



# IMSBC CODE GROUP 'A' BULK CARGOES

Prevention, Cause and Effect of Liquefaction

Presented by

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Director, Marine Consultant, LOC Hong Kong

## INTRODUCTION

- IMSBC CODE BULK CARGO GROUPS
- CASUALTY STATISTICS
- IMO PUBLICATIONS & BULLETINS
- CONSEQUENCES OF LIQUEFACTION
- SAMPLING PROCEDURES
- INACCURATE CARGO DECLARATIONS
- AWARENESS ON BOARD / EARLY WARNING SIGNS
- IMSBC CODE AMENDMENTS 1 JANUARY 2013

# INTRODUCTION

**How many Solid Bulk Cargoes are there?**

**306+**

# BULK CARGO GROUPS

**Bulk Cargoes are split into 3 groups**

## **Group A**

Cargoes that may liquefy

## **Group B**

Cargoes that possess a chemical hazard

## **Group C**

Cargoes that do not liquefy or possess a chemical hazard

# BULK CARGO GROUPS

**Group A:**  
Cargoes that may liquefy



Mineral Concentrates  
Nickel Ore  
Coal Slurry

# BULK CARGO GROUPS

## Group B:

Cargoes that possess a chemical hazard

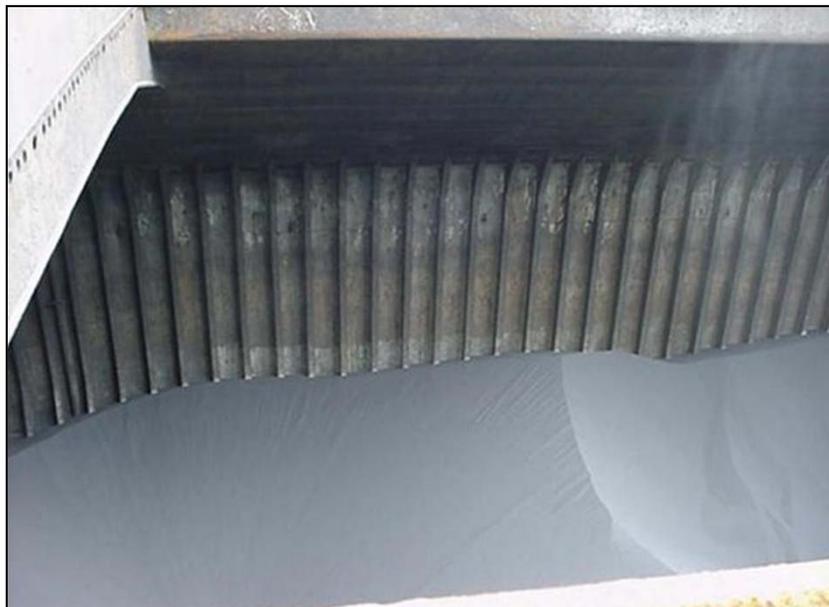
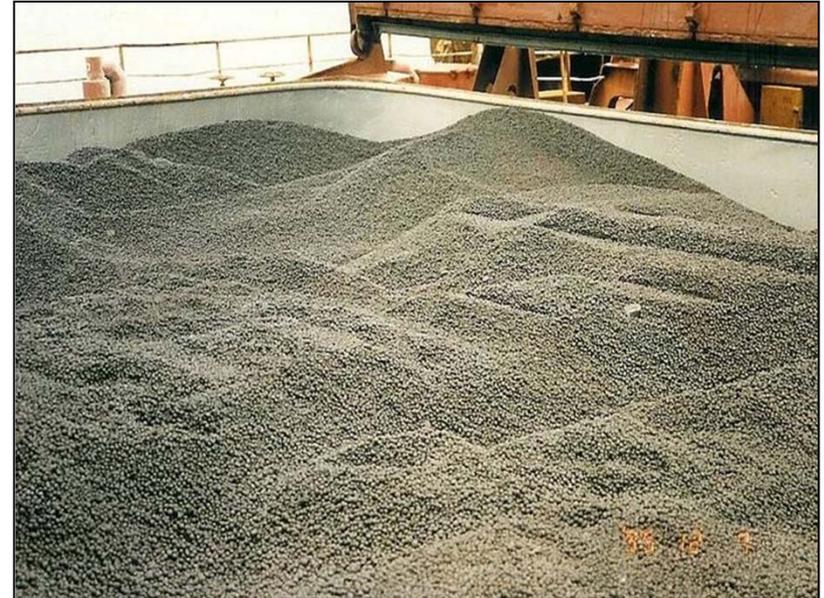


Coal  
Direct Reduced Iron  
Iron Oxide  
Sodium Nitrate

## BULK CARGO GROUPS

### Group C:

Cargoes that do not liquefy  
or possess a chemical  
hazard



Iron Ore Pellets

Cement

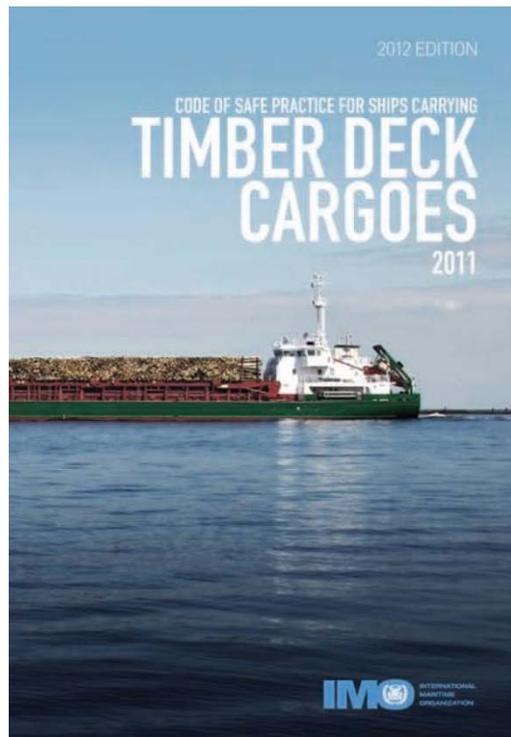
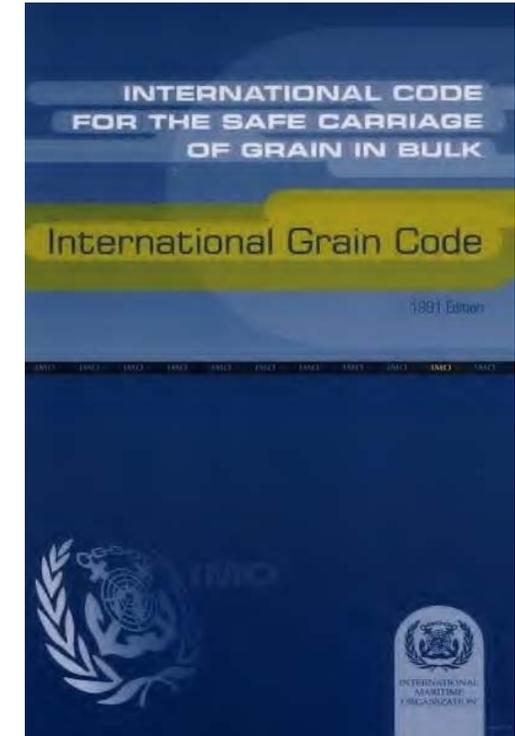
Limestone

Gypsum

# BULK CARGO GROUPS

## Grain in Bulk:

IMO International Code for the Safe Carriage of Grain In Bulk, 1991



## Timber Cargoes:

IMO International Code for the Safe Practice for Carrying Deck Cargoes, 2011



# BULK CARRIER CASUALTY STATISTICS

**2010:**

7 Total Losses, 4 Unrelated to Cargo

3 related to Cargo which suffered Liquefaction

44 Seafarers lives were lost.



# BULK CARRIER CASUALTY STATISTICS

**2011:**

13 Total Losses, 11 Unrelated to Cargo

2 related to Cargo which suffered Liquefaction

39 Seafarers lives were lost, 29 Seafarers lives lost due to Liquefaction



# BULK CARRIER CASUALTY STATISTICS

**2012:**

3 Total Losses, 3 Unrelated to Cargo

No Loss of Life.



