

# Liquefying Bulk Cargoes

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## Lessons learned about nickel ore



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# Overview

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- 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

*Chinese Nickel Ore Imports – 2005- 2011  
(in metric tonnes)*



Source: INSG

# Indonesia nickel ore: source to ship

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# Nickel ore incidents

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- 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...

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- 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

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## 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- Superseded the Code of Safe Practice for Solid Bulk Cargoes (BC Code) adopted in 2004 but wasn't mandatory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.)

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## IMSBC Code: Hazards of concerns and objectives

- Code addresses hazards of carriage of bulk cargoes associated with:
  - ü structural damage due to improper cargo distribution;
  - ü loss or reduction of stability during a voyage; and
  - ü chemical reactions of cargo.
- Code objectives are to:
  - ü facilitate safe stowage and shipment of certain bulk cargoes;
  - ü provide information on dangers associated with shipment of certain cargoes; and
  - ü provide instructions on procedures to be adopted for those cargoes.

# IMO regulations (cont.)

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## IMSBC Code Overview: Code sections

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



# IMO regulations (cont.)

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## IMSBC Code Overview: Appendices

- ü Individual schedules of solid bulk cargoes
- ü Laboratory test procedures, associated apparatus and standards
- ü Properties of solid bulk cargoes

# Cargo "angle of repose"

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*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.



# IMSBC Code Terminologies

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## *Cargo category*

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

# IMSBC Code Terminologies (cont.)

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## *Moisture content*

- ü Flow moisture point (FMP): percentage moisture content (wet mass basis) at which a flow state develops "*under prescribed methods of testing*"
- ü Transportable moisture limit (TML): maximum moisture content of the cargo which is considered safe for carriage



# Getting down to “brass tacks”

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## *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...”



# Getting down to “brass tacks” (cont.)

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## *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.)

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## *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*

Shipper		Reference number (s)
Consignee		Carrier
Name/means of transport	Port/place of departure	Instructions or other matters
Port/place of destination		
General description of the cargo __ (type of material/particle size)*  *For solid bulk cargo		<input type="checkbox"/> Gross mass (kg/tonnes) <input type="checkbox"/> General cargo <input type="checkbox"/> Cargo units <input type="checkbox"/> 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* <input type="checkbox"/> Certificate of moisture content and transportable moisture limit <input type="checkbox"/> Weathering certificate <input type="checkbox"/> Exemption certificate <input type="checkbox"/> 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

# Getting down to “brass tacks” (cont.)

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## *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:
  - ü a signed certificate of TML
  - ü TML certificate shall contain or be accompanied by results of TML tests
  - ü a signed certificate or declaration of the moisture content

# Getting down to “brass tacks” (cont.)

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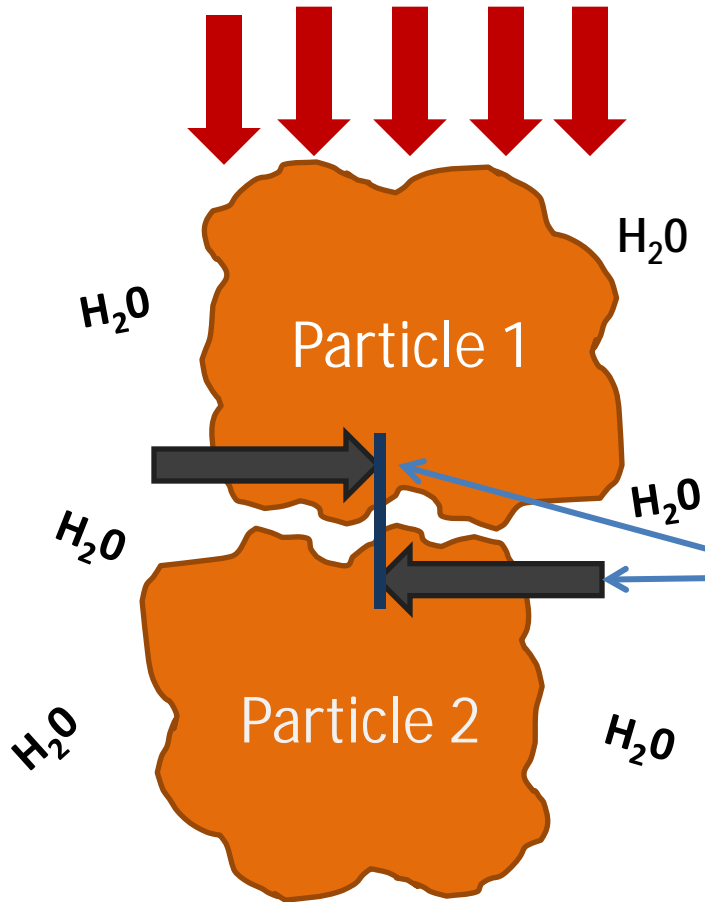
## *Sampling procedures*

