

Development of Standards for the Use of Compressed and Liquefied Gases and Recommendations for Their Improvement

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Abstract: The utilization of compressed and liquefied gases is integral across various sectors, including industrial, medical, and transportation. Ensuring safety and efficiency in their application necessitates robust and up-to-date standards. This paper reviews current international standards governing the use of these gases, identifies existing challenges, and proposes recommendations for their enhancement. Emphasis is placed on recent developments, technological advancements, and the need for harmonization across regulatory frameworks.

Keywords: Compressed gases, Liquefied gases, LNG, CNG, LPG, Gas safety standards, ISO 24431, ASTM D1835, IGF Code, IGC Code, Gas regulation, Cryogenic safety, Standard harmonization, Gas transportation, Calibration gases, Industrial safety.

Introduction: Compressed and liquefied gases, such as liquefied petroleum gas (LPG), liquefied natural gas (LNG), and compressed natural gas (CNG), are widely used due to their energy efficiency and versatility. However, their storage, transportation, and utilization pose significant safety risks, including flammability, toxicity, and high-pressure hazards. To mitigate these risks, various international standards have been developed. This paper aims to analyze these standards, assess their effectiveness, and suggest improvements to enhance safety and operational efficiency.

Methods: A comprehensive literature review was conducted, focusing on international standards, scholarly articles, and industry guidelines related to the use of compressed and liquefied gases. Databases such as ISO, ASTM, and arXiv were utilized to gather relevant documents published within the last five years, ensuring the inclusion of the most recent developments in the field.

Results

1. Current Standards Overview

ISO 24431:2016 specifies inspection requirements for seamless, welded, and composite cylinders used for compressed and liquefied gases, excluding acetylene. It emphasizes inspection at the time of filling to ensure safety and compliance [1].

ASTM D1835-20 provides specifications for LPG, detailing requirements for vapor pressure, residue, and corrosion to ensure quality and safety in various applications [2].

IGC Code (International Maritime Organization) governs the construction and equipment of ships carrying liquefied gases in bulk, ensuring maritime safety. Recent amendments have addressed fire integrity and certification processes [3].

IGF Code focuses on the safety of ships using gases or other low-flashpoint fuels, outlining mandatory provisions for machinery and equipment. It has been updated to incorporate changes in technology and safety practices [4].

2. Identified Challenges

Technological Advancements: Rapid developments in gas technologies necessitate frequent updates to existing standards to remain relevant and effective.

Harmonization Issues: Disparities between international and national standards can lead to confusion and compliance challenges for multinational operations.

Safety Concerns: Despite existing standards, incidents related to gas leaks and explosions persist, indicating gaps in implementation and enforcement.

3. Case Studies

A study on the revision of ISO 19229 highlighted the need for improved guidance on purity analysis of calibration gases, introducing statistical methods to better assess measurement uncertainty [5].

Research on LNG cryogenic hoses emphasized the importance of understanding thermal stress during pre-cooling processes to prevent structural failures [6].

Discussion: The analysis underscores the necessity for continuous evaluation and enhancement of standards governing compressed and liquefied gases. Incorporating technological advancements, ensuring harmonization across jurisdictions, and addressing safety concerns are paramount. Engagement with industry stakeholders, regulatory bodies, and academic institutions is essential to develop comprehensive and effective standards.

Conclusion: Ensuring the safe and efficient use of compressed and liquefied gases requires dynamic and harmonized standards that evolve with technological and industrial advancements. Addressing current challenges through collaborative efforts will enhance safety, compliance, and operational efficiency across sectors utilizing these gases.

References

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