# BULK CARRIER CASUALTY STATISTICS

**2013:**

12 Total Losses, 10 Unrelated to Cargo

2 Related to Cargo which suffered Liquefaction

15 Seafarers lives were lost.



# BULK CARRIER CASUALTY STATISTICS

**2014:**

2 Total Losses, 2 Unrelated to Cargo

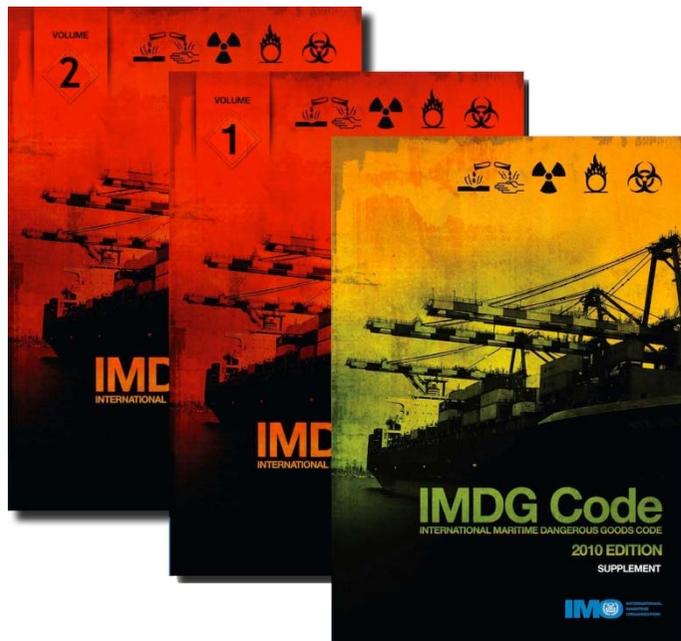
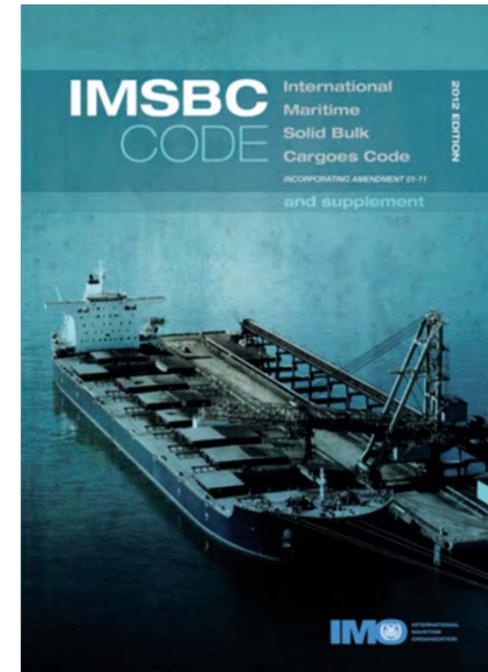
No Loss of Life.



# IMO PUBLICATIONS & BULLETINS

What publications does the Master have to hand?

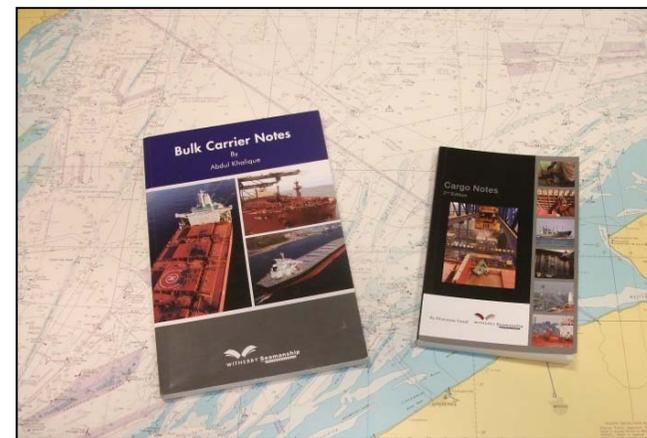
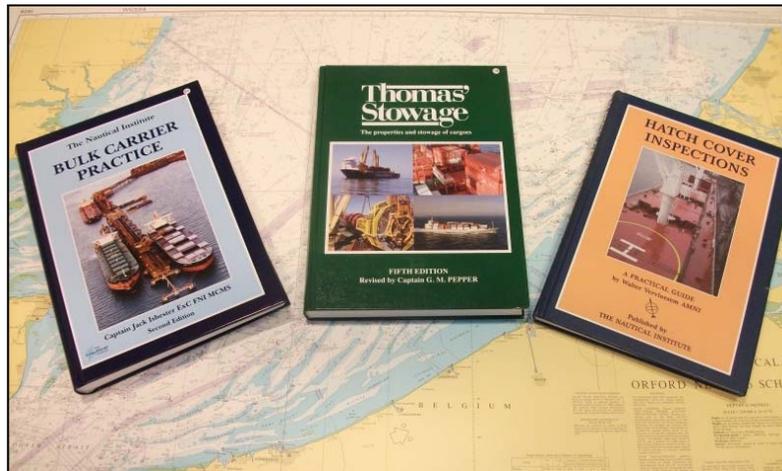
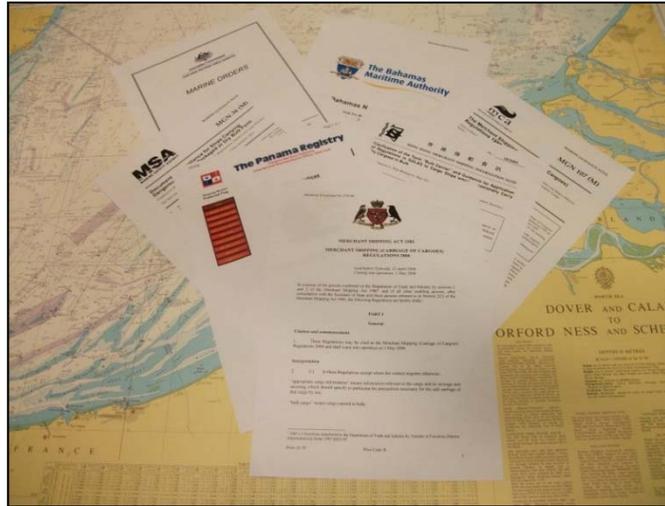
**IMSBC Code 2012 –**  
International Maritime Solid Bulk  
Cargoes Code and Supplement



**IMDG Code 2010 –**  
International Maritime  
Dangerous Goods Code,  
Vol. 1, Vol.2, and Supplement



# IMO PUBLICATIONS & BULLETINS

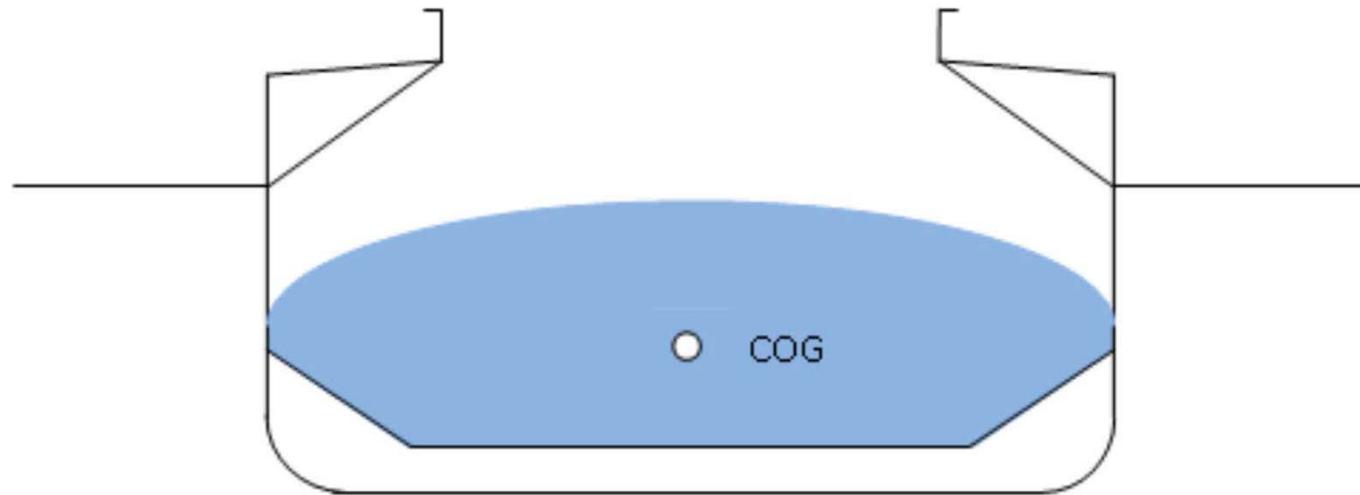


## CONSEQUENCES OF LIQUIFACTION

Liquefaction does not occur when one of the following conditions is satisfied:-

- *If the cargo particles are small, good cohesion is present then water pressure between the cargo particles does not increase.*
- *If the cargo contains large particles or lumps, water passes through the space and therefore no increase of water pressure.*
- *If the cargo contains a high percentage of air and a low moisture content. Dry cargoes cannot liquefy.*