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

- ü Type of material
- ü Particle size distribution
- ü Manner of which material was stored
- ü Variations in moisture distribution through consignments
- ü 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

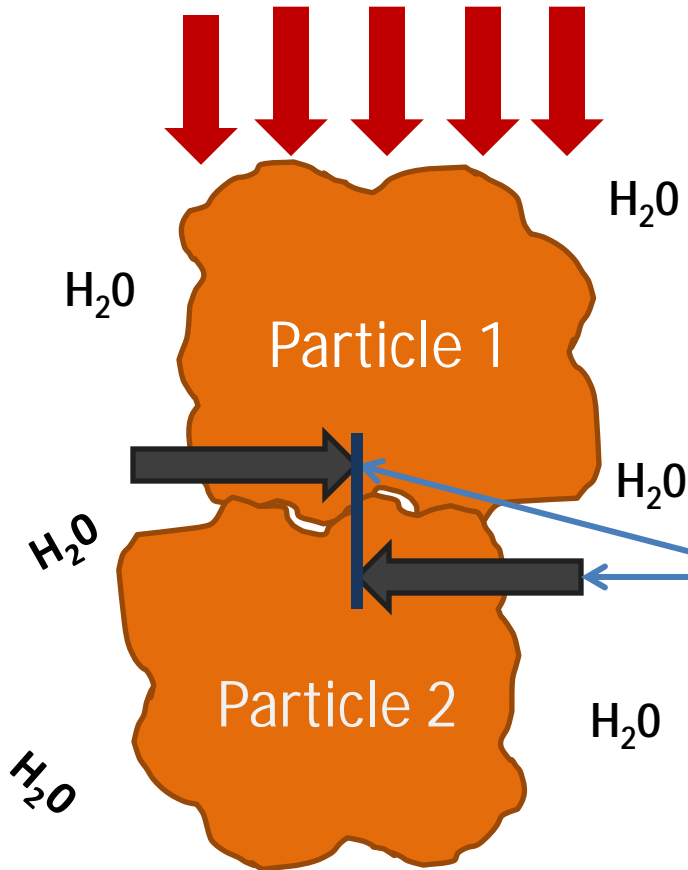
**Step 1:** Volume of space between particles reduce as cargo is compacted owing to ship motion

Sufficient equal and opposite shear forces between Particle 1 and Particle 2

# How does liquefaction occur? (cont.)

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Compression force from other cargo particles



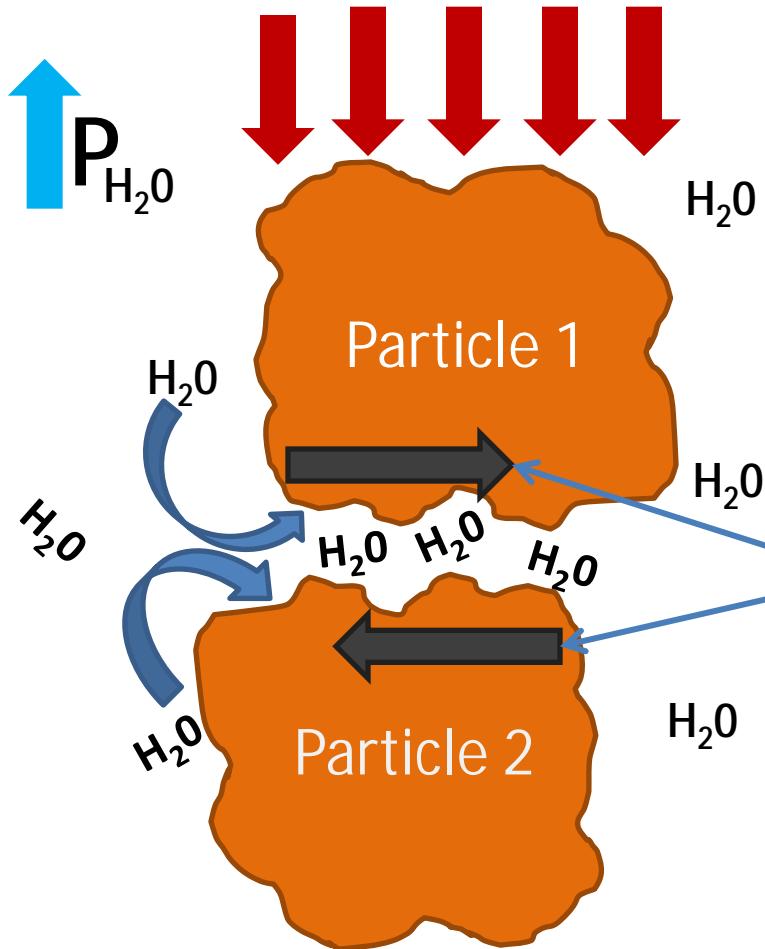
Space between Particle 1 and Particle 2 is further reduced

