Liquefaction of solid bulk cargoes

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What is liquefaction*?

- Solid state (left) – shear strength of cargo from direct contact between cargo particles with sufficient space between to accommodate moisture and air
- Ship’s motion/vibration = cargo compaction = space between cargo particles reduces and air is expelled
- Fluid state (right) - eventually the water pressure forces the particles apart and they lose direct contact

* IMSBC Code section 7
What are the potential consequences?

- the fluid state cargo flows to one side of the ship with a roll but does not completely return with a roll the other way
- the ship progressively reaches a dangerous heel and capsizes
- unpredictable, rapid, deadly…
“Vinalines Queen” 25/12/11*

22 crew lost

Nickel ore ex Indonesia

* cause not yet formally announced
According to the evidence available, the direct cause of these accidents* was the loss of stability as a result of cargo liquefaction…

3 ships - 45 crew lost

Nickel ore ex Indonesia

*MSC 89/7/4 March 2011 : China submission to IMO : “Jian Fu Star”, “Nasco Diamond”, “Hong Wei”, Oct/Nov 2010
“Investigation into these incidents …excessive moisture content in the cargo, liquefaction…” *

Iron ore fines ex India

Indian M Notice No.9 Aug 2010:
“Asian Forest” and “Black Rose”, July, Sept 2009
“The cargo was loaded with excessive moisture content. The vessel was subjected to heavy seas, which led to the cargo changing state from a solid to a viscous liquid in 4 of the 5 holds”

*ATSB report 1999: “Padang Hawk” nickel ore ex New Caledonia*
Thirst for resources, climate change?
The IMSBC Code

- The Code sets out the internationally agreed provisions for the safe stowage and shipment of solid bulk cargoes, including cargoes that may liquefy (Group A)
- The Code became mandatory internationally on 1st January 2011
- The Code is part of SOLAS
“Many fine-particled cargoes if possessing a sufficiently high moisture content are liable to flow. Thus any damp or wet cargo containing a proportion of fine particles should be tested for flow characteristics prior to loading*”

Listed as Group A:
- Mineral concentrates
- Coke Breeze
- Fluorspar

Not listed:
- Nickel ore
- Iron ore fines
- Mill scale

Listed as Group C:
- Chromite ore
- Barytes

*Appendix 3.2.1 of the Code
What to test?
- Flow Moisture Point (FMP)
- Moisture Content (MC)

Why?
- 90% of FMP = TML (Transportable Moisture Limit)
- only ship if MC < TML

Who should test & how?
- Shipper - methods set out in Code
- Ship - can test (check test - beware limitations)

When to test?
- MC \(\geq\) 7 days, TML \(\geq\) 6 months (Code provisos)
Why do unsafe cargoes get shipped?

- Hidden danger
- Lack of knowledge/understanding of the IMSBC Code
- Improper sampling/test procedures
- Deliberate mis-declaration
- Deliberate manipulation of samples/test results
- Lack of Competent Authority oversight
- Time, trouble and cost of testing
- Market forces
- Over-reliance on shippers documents/can-test
The heart of the problem - inaccurate declarations and certificates from shippers

- However, the cargo documentation provided to the masters indicated that the moisture content of the cargo samples was lower than the Transportable Moisture Limit (TML)
- “Investigation into these incidents highlighted improper cargo information…”
- “Iron ore fines may liquefy and should be treated as such..some shippers have in the past declared this cargo …as a Group C cargo”

MSC 89/7/4 March 2011, Indian M Notice No.9 Aug 2010, IMO DSC.1/Circ. 66 October 2010
Complicating factors/concerns

• Successful shipment history
  – unknown factors, 10% safety margin

• Sampling/testing
  – representative samples (no stockpiles, not nominated, rain)
  – testing competence, availability, methodology

• Cargoes not listed in the Code
  – section 1.3.2 of the Code
  – temporary definition of “iron ore fines”

• Local pressures
  – surveyors, authorities, master

• P&I cover
  – survey costs, prejudice to cover
When may P&I cover be lost/prejudiced?

- Depends on the facts of each case

- Grave risk of losing cover if a Member knowingly carries unsafe cargo, e.g., independent test results show MC > TML

- Significantly greater risk of prejudicing cover if unsafe cargo is loaded without any checks, or if Member loads unsafe cargo where there is a history of unreliable shippers’ certificates, doing so solely on the basis of ‘can tests’ and without independent sampling/analysis
Addressing the problem(s)

- Industry
  - submissions to IMO
  - published material
  - meetings
  - ship design
- National
  - Indian DGS
- International
  - 16th Session of the IMO Sub-Committee on Dangerous Goods (DSC 16)
  - Correspondence Group on iron ore fines

NICKEL ORE:
STOP, THINK, VERIFY!

Intercargo Guide for the Safe Loading of Nickel Ore
IMSBC Code changes (2014/15)

• The competent authority shall operate independently from the shipper
• TML and MC certificates to be issued by an entity recognised by the Competent Authority
• Shipper’s procedures for sampling, testing and controlling moisture content to be approved by the Competent Authority
• Shippers to facilitate access to stockpiles for inspection, sampling and testing by the ship
• Clarification of the limitations of the can test
• New schedule for nickel ore and probably iron ore fines
Self preservation

- Know what you are facing
  - own people aware of the dangers, precautions and the Code
  - P&I, shippers, charterers, service providers, authorities
  - prepared to sail without cargo and dealing with the consequences
- Know where you stand
  - c/p permissions/exclusions, clauses
  - law : reasonable steps to check, reasonable grounds for refusing
- Plan ahead
  - early contact with the Club
- Stand firm
  - demand & check documentation & certificates are Code compliant
  - avoid loading any cargo until properly tested and documented
  - support the master's overriding authority under SOLAS
We will help as much as we can, but… Members must protect themselves

• All factors leading to liquefaction are not fully understood

• The IMSBC Code is not perfect but adopts a cautious approach to a catastrophic risk

• The role of authorities in the ports of loading is vital to ensure that shippers comply with the IMSBC Code

• If they do not, Members and their P&I Clubs will have no option but to continue to take their own precautions

• Members who choose to run risks, calculated or otherwise, may have to face the consequences on their own
Cargo liquefaction
Nickel and iron ores

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