# CONSEQUENCES OF LIQUIFACTION



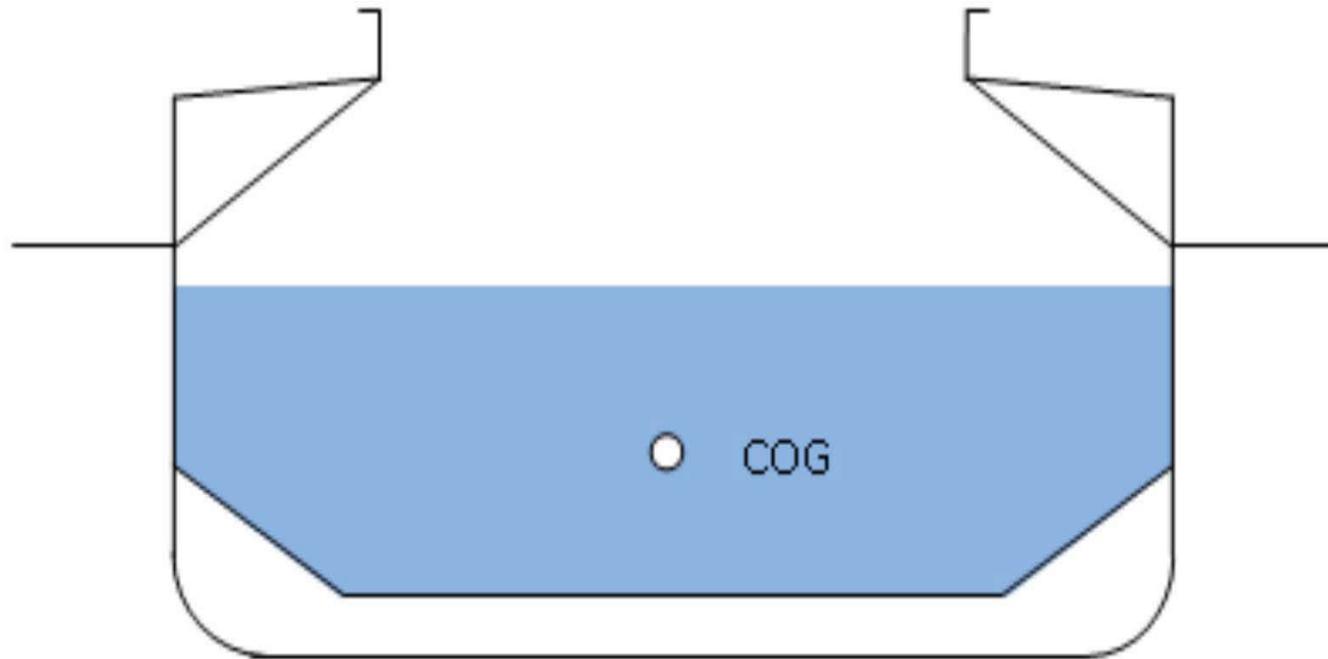
# CONSEQUENCES OF LIQUIFACTION

What is Liquefaction?

Liquefaction can be described as follows:-

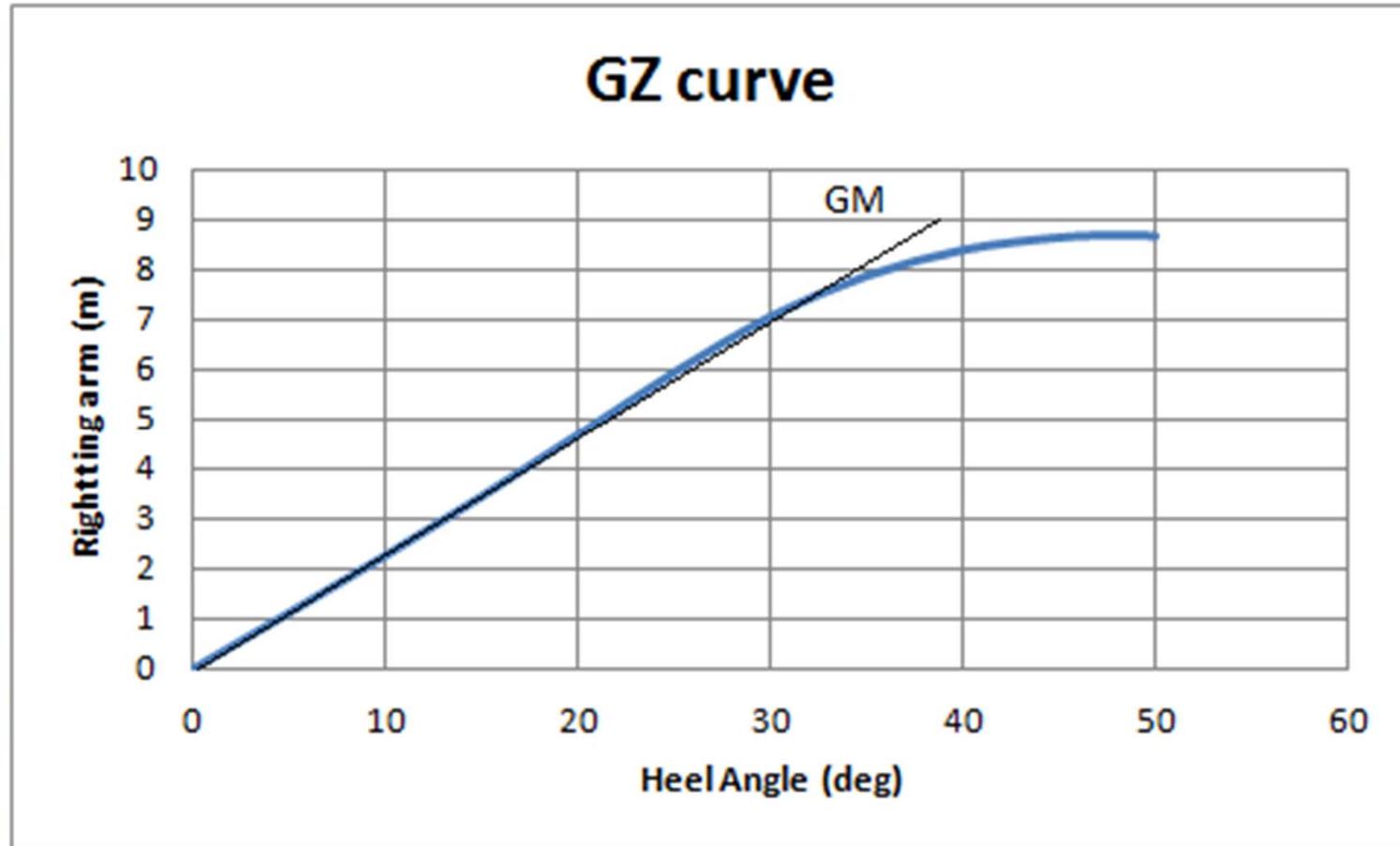
- *Volume of space between particles reduces, cargo compacts due to ship's motion*
- *Space reduction between particles causes an increase in water pressure*
- *Increased water pressure reduces friction between particles, resulting in reduced sheer strength*