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

Sufficient equal and opposite shear forces between particles maintained

# How does liquefaction occur? (cont.)

Compression force from other cargo particles



Water pressure forces water between Particle 1 and Particle 2

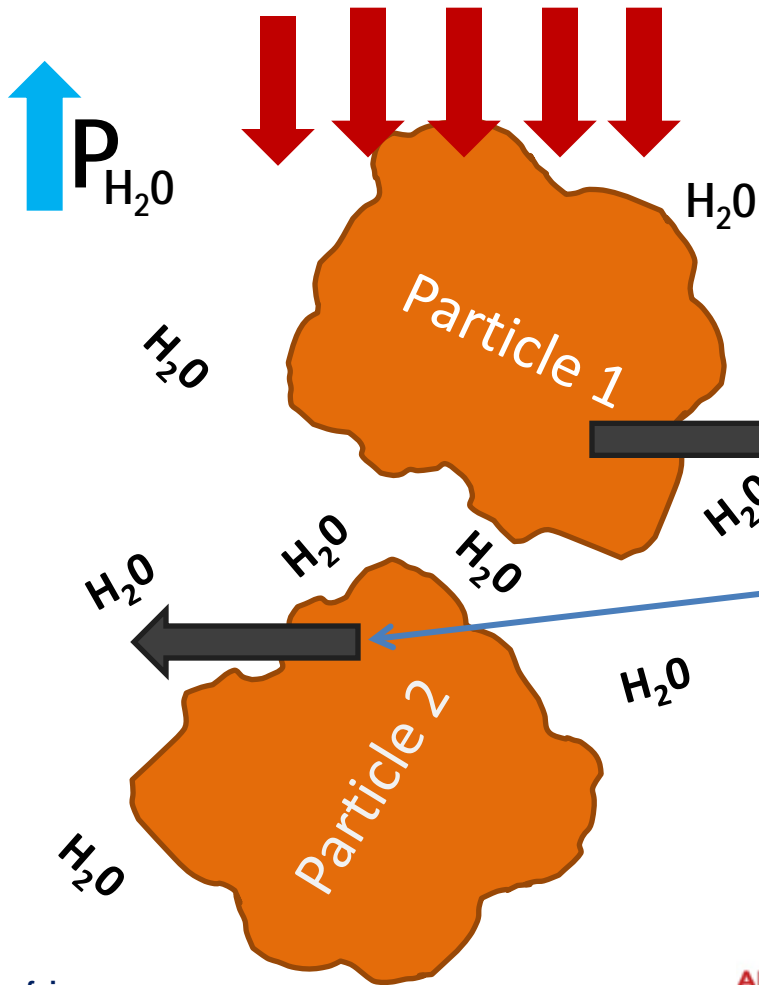
**Step 3:** Increase in water pressure reduces the friction between cargo particles

As water pressure increases and forces itself between particles, shear pressure decreases as space widens between particles



# How does liquefaction occur? (cont.)

Compression force from other cargo particles



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!

Shear forces between Particle 1 and Particle 2 no longer exists. Liquefaction occurs.

# How does liquefaction occur? (cont.)

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## 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.

