Liquefying Bulk Cargoes

Lessons learned about nickel ore

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Overview

• Concerns about nickel ore
• Demand for nickel ore
• International regulations: IMSBC Code
• Characteristics of liquefaction
• Risks to vessel
• Ship staff controlling loading?
• Compliance with IMSBC Code: What is really going on
• Insurance implications
Nickel ore demand

- Significant demand for nickel ore in China as it is the principal alloy component for stainless steel

Average of 50,000 ton of cargo per shipment... you need 1,000 shipments!
Indonesia nickel ore: source to ship

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Nickel ore incidents

- **27 October 2010**: JIAN FU STAR sank while carrying nickel ore from Indonesia to China. *(13 fatalities)*

- **10 November 2010**: NASCO DIAMOND sank while carrying nickel ore from Indonesia to China. *(21 fatalities)*

- **03 December 2010**: HONG WEI sank while carrying nickel ore from Indonesia to China. *(10 fatalities)*

- **25 December 2011**: VINALINES QUEEN went missing. One sole survivor. *(22 fatalities)*
HARITA BAUXITE

- February 16, 2012: HARITA BAUXITE sank off Sual, Philippines while carrying nickel ore from Indonesia to China...15 fatalities
The latest nickel ore incident...

TRANS SUMMER  ... luckily, no fatalities.

... but the prior cases noted... 81 dead.
Some sobering statistics...

• As of January 2012, nickel ore trade made up only 0.06% of bulk shipping world trade... but 80% of the fatalities in bulk carrier trade

• The Chinese nickel ore trade has approximately 4 times the rate of all seafarers killed by pirates around the world annually.
IMO regulations

International Maritime Solid Bulk Cargoes (IMSBC) Code

• Adopted on 4 December 2008 by IMO Resolution MSC 268(85)

• Superseded the Code of Safe Practice for Solid Bulk Cargoes (BC Code) adopted in 2004 but wasn’t mandatory

• Majority of IMSBC Code is mandatory through additional provisions made to Chapters II, VI, VII to the International Convention for the Safety of Life at Sea, 1974 (SOLAS Convention) as of 1 January 2011

• Recommendatory provisions remain regarding security, stowage factor conversion tables, reference information and all other appendices except Appendix 1 on individual cargo schedules.
IMO regulations (cont.)

IMSBC Code: Hazards of concerns and objectives

• Code **addresses hazards** of carriage of bulk cargoes associated with:
  - structural damage due to improper cargo distribution;
  - loss or reduction of stability during a voyage; and
  - chemical reactions of cargo.

• Code **objectives** are to:
  - facilitate safe stowage and shipment of certain bulk cargoes;
  - provide information on dangers associated with shipment of certain cargoes; and
  - provide instructions on procedures to be adopted for those cargoes.
IMO regulations (cont.)

IMSBC Code Overview: Code sections
- General provisions
- General loading, carriage and unloading precautions
- Safety of personnel and ship
- Assessment of acceptability of consignments for safe shipment
- Trimming procedures
- Methods for determining angle of repose
- Cargoes that may liquefy
- Test procedures for cargoes that may liquefy
- Material processing chemical hazards
- Carriage of solid waste in bulk
- Security provisions
- Stowage factor conversion tables
- References to related information and recommendations
IMO regulations (cont.)

IMSBC Code Overview: Appendices

- Individual schedules of solid bulk cargoes
- Laboratory test procedures, associated apparatus and standards
- Properties of solid bulk cargoes
Cargo "angle of repose"

The maximum slope angle to horizontal at which material will not slide

- Certain cargoes can be carried with an angle of repose (in a pile). Nickel ore cannot sustain an angle of repose and is trimmed flat.
- If you carry the cargo with an angle of repose, there is a risk of sheering.
- If you carry the cargo trimmed flat, there is a risk of sliding.
**Cargo category**

- **Group A**: cargoes which may liquefy if shipped with moisture content greater than TML
- **Group B**: cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship
- **Group C**: cargoes not liable to liquefy (Group A) and don’t possess chemical hazards (Group B)
Moisture content

- **Flow moisture point (FMP):** percentage moisture content (wet mass basis) at which a flow state develops “under prescribed methods of testing”

- **Transportable moisture limit (TML):** maximum moisture content of the cargo which is considered safe for carriage
Getting down to “brass tacks”

**Cargo declarations**

Cargo information: SOLAS Chapter VI, Part A, Regulation 2(1)

“The shipper shall provide the master or his representative with appropriate information on the cargo sufficiently in advance of loading...”