# CONSEQUENCES OF LIQUIFACTION



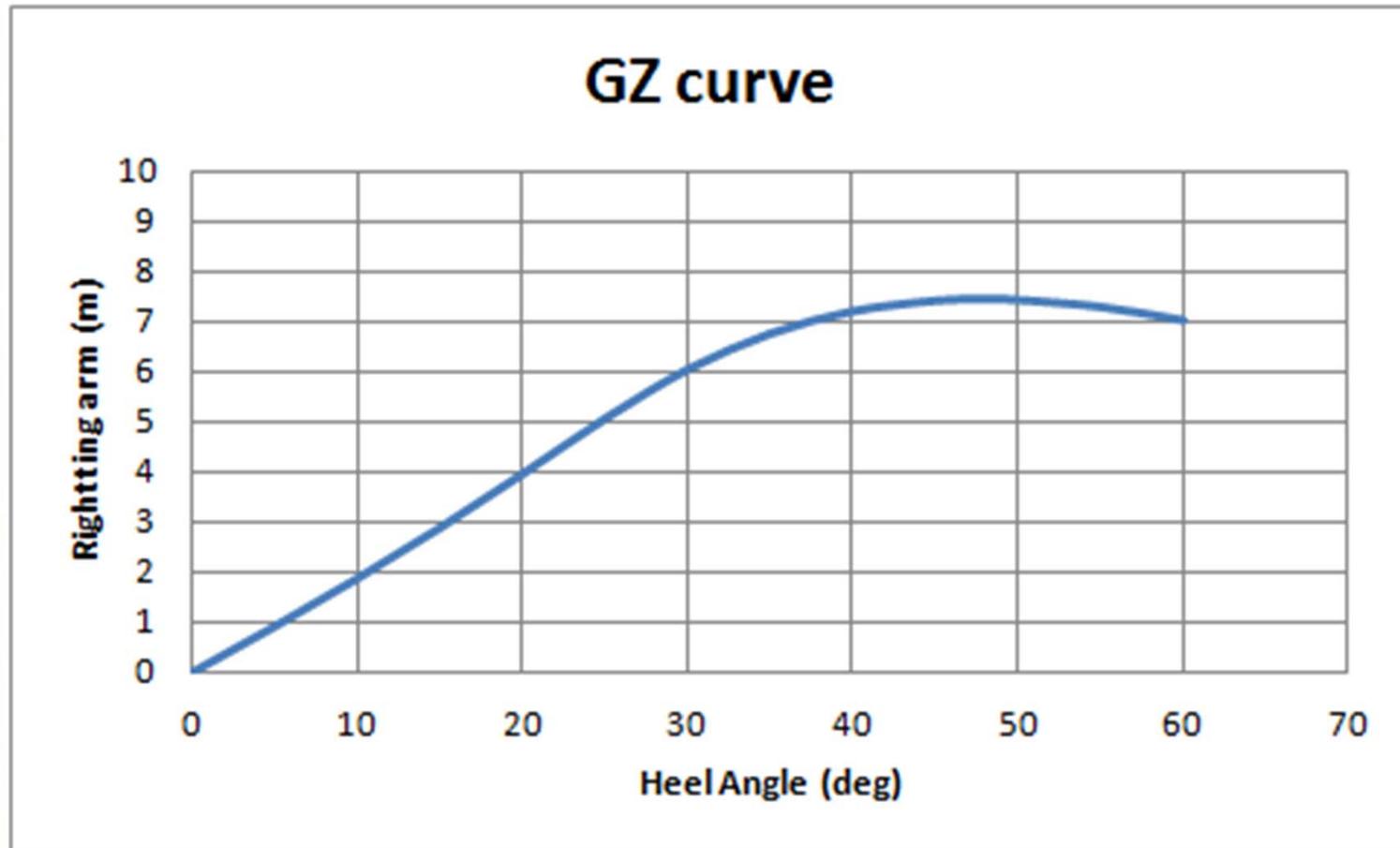
# CONSEQUENCES OF LIQUIFACTION

## Intact GZ Curve



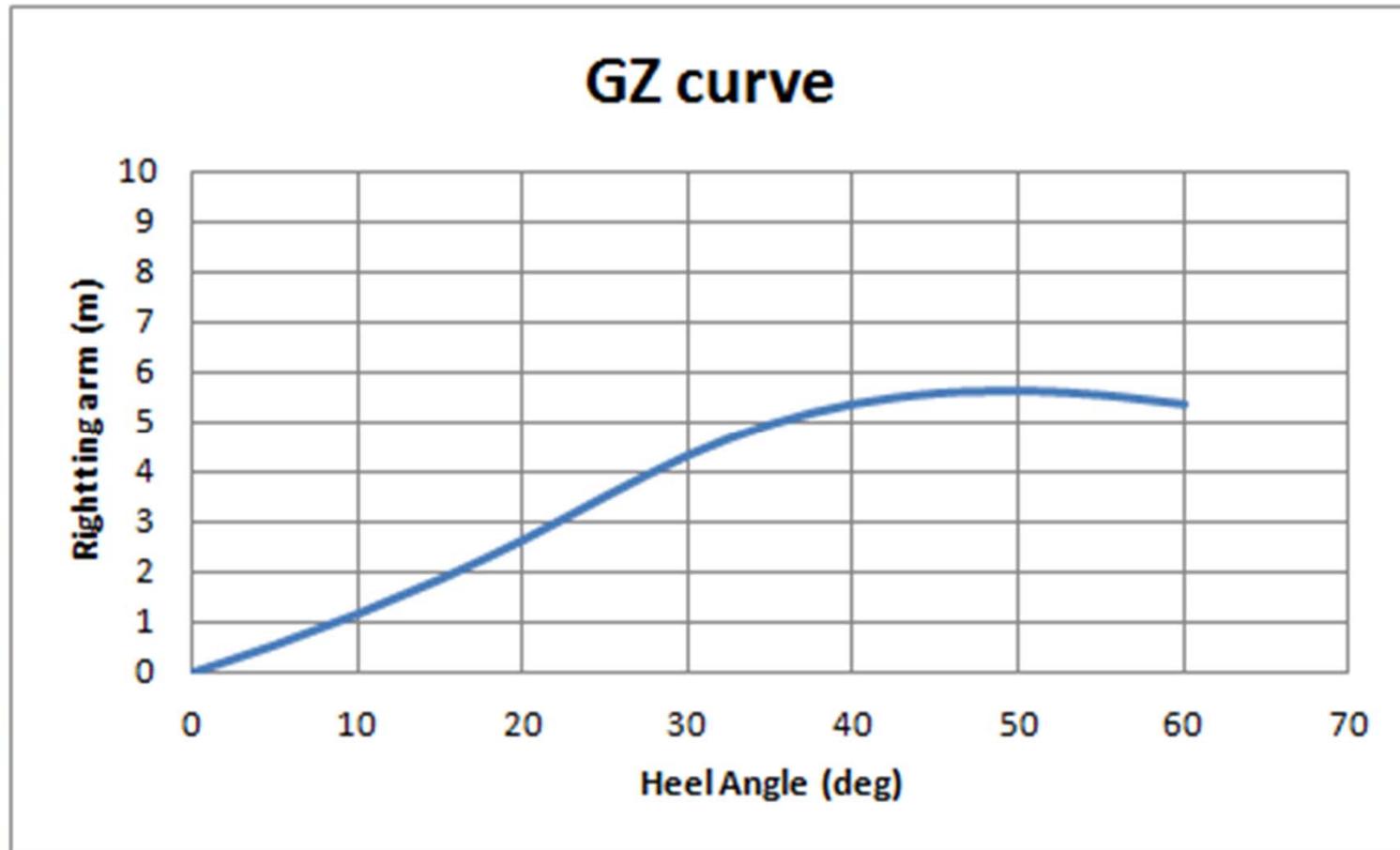
# CONSEQUENCES OF LIQUIFACTION

## One Hold suffers Liquefaction



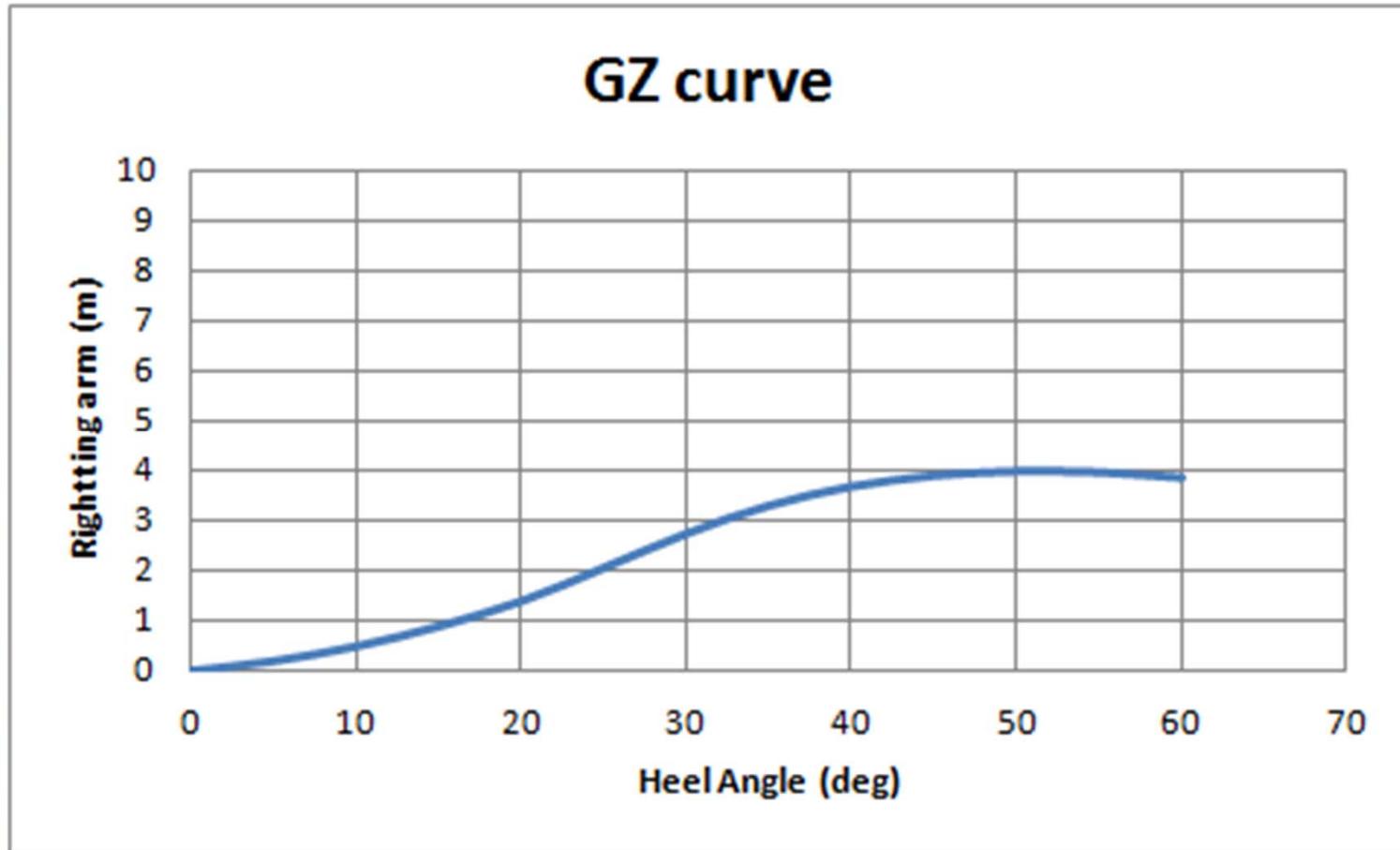
# CONSEQUENCES OF LIQUIFACTION

Two Holds suffer Liquefaction



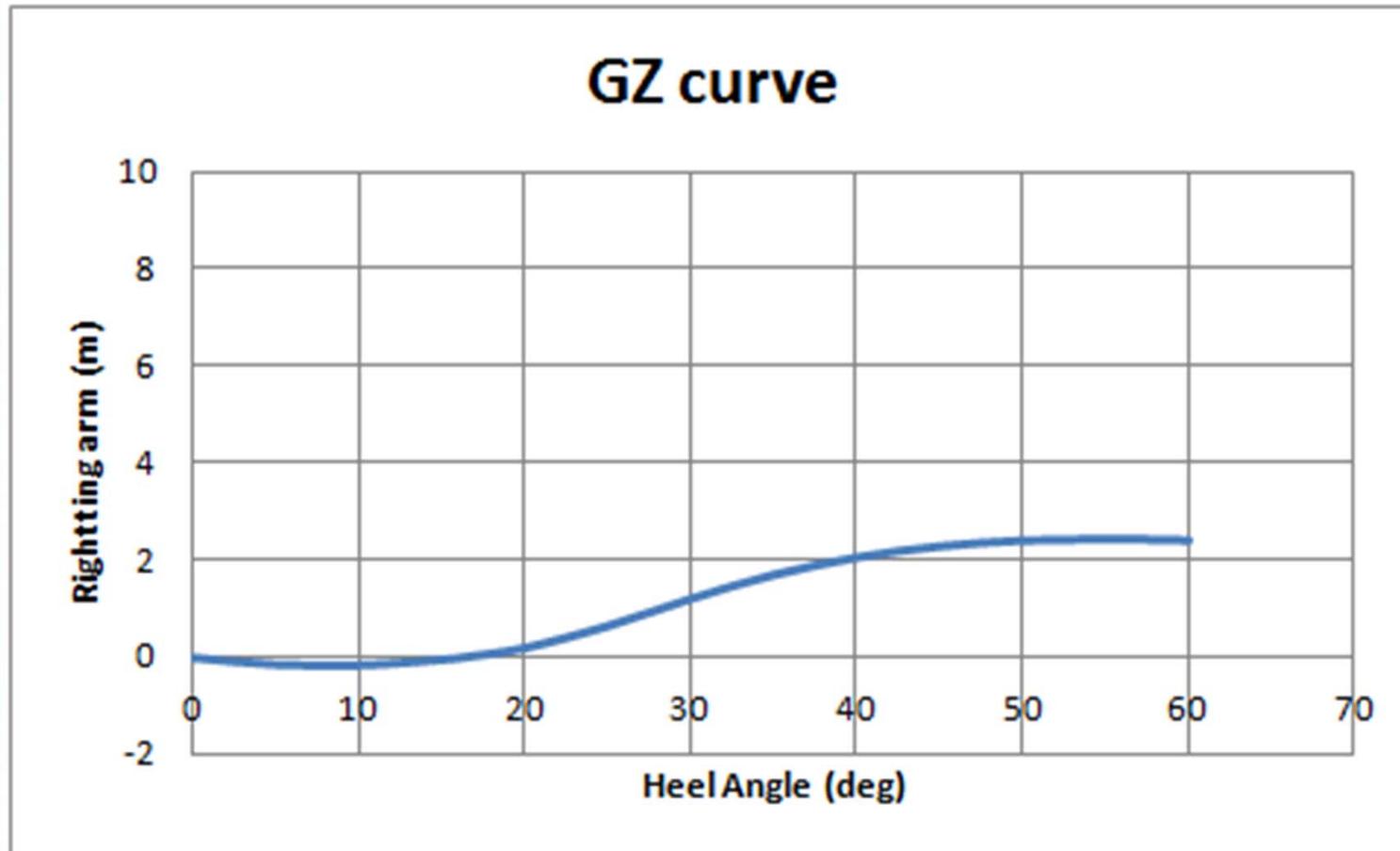
# CONSEQUENCES OF LIQUIFACTION

Three Holds suffer Liquefaction



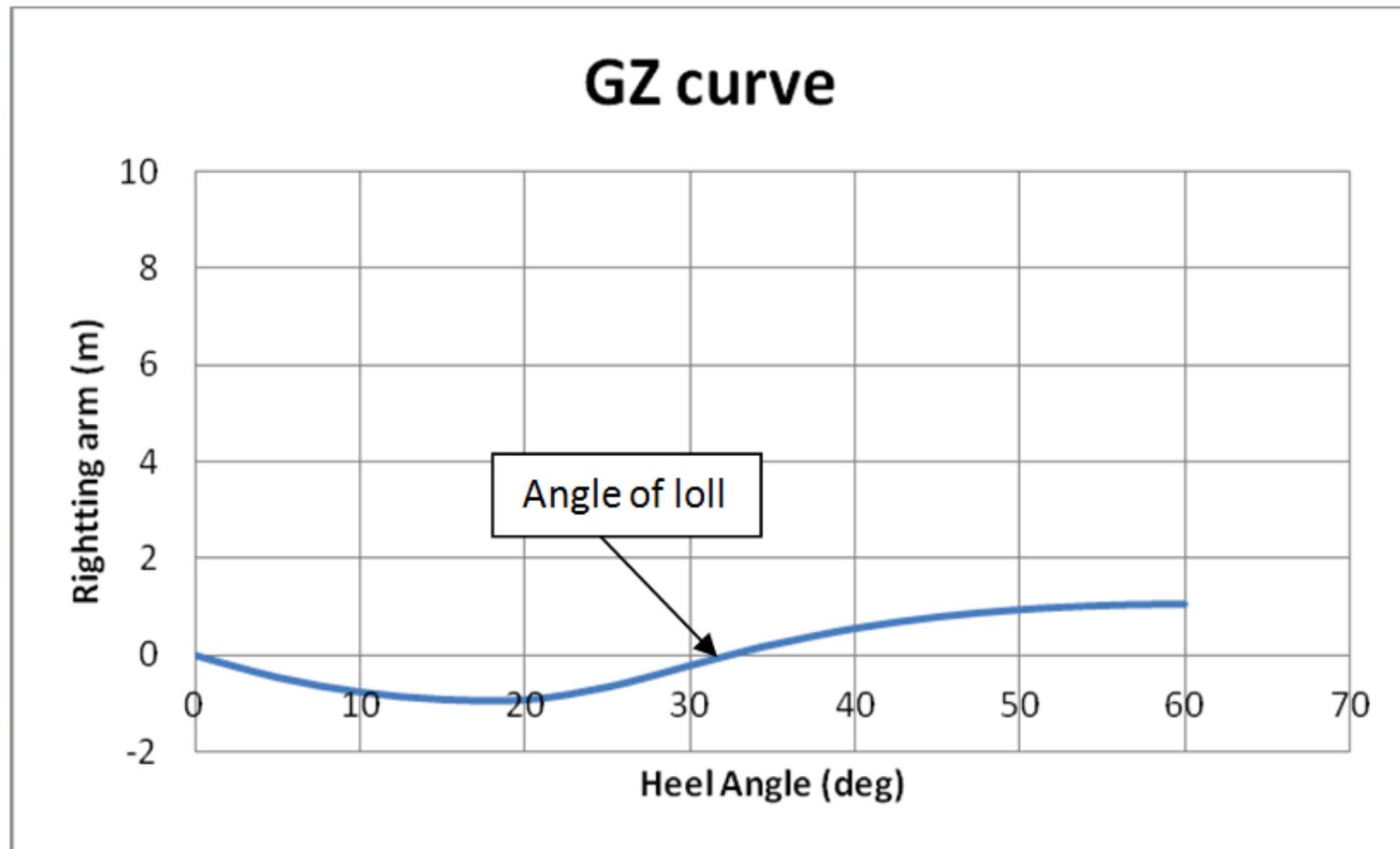
# CONSEQUENCES OF LIQUIFACTION

Four Holds suffer Liquefaction



# CONSEQUENCES OF LIQUIFACTION

Five Holds suffer Liquefaction



# CONSEQUENCES OF LIQUIFACTION

Where are the Problem  
Cargoes From?

- India
- Indonesia
- Philippines
- Ukraine
- Brazil



# CONSEQUENCES OF LIQUIFACTION

## What are the problems?

- Stockpiles/rail cars are not protected from the elements
- Shipper refuses to nominate a stockpile before vessel arrival
- Declarations are not compliant with IMSBC Code