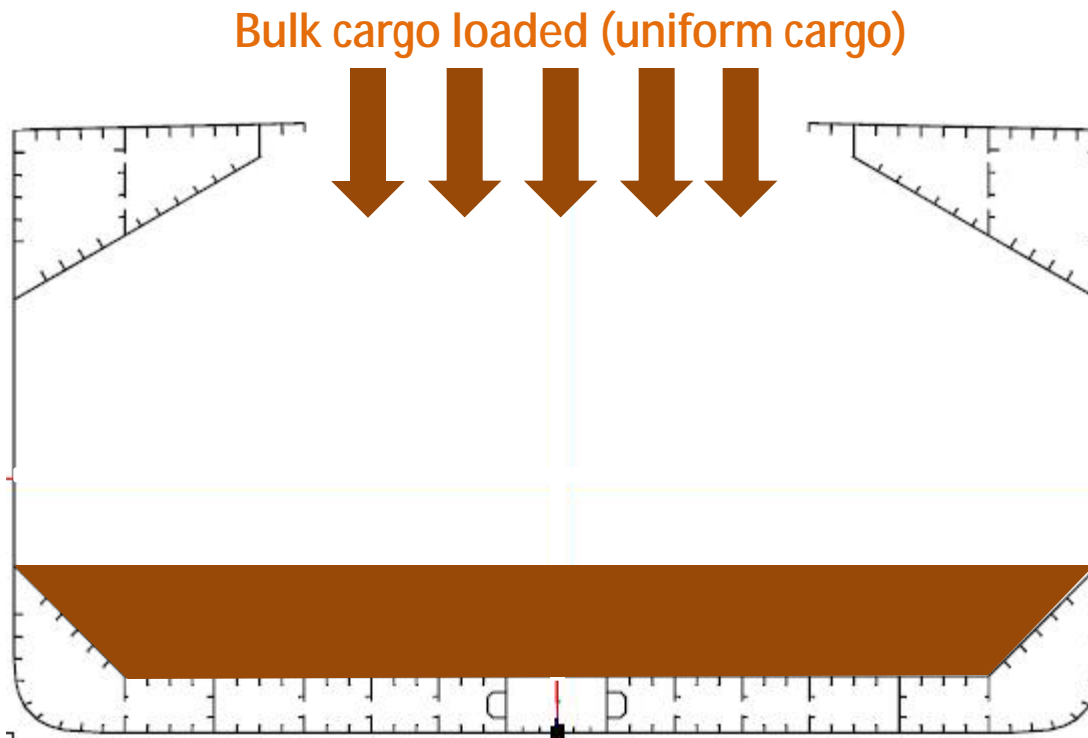
## Liquefaction may occur when...

- Moisture content exceeds the TML.

# Moisture migration

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Uniform loaded bulk cargo with moisture content < TML



# HARITA BAUXITE cargo holds

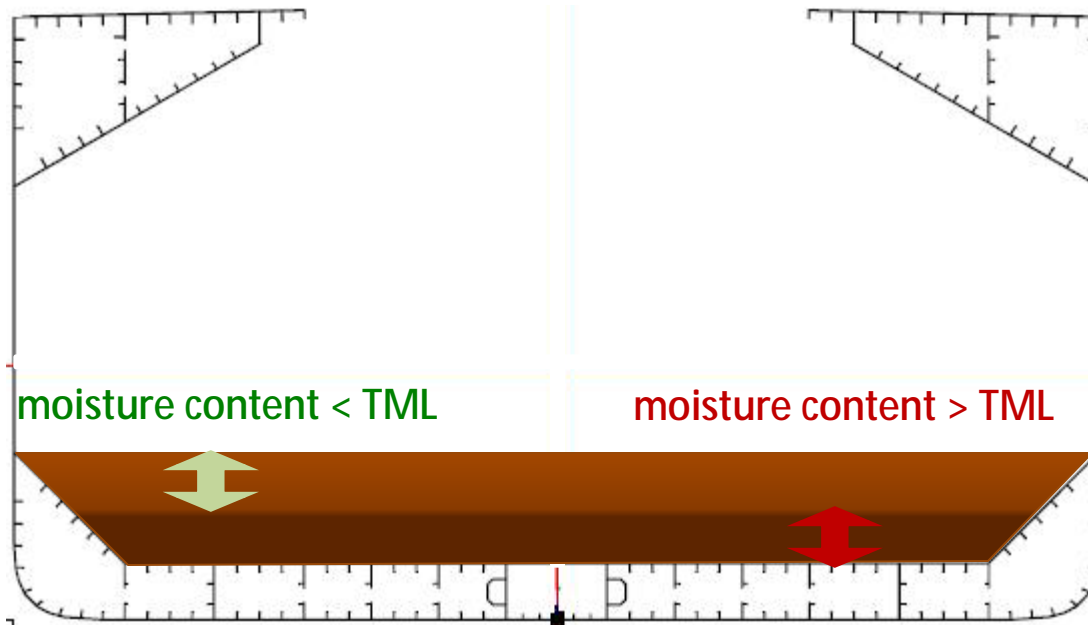
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# Moisture migration (cont.)

