

REVIEWER'S REPORT

Manuscript No.: IJAR- 59019

Title: Energy-Efficient Design and Performance Optimization of Pressure Vessels and Process Equipment in Saudi Oil and Gas Facilities

Recommendation:

Accept

Rating	Excel.	Good	Fair	Poor
Originality	Yes			
Techn. Quality		Yes		
Clarity	Yes			
Significance		Yes		

Reviewer Name: Dr. Ashish Yadav

Detailed Reviewer's Report

Reviewer's Comment for Publication.

Acceptance Comment are mentioned below suitable for the paper titled "Energy-Efficient Design and Performance Optimization of Pressure Vessels and Process Equipment in Saudi Oil and Gas Facilities"

Reviewer Comments: Accept

Reviewer Comments –

1. Introduction

The manuscript addresses a highly relevant topic concerning energy efficiency and performance optimisation of pressure vessels and process equipment in Saudi Arabia's oil and gas sector. The study appropriately challenges the conventional view of pressure equipment as passive hardware and demonstrates its important influence on plant-wide energy consumption and operational reliability. The introduction clearly establishes the connection between equipment design, operating conditions, and downstream heating, cooling, pumping, and compression requirements. The research is timely and well aligned with the increasing need for sustainable and efficient hydrocarbon operations in Saudi Arabia.

2. Literature Review

The literature review provides a well-structured synthesis of recent peer-reviewed research published between 2020 and 2025. It effectively integrates evidence relating to mechanical design optimisation, process integration, heat-transfer management, fouling control, rotating equipment, and digital condition assessment. The review successfully demonstrates the transition from conventional single-variable optimisation toward multi-objective approaches that consider energy, reliability, cost, emissions, stress, fatigue life, and pressure loss. The discussion is comprehensive and provides a strong scientific foundation for applying these findings to Saudi oil and gas facilities.

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3. Solution Approach

The proposed solution approach is technically sound and presents a practical framework that integrates equipment integrity constraints with energy performance indicators and plant-wide optimisation objectives. The distinction between opportunities for existing facilities and design strategies for new facilities is particularly valuable and enhances the practical applicability of the study. The inclusion of structural optimisation, high-resolution simulation, lifecycle decision criteria, and condition-based operating envelopes provides a comprehensive engineering perspective. Furthermore, the proposed physics-informed digital feedback loop represents a meaningful contribution toward continuous monitoring and performance improvement.

4. Results and Discussion

The results and discussion clearly demonstrate that energy-efficient pressure equipment design should not be considered independently from the wider process system. The study identifies several high-confidence opportunities, including pressure-drop management, insulation renewal, heat-exchanger retrofitting and cleaning, and improved compressor and pump configuration. The discussion appropriately considers the limitations and qualification requirements associated with advanced materials, including composite vessels used in hydrocarbon service. Overall, the findings are logically interpreted and provide useful guidance for improving energy efficiency while maintaining mechanical integrity, reliability, and safe operation.

5. Conclusion

The manuscript presents a coherent and valuable contribution to the field of energy-efficient process equipment design and optimisation. Its major strength lies in establishing a plant-wide, lifecycle-based perspective that connects mechanical integrity, process performance, energy efficiency, and digital condition assessment. The proposed implementation framework is particularly relevant to Saudi Arabia's oil and gas infrastructure and offers practical value for designers, operators, asset owners, and decision-makers. The conclusions are consistent with the objectives and findings of the study and clearly support the broader importance of integrated equipment optimisation.