- Local surveyors not fully conversant with sampling requirements

# CONSEQUENCES OF LIQUIFACTION

## What are the problems?

- Loading by barge
- Shipper refuses to allow access to the stockpiles
- Stockpiles are remote from vessel
- No knowledge of local surveyors' capabilities
- Remote locations (Indonesia & Philippines)
- Some local laboratories' results favour the shipper

## CONSEQUENCES OF LIQUIFACTION

If the Master is faced with the consequences of liquefaction



## SAMPLING PROCEDURES

### **Section 4.6 of the IMSBC Code outlines the Sampling Procedures for Concentrate Stockpiles:**

- Sub-samples to be taken from levelled stockpile.
- Plan of stockpile is drawn and divided into areas, each of which contains approximately 125t, 250t or 500t, depending on amount to be shipped.
- Each sub-sample to be drawn from approximately 50cm below surface of designated sampling area.

## SAMPLING PROCEDURES

### **Section 4.6 of the IMSBC Code outlines the Sampling Procedures for Concentrate Stockpiles:**

- Consignments < 15,000 tonnes = 1 x 200g sub-sample each 125 tonnes
- Consignments > 15,000 tonnes < 60,000 tonnes = 1 x 200g sub-sample each 250 tonnes
- Consignments > 60,000 tonnes = 1 x 200 g sub-sample each 500 tonnes

## SAMPLING PROCEDURES

### **Section 4.6 of the IMSBC Code outlines the Sampling Procedures for Concentrate Stockpiles:**

*Example:* A vessel is consigned to load 50,000mt of nickel ore

The IMSBC Code states

*Consignments of more than 15,000t but not more than 60,000t; one 200g sub-sample is to be taken for each 250t to be shipped*

**In total 200 sub-samples should be taken**

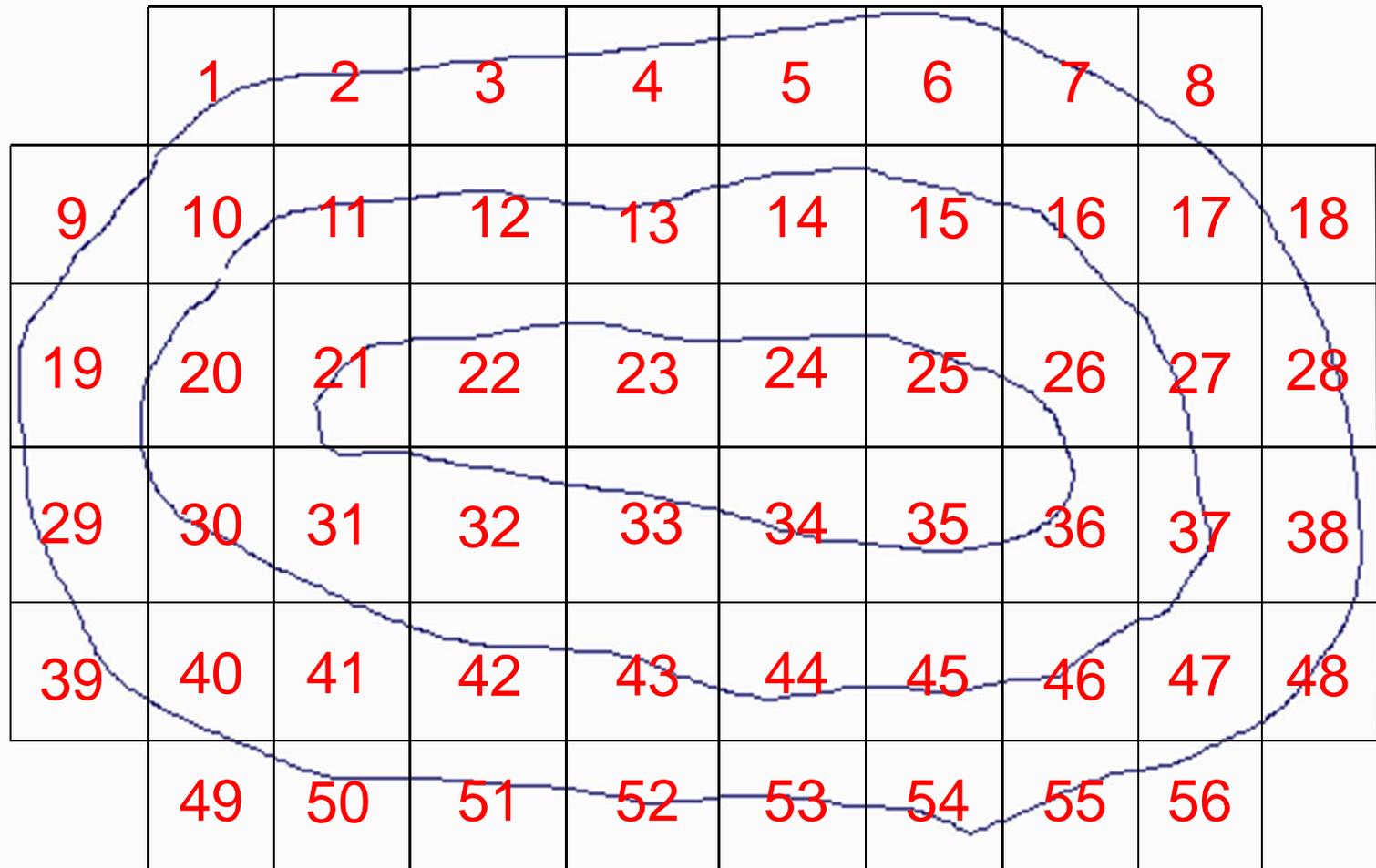
## SAMPLING PROCEDURES

- Sub-samples should be taken in a uniform pattern
- Wherever possible from a levelled stockpile



- As an example the 1st stockpile is approx. 14,000t

# SAMPLING PROCEDURES



# SAMPLING PROCEDURES

Each 200g sub-sample is drawn 50cm below the surface



## SAMPLING PROCEDURES

What are we testing these samples for?