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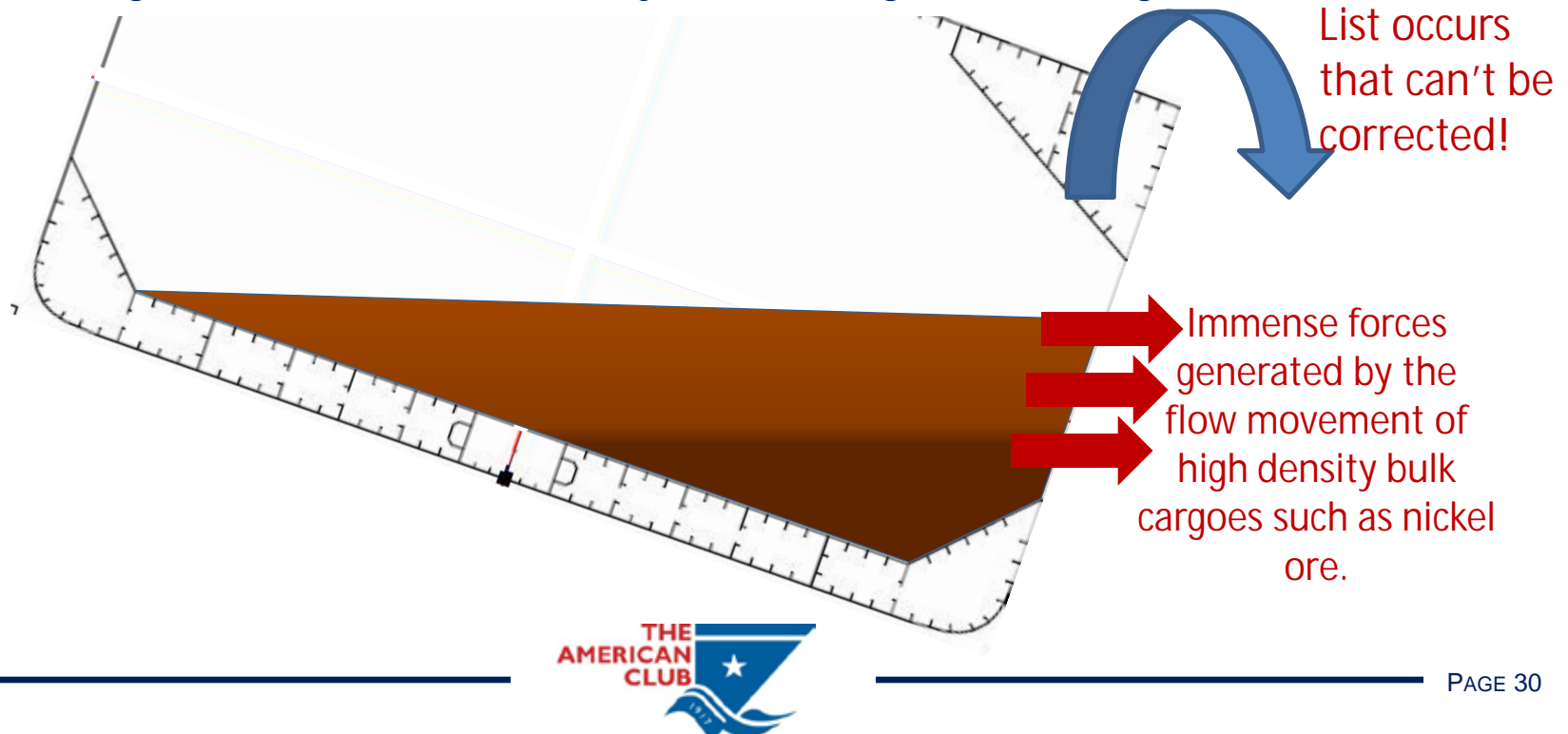
Water migrates via gravity...



