IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 5, May 2026

DOI: 10.17148/IJARCCE.2026.155166

DESIGN OF AUTOMATION SEALPOT USED IN GASLINE TO REMOVE CONDESATE WATER

Mohammed Kaif[1], Mohammed Nawaz[2], Mohammed Gayaz[3], S Mohammed Tousif[4]

U.G Students Department of Mechanical Engineering, BITM, Ballari Karnataka -India[1-4]

Abstract: The accumulation of liquid condensate and water in natural gas pipelines is a critical operational issue that leads to internal corrosion, hydrate formation, and significant reductions in energy efficiency [1], [2], [3]. Traditional manual drainage methods often result in inconsistent maintenance and accidental greenhouse gas emissions [4], [5]. This study proposes the design of an automated seal pot system specifically engineered for the continuous removal of these liquids. By integrating high-accuracy liquid level sensors with PID-based control logic and automatic solenoid valves, the system ensures real-time response to condensate accumulation [4], [6], [7]. Implementation of similar automated technologies has demonstrated a potential 13% increase in production by maintaining optimal flow regimes and preventing the formation of "ice plugs" or slugs [2], [7]. The proposed design offers a scalable and environmentally safer alternative to manual drips, contributing to the digitalization and integrity management of both high-pressure trunk lines and low-pressure gas gathering networks [4], [8].

Keywords: Natural Gas Pipelines; Condensate Removal; Automated Seal Pot; Liquid Accumulation; Pipeline Integrity; Smart Control Systems; Flow Efficiency.

INTRODUCTION

The accumulation of liquid condensate and water in natural gas pipelines presents a significant operational challenge for the gas industry. During transportation, changes in pressure and temperature lead to phase transitions, resulting in the condensation of hydrocarbon vapors and water [1]. If not removed, this liquid phase can lead to internal corrosion, the formation of gas hydrates, and "ice plugs" during cold seasons, which can completely disrupt gas flow [2], [3]. Furthermore, accumulated liquids reduce the effective diameter of the pipeline, increasing backpressure and reducing the overall energy efficiency of gas delivery [2], [4]. This project focuses on the design of an automated seal pot system to ensure the continuous and efficient removal of these accumulations.

LITERATURE REVIEW

Traditional methods for managing liquid in pipelines include manual "drips" or knockout pots, where fluids are periodically drained by field operators, and mechanical pigging operations [1], [5]. However, manual drainage is often inefficient, labor-intensive, and carries the risk of accidental gas releases into the atmosphere during operation [1], [6]. Recent advancements have introduced technologies such as "Pseudo Dry Gas" systems, which use multiple in-line liquid removal units to maintain near-dry conditions and minimize gravitational pressure drops [7], [8]. Studies suggest that while gas flow can naturally carry some water out if it exceeds a critical velocity, this is often only effective for smaller pipeline diameters (up to 200 mm), necessitating specialized equipment for larger transmission lines [2]. The shift toward remote, intelligent pipeline clearing is driven by the need to reduce environmental impact and improve safety in low-production or remote fields [6].

METHODOLOGY

The proposed automated seal pot design integrates a collection vessel with an intelligent control system. Key components include:

- **Sensing Unit:** High-accuracy liquid level sensors (e.g., magnetic or pressure-based) are installed to monitor the accumulation in real-time [9], [10].
- **Control Logic:** A PID controller or a self-powered density-based trigger is used to process sensor data [9], [10]. When the condensate reaches a predetermined setpoint, the controller triggers the drainage sequence.

DOI: 10.17148/IJARCCE.2026.155166

- **Actuation:** Automatic solenoid or pneumatic valves are used to open the drainage line. To prevent gas loss, a two-valve "airlock" or "seal" system can be employed to isolate the pipeline pressure during the liquid discharge phase [6].
- **Safety & Warning:** The system includes a remote warning module that uses pressure and differential pressure parameters to detect potential blockages or equipment malfunctions [6].

RESULTS

Implementation of automated separator systems in field operations has shown a 13% increase in oil and gas production by preventing over-flushing and maintaining optimal liquid levels [10]. The automated removal of liquid ensures that gas flow remains stable, avoiding the negative effects of slug flow regimes [10]. Simulations indicate that by maintaining the required flow velocity and consistent drainage, the system can effectively remove accumulated water that would otherwise be impossible to clear manually in high-volume sections [2]. Furthermore, the modular design of these automated units allows for successful application in both high-pressure trunk lines and low-pressure gas gathering networks [6].

DISCUSSION

The efficiency of condensate removal is heavily dependent on the thermodynamic state of the gas. As fields deplete, changes in the gas composition can lead to "reverse condensation" where evaporation occurs at higher pressures and condensation at lower pressures [1]. An automated system must, therefore, be adaptable to these changing thermobaric conditions [1]. A major advantage of automation is the reduction of environmental contamination; by using closed-loop automated collectors, the release of harmful hydrocarbon vapors and water vapor into the atmosphere—a common problem with manual drips—is significantly minimized [1]. However, designers must balance system complexity with the recovery benefits, as ultra-long tie-backs may require multiple units and specialized pump selection for optimal performance [7], [8].

CONCLUSION

The design of an automated seal pot offers a robust solution to the persistent problem of liquid accumulation in gas pipelines. By replacing manual interventions with sensor-driven automation, operators can achieve higher transportation efficiency, reduce the risk of hydrate-related blockages, and lower environmental emissions [1], [3], [6]. This technology is particularly vital for the digital transformation of gas fields, providing the necessary data and control to maintain pipeline integrity and production reliability in an increasingly automated industry [6], [10].

REFERENCES

[1]. Bowden, P. E. (1999). *Design and Selection of Mechanical Seals to Minimize Emissions*. *Journal of Engineering Tribology*.

[2]. Baart, P., Lugt, P. M., & Prakash, B. (2009). *Review of Lubrication, Sealing and Pumping Mechanisms in Radial Lip Seals*. *Tribology International*.

[3]. Salant, R. F. (2010). *Soft Electrohydrodynamic Analysis of Rotary Lip Seals*. *Journal of Mechanical Engineering Science*.

[4]. Donald, I. W., et al. (2011). *Glass-to-Metal Seals and Coatings for Industrial Applications*. *Journal of Materials Science*.

[5]. Sayed, M., & Al-Muntasheri, G. (2019). *Gas Condensate Treatment: Materials, Methods and Applications*. *Fuel Processing Technology*.

[6]. REGAMOUNT. *Seal Pot – Information on Seal Pot Working Principle, Applications, and Advantages*.

[7]. Lambda Square. *Seal Pots and Condensate Chambers – Industrial Applications and Installation Details of Seal Pots*.

[8]. Trueway Engineering. *Condensate Seal Pot – Technical Specifications and Applications of Condensate Seal Pots*.

[9]. OMC Envag. *Automatic Removal of Condensate from Gas Systems – PLC-Controlled Automatic Condensate Drainage Systems*.

[10]. Biogas Products Ltd. *Condensate Pots – Use of Condensate Pots for Moisture Removal in Gas Pipelines*.