### Moisture content (MC)

Is calculated as a percentage of the total mass weight based on the dry weight of soil.

### Flow Moisture Point (FMP)

Is the inherent moisture content (%) in a material at which a flow state develops.

### Transportable Moisture Limit (TML)

Of a cargo is determined as 90% of the Flow Moisture Point.

## SAMPLING PROCEDURES

How often should this sampling be conducted?



IMSBC Code Section 4.5 states:-

The Interval between sampling / testing for MC shall not be more than 7 days prior to loading

The Interval between sampling / testing for TML shall not be more than 6 months prior to loading



# SAMPLING PROCEDURES

How do we test these samples?

Flow Table Test

Moisture Content &  
Flow Moisture Point

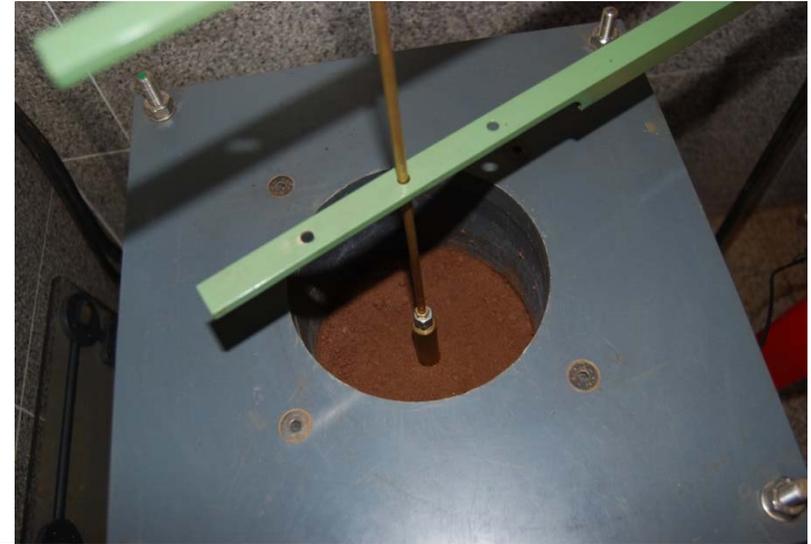


# SAMPLING PROCEDURES

How do we test these samples?

Penetration Test

Flow Moisture Point



# SAMPLING PROCEDURES

How do we test these samples?

Proctor / Fagerberg Test

Transportable Moisture Limited



# INACCURATE CARGO DECLARATIONS



# INACCURATE CARGO DECLARATIONS

## Certificate of Test

Certificate No. 02392/GBDBAB  
Date: June 11, 2008

Jl. Urip Sumoharjo 1  
P1

**REPORT MOISTURE TESTING OF BULK MATERIAL FOR OCEAN TRANSPORTATION**

VESSEL : MV  
QUANTITY : SAID TO BE ± 55.000 WMT  
DESCRIPTION OF GOODS : SAPROLITE NICKEL ORE IN BULK  
SAMPLING DATES : 06/06/2008  
SAMPLING LOCATION : KABAENA ISLAND, INDONESIA

Flow Moisture Point , Transportable Moisture Limit and Moisture Content of Material

TEST RESULTS :

Flow Moisture Point (FMP) of the test material  
Transportable Moisture Limit (TML) of the test material  
Moisture Content (MC) - 7 mm of the test material  
Moisture Content (MC) + 7 mm of the test material  
Average Moisture Content of Stockpile Material

This Certificate/report is issued under our General Terms and Conditions

MKS.MIN 00575.2008

0100410

### Flow Moisture Point , Transportable Moisture Limit and Moisture Content of Material

#### TEST RESULTS :

Flow Moisture Point (FMP) of the test material	= 34.00%
Transportable Moisture Limit (TML) of the test material	= <u>30.60%</u>
Moisture Content (MC) - 7 mm of the test material	= <u>27.70%</u>
Moisture Content (MC) + 7 mm of the test material	= 19.06%
Average Moisture Content of Stockpile Materials	= 27.53%

# INACCURATE CARGO DECLARATIONS

Certificate No. 07212/GBAAAB  
Date: June 10, 2008

Jl. Raya Pasar Minggu I  
Phon

**CERTIFICATE OF SAMPLING AND MOISTURE TESTING**

CONSIGNMENT : NICKEL ORE IN BULK  
QUANTITY : SAID TO BE ± 55,000 WMT  
SAMPLING DATES : 06/06/2008 to 08/06/2008  
SAMPLING LOCATION : KABAENA ISLAND, INDONESIA

This is to certify that we have conducted sampling and Moisture Testing of Ni Ore to be loaded to MV

Sampling and Moisture Testing of Ni Ore Procedures are in accordance with JIS M 8109

Sampling was carried out by us by systematic sampling on a mass basis during the stockpiling, or in the moving state, not in the stationary state.

All parts of the Ni Ore are of equal oppo  
sample for analysis., carried out so that in  
sampling device, and being near uniform

**Moisture Content Results**

NO	STOCKPILE / BARGE	AVERAGE (%)
1	A.P.A.P	27.60
2	HS 999	26.85
3	OCEAN II	27.09
4	KING POST	30.41
5	SURYA 5	27.25
6	SUMBER SAWIT	30.95
7	WR. 132	26.62
8	WR. 127	28.55
9	WR. 117	25.64
10	WR. 124	25.45
11	WR. 133	26.38

This certificate refers to the above inter  
reflects our findings at time and place of ir

This Certificate report is issued under our General Terms and C

MKS.MIN.00.2008

0197210

## Certificate of Test

# INACCURATE CARGO DECLARATIONS

## Example 1 Alleged Description

Lump Ore Non-Screened  
IMSBC Code Group C  
Lumps - 3mm to 50mm  
Physically – Looked smaller

BULK CARGO INFORMATION	
LUMP ORE	
VESSEL:	PORT OF DEPARTURE: GUAIBA ISLAND TERMINAL
CARGO NAME: LUMP ORE NON-SCREENED GUAIBA	AVERAGE GROSS MASS LOADED ABOUT 160,000.000 METRIC TONS 10 PCT MOLOO
GENERAL DESCRIPTION OF THE CARGO: IRON ORE RANGING FROM 3 MM TO 50 MM	
Bulk cargo specification: Fe <sub>2</sub> O <sub>3</sub> = 94,1%; SiO <sub>2</sub> = 1,8%; Al <sub>2</sub> O <sub>3</sub> = 1,5%; LOI = 2,0%; Other elements = 1,0%. H <sub>2</sub> O: estimated moisture content = 3,0%; H <sub>2</sub> O maximum = 4,5%. Stowage factor: 0,36 m <sup>3</sup> /t. Angle of repose: 38 to 40 degrees. Density: 2.770 Kg/m <sup>3</sup> Loading temperature: room temperature. IMO Bulk Carrier Code (B.C. CODE) Category: Appendix C "Iron Ore". Trimming procedures: standard requirements applied (Reference: Stowage Plan). Relevant special properties of the cargo and other Information:	
Additional Certificate(s) <input type="checkbox"/> No additional certificate is required.	
<ul style="list-style-type: none"> <li>• According to IMSBC CODE(IMO, 2009 Edition), Appendix 3, this cargo is not liable to</li> <li>• TML certificate are required only for cargoes which may liquefy (Group A and B cargoes). TML</li> </ul>	

