

RECOGNISING POTENTIAL DANGERS

Solid Bulk Cargo Liquefaction: Strategies for Effective Control

Developing practical technical, regulatory, educational and communication tools to mitigate risks of solid bulk cargo liquefaction and reduce loss of life.



Find out more

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SOLID BULK CARGO LIQUEFACTION: STRATEGIES FOR EFFECTIVE CONTROL

Solid bulk cargo liquefaction was responsible for nearly 20% of bulk carrier losses over the last decade and over 50% of fatalities from bulk carrier losses. This project will identify key factors contributing to the risk of solid bulk cargo liquefaction and develop practical technical, regulatory, educational and communication tools to mitigate risks and reduce loss of life.

Funded by the Lloyd's Register Foundation and the Southampton Marine & Maritime Institute at the University of Southampton, UK.



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The Challenge

Carriage of solid bulk cargo is the largest sector by dry weight tonnage (dwt) of the shipping sector. A global fleet of more than 11,000 bulk carriers, typically with a crew of 20 – 25, carries over 40% by dwt of goods transported by sea, equal to over 800 million tonnes of cargo annually [1].

Over the last decade 48 losses of bulk carriers have been reported, 9 of which have been attributed to liquefaction of the cargo during the voyage [2]. While cargo liquefaction is the cause of less than 20% of all bulk carrier vessel losses, it is responsible for the highest loss of life, 101 lives lost from a total of 188 from all 48 bulk carrier losses in the period [2].

Despite improvements in shipping safety and technology, cargo liquefaction remains an issue for bulk carriers, and from the incident report data, particularly smaller size carriers [2].

That solid bulk cargo liquefaction is responsible for < 20% of recorded bulk carrier losses but > 50% of fatalities from those losses [2], evidences the importance of tackling this phenomenon in order to have significant impact on the safety of crew on board bulk carriers.

The Project

The objective of this project is to reduce fatalities from vessel loss caused by solid bulk cargo liquefaction. This will be achieved through measures to enhance safety on land and at sea through culturally and situationally relevant technological, educational and regulatory solutions that are evidence based and founded in improving understanding of risk and access to information.

A distinctive characteristic of this project is the extent of cross-sector engagement, spanning mining companies, ship owners, trade associations, insurers, a class society, lawyers, consultants, testing houses, a regulator, NGOs, and academics from UK and international institutions with a range of discipline expertise across the physical and social sciences and law. More than 20 partners, who represent many more organisations from across the sector, are working together to ensure there is real impact in the industry to reduce loss of life from solid bulk cargo liquefaction.

The sector has coalesced to form the consortium underpinning this proposal, to rise to the international and multi-disciplinary challenge posed by solid bulk cargo liquefaction, to raise safety levels and reduce loss of life.

Safety of seafarers is central to the objectives of the project and programme of work, and the activities have been developed to ensure real impact is achieved for the industry.



More than 20 partners

are working together to ensure there is real impact to reduce loss of life from solid bulk cargo liquefaction



The inter-related objectives of the project are:

Objective 1. Improved capability to determine risk of solid bulk cargo liquefaction

Objective 2. Improved awareness and education on risks and control of liquefiable solid bulk cargoes

Objective 3. Improved guidance and regulation to reduce risk of solid bulk cargo liquefaction.

These objectives will be undertaken within three interconnected working groups addressing (1) Engineering challenges, (2) Data & Communication and (3) Law & Regulation, to result in integrated and holistic solutions to control solid bulk cargo liquefaction events and reduce loss of life.

OUR INTERCONNECTED WORKING GROUPS



Engineering challenges



Data & Communication



Law & Regulation

Solid Bulk Cargo Liquefaction

What is solid bulk cargo?

Solid bulk cargo describes any cargo consisting of a combination of particles, granules or any larger pieces of material generally uniform in composition, which is loaded directly into the cargo spaces of a ship without any intermediate form of containment [4], called a 'bulk carrier'. Common solid bulk cargoes include crushed mineral ores (e.g. iron ore, nickel ore, bauxite), concentrates (processed ore), mineral sands, coal and grain.

What is liquefaction?

Liquefaction is the process of a granular material transforming from behaving in a solid state to a liquid state. Solid bulk cargoes are typically "three-phase" materials as they contain air and water between the solid particles. When the particles can touch, the friction between them makes the material act like a solid (even though there is liquid present). When the water pressure rises, these inter-particle forces reduce and the strength of the material decreases. When the friction is sufficiently reduced, the material acts like a liquid (even though the solid particles are still present).

Solid bulk cargo liquefaction results from any moisture related instability of a cargo within a vessel's cargo holds; that in turn may impact the vessel stability, i.e. ability to remain upright. Liquefaction phenomenon in bulk cargoes is varied but ultimately results in loss of stability of the cargo which in turn affects the stability of the bulk carrier, either partially or fully.



Common solid bulk cargoes include **crushed mineral ores** (e.g. iron ore, nickel ore, bauxite), **concentrates** (processed ore), **mineral sands**, **coal** and **grain**



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References

- 1 United Nations Conference on Trade and Development (2018) Review of Maritime Transport 2018, available [here](#).
- 2 Intercargo (2019) Bulk Carrier Casualty Report, available [here](#).
- 3 Allianz (2018) Allianz Global Corporate and Specialty Global Claims Review 2018, available [here](#).
- 4 International Maritime Organisation, International Maritime Solid Bulk Cargoes, available [here](#)



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Our partners are active across the solid bulk cargo sector and include:

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