissions through the use of drilling fluids and the associated processes.

The European Union's 2050 goal of achieving zero emissions underscores the importance of implementing innovative solutions to monitor and reduce emissions during drilling operations. Establishing baseline CO_2 eq. emissions over time provides a reference for measuring the impact of reduction initiatives. This paper focuses on the selective flocculation process as a method to optimize PER-FLEX fluid consumption and reduce the carbon footprint in drilling operations.

1.1. Selective Flocculation in Oil and Gas Drilling Fluids

Selective flocculation is a process that involves the use of polymers to aggregate and remove specific contaminants from drilling fluids. This method is particularly effective in water-based mud systems where contaminants such as clay can adversely affect fluid performance. By adjusting the polymer concentration and injection rate, the flocculation process can enhance the removal of undesirable solids, maintaining the fluid's chemical and physical properties within the desired range.

* Corresponding author: Muhammad Ahsan

1.2. Types of Selective Flocculation Units

- Polymer Injection Units: These units are designed to inject precise amounts of polymer into the drilling fluid system. The injection rate can be adjusted based on the concentration of contaminants and the desired level of flocculation.
- Centrifuges: High Gravity Solids (HGS) and Low Gravity Solids (LGS) centrifuges are used to separate solid particles from the drilling fluid. When used in conjunction with polymer injection, centrifuges can effectively remove flocculated particles, enhancing fluid cleanliness.
- Mud Cleaners: These units combine shale shakers and hydrocyclones to remove larger particles from the drilling fluid. The addition of selective flocculation can improve the efficiency of mud cleaners by aggregating fine particles into larger flocs that are easier to remove.

1.3. Case Study: Implementation in a Colombian Oil Field

The implementation of the selective flocculation process was conducted in a cluster of seven wells in a Colombian oil field. The objective was to maintain the performance of the PER-FLEX system while reducing the need for fluid dilution. This section provides a detailed account of the methodology, results, and impact on CO_2 eq. emissions.

2. Methodology

- Baseline Establishment: CO_2 eq. emissions associated with the drilling fluid operations were recorded over a baseline period to provide a reference for measuring the impact of the flocculation process.
- Polymer Concentration and Injection Rate Adjustment: The concentration of the polymer and its injection rate were optimized based on the contaminant levels in the drilling fluid. This involved continuous monitoring and adjustment to ensure effective flocculation.
- Monitoring and Analysis: The performance of the primary and secondary solids control equipment was closely monitored to evaluate the efficiency of the selective flocculation process.

3. Results

- Fluid Performance: The selective flocculation process effectively maintained the chemical and physical properties of the PER-FLEX system within the desired range, preventing issues such as hole cleaning problems, stuck pipe, and circulation loss.
- Reduction in Fluid Volume: The need for fluid dilution was eliminated, resulting in a reduction of up to 31% in the volume of prepared fluid.
- CO_2 eq. Emissions: The reduction in fluid volume and associated water and chemical consumption led to a 27% decrease in CO_2 eq. emissions per barrel/foot drilled.

3.1. Impact

The successful implementation of the selective flocculation process demonstrated its potential to enhance drilling fluid performance while contributing to sustainability goals. The reduction in fluid consumption and CO_2 eq. emissions underscores the importance of adopting innovative solutions in drilling operations.

4. Conclusion

The case study highlights the effectiveness of the selective flocculation process in optimizing PER-FLEX fluid consumption and reducing the carbon footprint in drilling operations. By adjusting polymer concentration and injection rates, the process ensures efficient removal of contaminants, maintaining fluid performance and minimizing the need for dilution. This approach not only reduces operational costs but also significantly lowers CO_2 eq. emissions, contributing to the global goal of zero emissions by 2050. This paper provides a comprehensive overview of the selective flocculation process, showcasing its benefits in reducing the environmental impact of drilling operations. The findings support the adoption of such innovative techniques to achieve sustainability goals in the oil and gas industry.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed. The paper has been presented at Empower 2024 Sustainable Energy Conference.

References

[1] European Union. (2020). The European Green Deal. Retrieved from https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[2] Baker Hughes. (2022). High-Performance Water-Based Mud Systems. Retrieved from https://bakerhughes.com/drilling-fluids/WBM

[3] Smith, J. (2021). Advances in Selective Flocculation for Drilling Fluids. Journal of Petroleum Technology, 73(4), 45-53.

[4] Environmental Protection Agency. (2021). Greenhouse Gas Emissions Inventory. Retrieved from https://www.epa.gov/ghgemissions/overview-greenhouse-gases