LUMP ORE	
VESSEL:	PORT OF DEPARTURE: GUAIBA ISLAND TERMINAL
CARGO NAME: LUMP ORE NON-SCREENED GUAIBA	AVERAGE GROSS MASS LOADED ABOUT 160,000.000 METRIC TONS 10 PCT MOLOO
GENERAL DESCRIPTION OF THE CARGO: IRON ORE RANGING FROM 3 MM TO 50 MM	

# INACCURATE CARGO DECLARATIONS

## Example 1 Actual Description

Standard Sinter Feed  
IMSBC Code - Group A  
Fines – 0.075mm to 10mm

BULK CARGO INFORMATION	
FINES	
VESSEL:	PORT OF DEPARTURE: GUAIBA ISLAND TERMINAL
CARGO NAME: STANDARD SINTER FEED GUAIBA	AVERAGE GROSS MASS LOADED ABOUT <b>160.000,000 METRIC TONS 10 PCT MOLOO</b>
GENERAL DESCRIPTION OF THE CARGO: <b>IRON ORE FINES SIZED FROM 0,075mm to 10mm</b>	
<p>Bulk cargo specification: Fe<sub>2</sub>O<sub>3</sub>= 93,0%; SiO<sub>2</sub>= 3,2%; Al<sub>2</sub>O<sub>3</sub>= 1,2%; LOI = 1,7%; Other elements = 1,0%.                      H<sub>2</sub>O: estimated moisture content = 6,5%; H<sub>2</sub>O maximum = 8,5%.                      Stowage factor: 0,35 m<sup>3</sup>/t.                      Angle of repose: 38 to 40 degrees.                      Density: 2.857 Kg/m<sup>3</sup>                      Loading temperature: room temperature.                      IMO Bulk Carrier Code (B.C. CODE) Category: Appendix C "Iron Ore".                      Trimming procedures: standard requirements applied (Reference: Stowage Plan).</p>	
Relevant special properties of the cargo and other Information:	Additional Certificate(s) <input type="checkbox"/> No additional certificate is required.
<ul style="list-style-type: none"> <li>According to IMSBC CODE(IMO, 2009 Edition), Appendix 3, this cargo is not liable to liquefy nor to possess any chemical hazard.</li> </ul>	<ul style="list-style-type: none"> <li>TML certificate are required only for cargoes which may liquefy (Group A and B cargoes). TML certificates are not applicable for cargoes not liable to liquefy (Group C cargoes).</li> </ul>

FINES	
VESSEL:	PORT OF DEPARTURE: GUAIBA ISLAND TERMINAL
CARGO NAME: STANDARD SINTER FEED GUAIBA	AVERAGE GROSS MASS LOADED ABOUT <b>160.000,000 METRIC TONS 10 PCT MOLOO</b>
GENERAL DESCRIPTION OF THE CARGO: <b>IRON ORE FINES SIZED FROM 0,075mm to 10mm</b>	

# INACCURATE CARGO DECLARATIONS

## Example 2

### Alleged Description

Iron Oxide Pilha

IMSBC Code - Group B

IMDG Class 4.2

CERTIFICATE N° AI-11060-Jun

**Messrs.**

In compliance with the instructions received of BUREAU VERITAS do BRASIL, we certify that carried out IMO test on one sample, corresponding to "Iron Oxide Pilha", whose characteristics are as following:

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MOISTURE AS RECEIVED : 17.97 %

that carried out IMO test on one sample, corresponding to "Iron Oxide Pilha", whose characteristics are as following:

---

MOISTURE AS RECEIVED	:	17.97 %
FLOW MOISTURE POINT	:	22.35 %
TRANSPORTABLE MOISTURE LIMIT	:	20.12 %
STOWAGE FACTOR	:	0.60 m <sup>3</sup> / Ton
ANGLE OF REPOSE	:	33 +/- 2°

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# INACCURATE CARGO DECLARATIONS

**Example 2**  
**Actual Description**  
Iron Ore Fines  
IMSBC Code - Group A  
Safe to Load as MC below  
TML



**CERTIFICATE N° 220611**

**Messrs. Engessul Ind. e Com. Ltda.**

In compliance with the instructions received from Engessul Ind. e Com. Ltda., we certify that we have carried out IMO test on one sample, corresponding to "Iron Ore Fines", whose characteristics are as following:

MOISTURE AS RECEIVED	:	17.97 %
FLOW MOISTURE POINT	:	22.35 %
TRANSPORTABLE MOISTURE LIMIT	:	20.12 %
STOWAGE FACTOR	:	0.60 m <sup>3</sup> / Ton

**we have carried out IMO test on one sample, corresponding to "Iron Ore Fines", whose characteristics are as following:**

MOISTURE AS RECEIVED	:	17.97 %
FLOW MOISTURE POINT	:	22.35 %
TRANSPORTABLE MOISTURE LIMIT	:	20.12 %
STOWAGE FACTOR	:	0.60 m <sup>3</sup> / Ton
ANGLE OF REPOSE	:	33 +/- 2°

# AWARENESS ABOARD / EARLY WARNING SIGNS

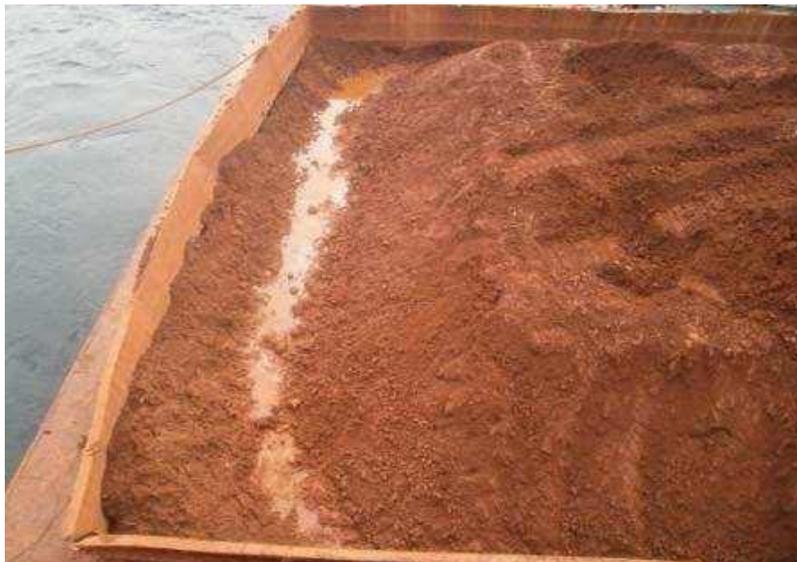
**Prevention is recognising  
the early warning signs**



## AWARENESS ABOARD / EARLY WARNING SIGNS

**Prevention is recognising  
the early warning signs**

Loading Iron Ore Fines in  
India during SW Monsoons



Water on the surface of  
the cargo and within the  
barges

## AWARENESS ABOARD / EARLY WARNING SIGNS

**Prevention is recognising  
the early warning signs**

Splatter within the hold  
during the initial loading



Clay like appearance of  
the cargo

## AWARENESS ABOARD / EARLY WARNING SIGNS

**On arrival and throughout the loading operation**

**Can Test : Iron Ore**

Complementary test procedure for determining the possibility of liquefaction – IMSBC Code (Section 8.4)



## AWARENESS ABOARD / EARLY WARNING SIGNS

**On arrival and throughout the loading operation**

### **Can Test : Nickel Ore**

Complementary test procedure for determining the possibility of liquefaction – IMSBC Code (Section 8.4)



# IMSBC CODE - AMENDMENTS

## IMSBC CODE

### Amendments 1 January 2013 / MSC 318(89)

- Entities that issue Certificates and Declarations must be approved by the Competent Authority (CA) i.e. better oversight required
- CA must be independent from the Shipper
- Management of barges
- Crew, surveyors, etc., allowed access to stockpiles iron ore fines and nickel ore

# IMSBC CODE - AMENDMENTS

## IMSBC CODE

### Amendments 1 January 2013 (MSC 318(89))

- Better explanation and appreciation of the Can Test
- New schedules included in Appendix 1 for iron ore fines, nickel ore, etc.
- Guidelines for better control of moisture content from the mines to the vessel
- New guidelines for the loading of cargoes that may liquefy

# IMSBC CODE GROUP 'A' BULK CARGOES

Prevention, Cause and Effect of Liquefaction



END OF PRESENTATION  
Thank you for your kind attention