# Moisture migration (cont.)

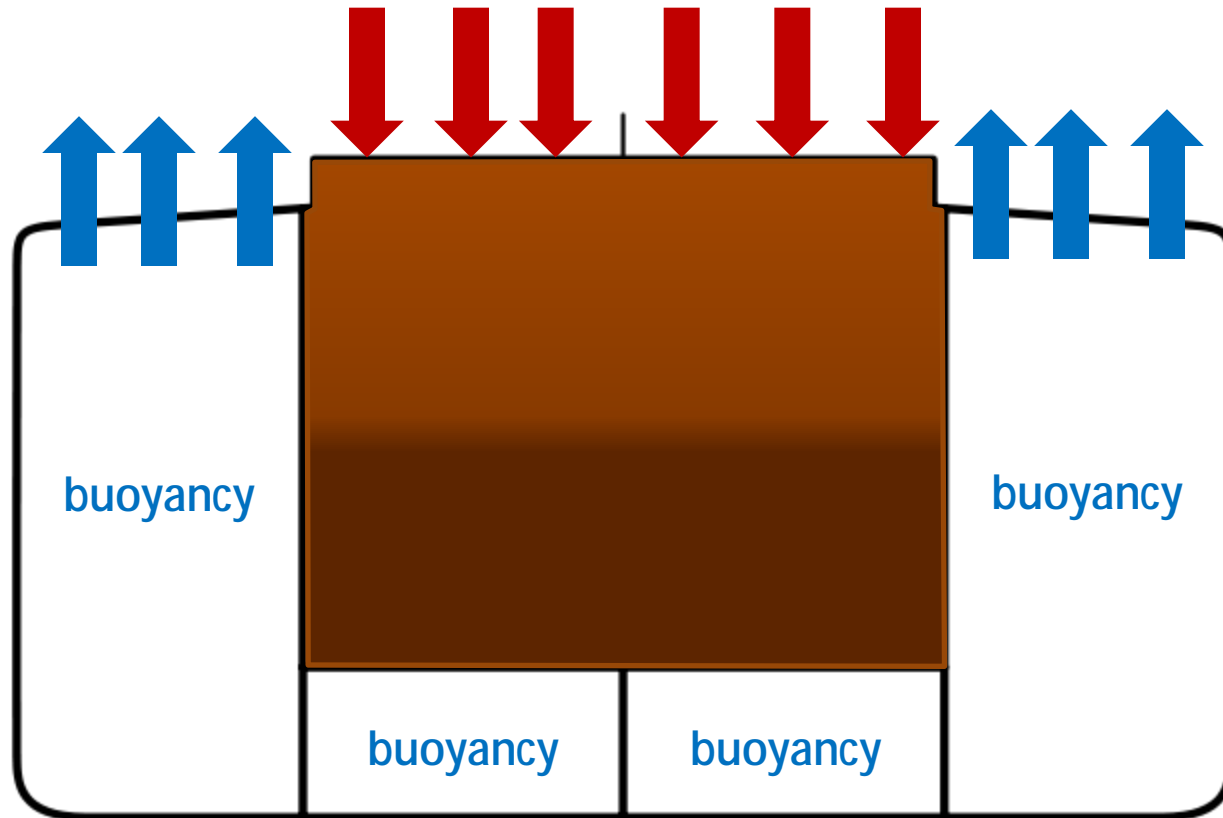
## Cargo testing: IMSBC Code, Section 7, Regulation 7.3.2

"...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 angles."



