



(REVIEW ARTICLE)



Transforming Saudi Arabia's chemical industry: A sustainable approach to drilling fluids

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World Journal of Advanced Engineering Technology and Sciences, 2024, 12(02), 948–949

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.2024.12.2.0312>

Abstract

The Kingdom of Saudi Arabia is undergoing a significant transformation in its chemical industry as part of its broader commitment to achieving net-zero carbon emissions. This paper explores the integration of sustainability practices within the oil and gas drilling fluid chemical business, highlighting key methodologies and projects that contribute to this goal. By implementing comprehensive life cycle analysis (LCA) methodologies, Saudi Arabia aims to reduce the environmental impact of drilling operations while enhancing economic and operational efficiencies. This study presents an overview of the kingdom's strategic initiatives, projects, and the role of advanced technologies in driving sustainability within the chemical industry.

Keywords: Drilling Fluids; KSA; Transformation; Net-zero; Environmental Impact

1. Introduction

The Kingdom of Saudi Arabia has embarked on an ambitious journey to transform its economy and achieve net-zero carbon emissions by 2060, in alignment with the global sustainability agenda. Central to this vision is the chemical industry, which plays a crucial role in the oil and gas sector, particularly in the production and management of drilling fluids. These fluids are essential for the safe and efficient extraction of hydrocarbons but also pose significant environmental challenges. As such, Saudi Arabia is prioritizing the integration of sustainable practices within this industry to mitigate environmental impacts and drive innovation. This paper examines the kingdom's efforts to align its chemical industry with sustainability goals, focusing on the application of life cycle analysis (LCA) to assess and reduce the environmental footprint of drilling fluid chemicals. Additionally, it highlights key projects and initiatives that demonstrate Saudi Arabia's commitment to a sustainable future.

2. Life Cycle Analysis Methodology

Life Cycle Analysis (LCA) is a systematic approach used to assess the environmental impacts associated with all stages of a product's life, from raw material extraction through production, use, and disposal. In the context of drilling fluid chemicals, LCA involves the following steps:

- Goal and Scope Definition: Establishing the objectives, system boundaries, and functional units for the analysis.
- Inventory Analysis: Collecting data on energy and material inputs and outputs associated with each stage of the drilling fluid's life cycle.
- Impact Assessment: Evaluating the potential environmental impacts using metrics such as greenhouse gas emissions, water usage, and toxicity.

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- Interpretation: Analyzing the results to identify key impact drivers and opportunities for improvement. By applying LCA, Saudi Arabia aims to identify and implement strategies that minimize the environmental impact of drilling fluids, enhance resource efficiency, and support the kingdom's net-zero objectives.

3. Sustainable Projects Implemented by the Kingdom

- Eco-friendly Drilling Fluid Formulations: Saudi Aramco, the national oil company, has been at the forefront of developing environmentally friendly drilling fluid formulations. These new formulations use biodegradable and non-toxic additives, significantly reducing the ecological footprint of drilling operations.
- Carbon Capture and Utilization (CCU) Projects: The kingdom has invested in CCU technologies to capture carbon dioxide emissions from drilling operations and repurpose them in the production of valuable chemicals, such as methanol and urea, thereby creating a circular carbon economy.
- Advanced Waste Management Systems: Projects focusing on the recycling and reprocessing of drilling fluids have been implemented to reduce waste and lower the demand for raw materials. These systems are designed to recover valuable components from used drilling fluids and minimize environmental contamination.
- Digitalization and Real-Time Monitoring: The integration of digital technologies, such as IoT and AI, in drilling operations allows for real-time monitoring and optimization of drilling fluid use. This leads to improved efficiency, reduced wastage, and lower environmental impact.
- Collaborative Research and Development: Partnerships with international research institutions and technology providers have been established to drive innovation in sustainable drilling fluid technologies. These collaborations focus on developing advanced materials and processes that align with global sustainability standards. These projects exemplify Saudi Arabia's proactive approach to transforming its chemical industry and demonstrate the kingdom's commitment to achieving net-zero carbon emissions through sustainable practices in the oil and gas sector.
- Solar-Battery Hybrid System: Saudi Aramco has implemented a solar-battery hybrid system at its remote oilfields, leveraging Li-ion batteries to store solar energy and reduce diesel consumption. This system has decreased CO₂ emissions by 25% (Saudi Aramco, 2021).

4. Conclusion

The Kingdom of Saudi Arabia's chemical industry is at a pivotal juncture as it strives to balance economic growth with environmental sustainability. Through initiatives focused on reducing emissions, enhancing energy efficiency, and embracing circular economy principles, the sector is setting a strong foundation for a sustainable future. Investments in green technologies, collaboration with global sustainability programs, and alignment with Saudi Vision 2030 highlight the industry's commitment to reducing its environmental footprint while maintaining its competitive edge. However, challenges remain, such as the need for continuous innovation, skilled workforce development, and policy support to accelerate progress. With strategic actions and sustained commitment, Saudi Arabia's chemical industry has the potential to emerge as a global leader in sustainable industrial practices, contributing not only to national goals but also to global sustainability efforts.

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.

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