“Such information shall be in writing...”
Identification and classification of cargo

Cargo testing: IMSBC Code, Section 4, Regulation 4.1.4:

“Bulk cargoes shall be classified... in accordance with the UN Manual of Tests and Criteria, part III.”

“The various properties of a solid bulk cargo... shall be determined... in accordance with the test procedures approved by a competent authority in the country of origin...”
Getting down to “brass tacks” (cont.)

Cargo information to be provided

IMSBC Code: Section 4.2: Provisions of information to be provided onto the appropriate shipping documents include...
## Getting down to “brass tacks” (cont.)

### Cargo information

<table>
<thead>
<tr>
<th>Shipper</th>
<th>Reference number(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consignee</td>
<td>Carrier</td>
</tr>
<tr>
<td>Name/means of transport</td>
<td>Port/place of departure</td>
</tr>
<tr>
<td>Port/place of destination</td>
<td></td>
</tr>
</tbody>
</table>
| General description of the cargo*  
(type of material/particle size)** |
| *For solid bulk cargo |
| Specifications of bulk cargo*  
Stowage factor  
Trimming procedures  
Chemical properties ** if potential hazard  
Angle of repose |
| *If applicable  
**e.g. IMO class, UN number or BC number and EmS number |
| Relevant special properties of cargo | Additional certificate*  
- Certificate of moisture content and transportable moisture limit  
- Weathering certificate  
- Exemption certificate  
- Other (specify)  
*if required |
| DECLARATION  
I hereby declare that the consignment is fully and accurately described and that the given test results and other specifications are correct to the best of my knowledge and belief and can be considered as representative for the cargo loaded.  
| Name/status, company/organization of signatory  
Place and date  
Signature on behalf of shipper |

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Liquefying Cargoes

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The American Club
Getting down to “brass tacks” (cont.)

Certificates to tests

- Cargo testing: IMSBC Code, Section 4.3, Regulation 4.3.1:
  “...the shipper shall arrange for the cargo to be properly sampled and tested.”

- Cargo testing: IMSBC Code, Section 4.3, Regulation 4.3.2 states the shipper shall provide:
  - a signed certificate of TML
  - TML certificate shall contain or be accompanied by results of TML tests
  - a signed certificate or declaration of the moisture content
Getting down to “brass tacks” (cont.)

**Sampling procedures**

Cargo testing: IMSBC Code, Section 4, Regulation 4.4 are to take into account important factors such as:

- Type of material
- Particle size distribution
- Manner of which material was stored
- Variations in moisture distribution through consignments
- Characteristics to be determined: TML, angle of repose, bulk density/stowage factor
How does liquefaction occur?

Compression force from other cargo particles

Particle 1 compressing down on Particle 2

**Step 1**: Volume of space between particles reduce as cargo is compacted owning to ship motion

Sufficient equal and opposite sheer forces between Particle 1 and Particle 2
How does liquefaction occur? (cont.)

Step 2: Reduction in space between cargo particles causes an increase in water pressure in the space between particles.

Compression force from other cargo particles

Space between Particle 1 and Particle 2 is further reduced.

Sufficient equal and opposite sheer forces between particles maintained.
How does liquefaction occur? (cont.)

Compressing force from other cargo particles

Water pressure forces water between Particle 1 and Particle 2

**Step 3:** Increase in water pressure reduces the friction between cargo particles

As water pressure increases and forces itself between particles, sheer pressure decreases as space widens between particles.
How does liquefaction occur? (cont.)

Water pressure forcing water into space between Particle 1 from Particle 2 leads to further separation.

**Step 4**: Reduction in sheer strength in the cargo and the cargo liquefies!

Sheer forces between Particle 1 and Particle 2 no longer exists. Liquefaction occurs.
How does liquefaction occur? (cont.)

