

LCO₂ CARRIAGE

CONSIDERATIONS FOR A DEVELOPING TRADE

AS CARBON CAPTURE AND STORAGE (CCS) INITIATIVES EXPAND, THE CARRIAGE OF LIQUEFIED CARBON DIOXIDE (LCO₂) IS EMERGING AS A SPECIALISED TRADE WITH DISTINCT LEGAL, TECHNICAL AND OPERATIONAL IMPLICATIONS PRESENTING UNFAMILIAR RISKS. UNLIKE MANY LIQUEFIED GAS CARGOES, LCO₂ IS NOT YET GOVERNED BY MATURE OPERATIONAL CONVENTIONS OR A WIDELY ADOPTED REGULATORY FRAMEWORK.

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UNDERSTANDING LCO₂: PHYSICAL PROPERTIES AND ASSOCIATED RISKS

Although carbon dioxide is chemically inert and non-flammable, LCO₂ poses several operational safety risks. It must be stored under pressure and at very low temperatures to remain stable. A drop in pressure may cause LCO₂ to solidify into dry ice, which can accumulate at the bottom of tanks. If heating or pressurisation is attempted without care, the resulting stress may exceed the tank's design limits. Loss of containment can also result in structural damage, as exposure to extremely low temperatures can cause steel components to become brittle¹.

While LCO₂ is not classified as a pollutant under MARPOL, large-scale releases may pose localised environmental and health hazards. CO₂ is heavier than air and can displace oxygen in confined or low-lying spaces², presenting a significant asphyxiation risk³ for personnel.

Shipowners and operators are encouraged to:

- **Clearly define and integrate emergency response protocols into the Safety Management System (SMS)**
- **Engage with classification societies and flag administrations to align safety measures with prevailing standards and best practices⁴**
- **Consider engaging external experts to provide training and raise preparedness among crew and technical teams where there is uncertainty or limited familiarity with LCO₂-specific hazards.**

CARGO COMPOSITION AND MANAGING IMPURITY

Unlike food-grade CO₂, industrially captured CO₂ is more variable in quality⁵, and may add challenges to the conditioning process before loading. Impurities such as water, oxygen, hydrogen sulfide and nitrogen oxides can lead to corrosion, pressure variability and solid formation, impacting the safety and efficiency of transport.

Operational considerations should include:

- **Verifying tank material compatibility with potential corrosive compounds⁶**
- **Confirming that post-conditioning LCO₂ specifications are aligned with vessel design and safe operational limits**
- **Assessing risks associated with shared systems e.g. common cargo piping.**

The absence of standardised international guidelines for impurity levels in LCO₂ cargo presents regulatory and technical challenges that need to be addressed as the trade develops.

CROSS-BORDER AND CONTRACTUAL CONSIDERATIONS

LCO₂ is typically classified as "waste" and is subject to varying jurisdictional controls. As the regulatory landscape remains largely unsettled and dependent on bilateral or multilateral agreements, shipowners are advised to seek early legal and technical guidance before engaging in cross-border LCO₂ carriage to confirm route-specific compliance.

There is currently no standard charterparty form specifically designed for LCO₂ carriage⁷. While LNG charterparty models have been partially adapted, they do not adequately address the unique characteristics of LCO₂ transport. Bespoke terms will likely be required to cover:

- **Allocating responsibilities and costs for cargo tank cool-down and inerting procedures**
- **Defining cargo loss tolerances and reconciliation processes**
- **Permissible impurity thresholds/specification to determine suitability within a particular network⁸**
- **Compatibility with specialised terminals/offshore platforms**
- **Clear delineation of title and risk transfer points.**

Shipowners and charterers are also advised to stay updated on applicable requirements and the evolving risk profile of the trade, to ensure that operational practices and contractual frameworks remain properly aligned and appropriate.

PORT INFRASTRUCTURE AND READINESS

While this article focuses on dedicated LCO₂ carriers, parallels can be drawn with findings from a 2024 study report by Lloyd's Register, the Global Centre for Maritime Decarbonisation (GCMD), and Arup. The study, examining offloading of CO₂ captured on board vessels (OCCS systems), identified low port readiness as a key barrier to large-scale commercialisation. Most existing port facilities for CO₂ handling are configured for small-scale, food-grade applications. It is also noted that although mature offloading technologies exist, there is currently limited demonstration of safe operationalisation by trained port personnel⁹.

This highlights the broader challenges and readiness gap that may similarly affect dedicated LCO₂ carrier operations, particularly in early projects. As such shipowners should:

- **Evaluate terminal readiness during fixture negotiations**
- **Confirm compatibility of terminal infrastructure with high-volume, pressurised LCO₂ offloading, agreed pumping rates, etc**

- **Clarify demurrage provisions related to delays from incompatible facilities.**

Additional attention may be required where the delivery chain includes direct injection from the ship into an offshore storage site or transfers to offshore storage and injection platforms¹⁰. In such cases, ship-shore interface standards may also be absent, underdeveloped or vary significantly across jurisdictions - factors expected to add further complexity to operational planning.

LIABILITY FRAMEWORKS: LLMC AND HNS CONVENTION

For now, the main liability regime applicable to CO₂ leakage is the Convention on Limitation of Liability for Maritime Claims (LLMC). However, this framework remains untested in the specific context of LCO₂-related incidents⁷.

Looking ahead, the Hazardous and Noxious Substances (HNS) Convention - once in force - could apply to the carriage of LCO₂ being amongst the substances listed in the International Gas Carrier (IGC) Code. While the HNS Convention was originally developed to address chemical pollution risks, its structure is broad, applying to any cargo referenced in IMO instruments such as the IGC Code. This means that dedicated LCO₂ ships carrying liquefied CO₂ in bulk could fall within the Convention's scope.

Note: This article is intended for informational purposes and should not be construed as legal or technical advice. Shipowners and operators are encouraged to consult with relevant experts and authorities when considering LCO₂ carriage or where specific concerns arise.

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