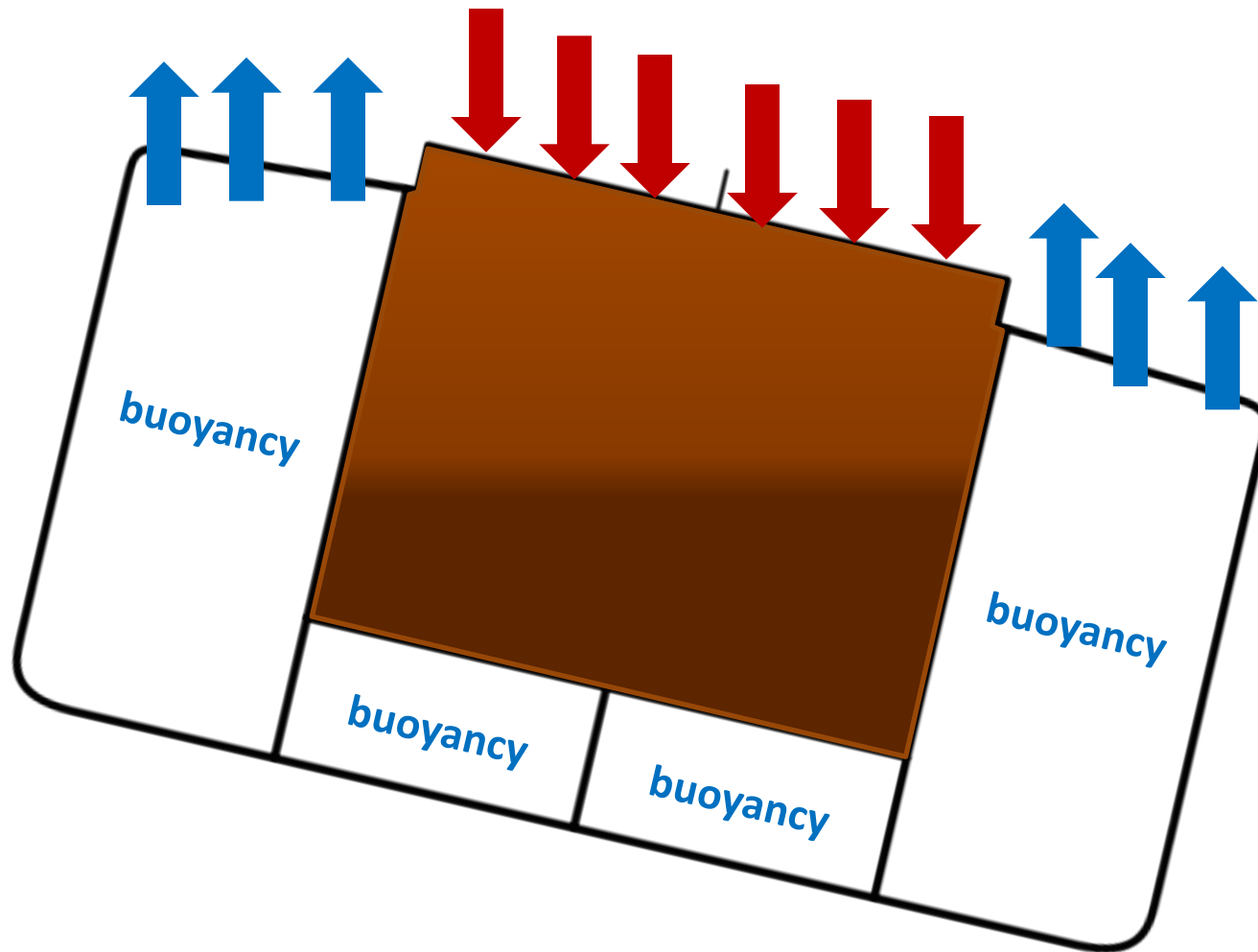
# Designed to carry Group A cargoes?

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# Designed to carry Group A cargoes?

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# What can the crew do?

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## 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.)

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## 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?

**RIMEGAH BANGUN PERSADA**  
General Trading and NICKEL MINE

PT. TRIMEGAH BANGUN PERSADA  
Jl. Yasin Gamsugi No.94 RT.003 / RW.02  
Kelurahan Makasar Timur  
Ternate 97724 – Maluku Utara

**DECLARATION OF QUALITY**

As per shipment of [REDACTED]

This is to declare that the Laterite Nickel Ore, carried on the above mentioned vessel content as follows:

Ni : 1.00 PCT (Min)  
H<sub>2</sub>O : 35.00PCT (Max) → H<sub>2</sub>O: 35%???

Kawasi, February 10<sup>th</sup>, 2013  
Ref : 57-dog 0213

Sign on behalf of  
PT. TRIMEGAH BANGUN PERSADA

*Eddy Suwardy*  
Eddy Suwardy  
General Manager

RECEIVED BY  
M/V DELPHIS  
RANAMA  
*[Signature]*  
Master  
M.V. DELPHIS



# Insurance considerations

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## 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



# Insurance considerations (cont.)

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## 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

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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

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- 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.