Liquefaction does not occur when...

- **Cargo carries many small particles.** Particle cohesion and restrictions on water pressure.

- **Very large particles or lumps.** Water is able to pass easily between particles without an increase in water pressure.

- **Cargo contains a high percentage of air and low moisture content.** Increase in water pressure is inhibited and dry cargoes are unable to liquefy.

Liquefaction may occur when...

- **Moisture content exceeds the TML.**
Moisture migration

Uniform loaded bulk cargo with moisture content < TML

Bulk cargo loaded (uniform cargo)
HARITA BAUXITE cargo holds

Note cargo loaded to top of hopper plate
Moisture migration (cont.)

Water migrates via gravity...

moisture content < TML

moisture content > TML
Cargo testing: IMSBC Code, Section 7, Regulation 7.3.2

“...the cargo surface may appear dry, undetected liquefaction may take place resulting in shifting of cargo. Cargoes with high moisture content are prone to sliding, particularly when the cargo is shallow and subject to large heel angels.”

List occurs that can’t be corrected!

Immense forces generated by the flow movement of high density bulk cargoes such as nickel ore.
Liquefying Cargoes

Designed to carry Group A cargoes?

![Diagram showing buoyancy in liquefying cargoes.](image)
Designed to carry Group A cargoes?
What can the crew do?

Pre-Loading/Loading

• Visual inspections of cargo prior to and during loading
• Can tests at loading: IMSBC Code calls can testing “complimentary”
• Question/verify moisture content figures in the cargo declaration

Voyage

• Regular visual checks of the cargo surface
• Daily cargo hold bilge soundings
What can the crew do? (cont.)

But... BEWARE!

Pre-Loading/Loading

• A positive can test result does not necessarily mean the cargo is safe for shipment
• Even when the cargo appears to be dry, it may still contain moisture in excess of the TML

Voyage

• Regular visual cargo surface inspections may not reveal cargo condition
• If there is free water, the cargo might be expected to drain... but the cargo can hold the moisture and develop a wet base
What is really going on?

Liquefying Cargoes

H₂O: 35%???
Insurance considerations

A tangled web of potential problems!

- **Crew claims: injury and death**
- **Pollution (bunker) claims**
- **Wreck removal**
- **Bills of Lading**: shipper’s responsibility to provide clear information about nature and property of cargo prior to loading (cargo safety certificate)
- **Charterers disputes**: charterer’s responsibility to properly load and store cargo safely versus vessel/Master obligation to intervene in case of bad stowage
And more...

- **P&I policy**: unsafe cargo is loaded and shipped with advance knowledge that it is unsafe can prejudice cover (non compliance with SOLAS Convention and IMSBC Code)

- **H&M policy**: depends on policy wording but potential defense of cover based on vessel being unseaworthy at commencement of voyage with owner’s prior knowledge

- **Cargo insurance**: depends on policy wording. Non-communication of moisture content/TML before concluding contract is a possible breach of duty of disclosure to the insurer.
Club Guidance on nickel ore

Found at our website at [www.american-club.com](http://www.american-club.com)

- **Circular No. 15/12 Dangers Of Carrying Nickel Ore From Indonesia And The Philippines - Mandatory Notification Requirements** (30 May 2012)

- **Circular No. 06/11 Indonesia and The Phillipines: Safe Carriage of Nickel Ore Cargoes** (28 January 2012)

- **Member Alert: Intercargo Guide for the Safe Loading of Nickel Ore** (02 February 2012)

- **Member Alert: Dangers With Respect to the Carriage of Nickel Ore and Other Bulk Cargoes Prone to Liquefaction** (16 December 2010)
Summary

- 81 seafarers have lost their lives since October 2010 on ships carrying nickel ore. Sadly, there are likely more to come.

- **Regulations are lagging far behind the realities of the nickel ore trade.**

- Political, economics and commercial interests and pressures make any significant progress difficult.

- Industry stakeholders (e.g. Intercargo, BIMCO, IG Clubs) undaunted but challenged to produce unified solutions

- If a ship sinks carrying nickel ore... it is more than likely because of the nickel ore.