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** –
IMO PUBLICATIONS & BULLETINS
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
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 Liquefactionation

GZ curve

Righting arm (m) vs Heel Angle (deg)
CONSEQUENCES OF LIQUIFACTION

Two Holds suffer Liquefactionation

![GZ curve](image)

- Righting arm (m) vs. Heel Angle (deg)
CONSEQUENCES OF LIQUIFACTION

Three Holds suffer Liquefaction

GZ curve

- Righting arm (m)
- Heel Angle (deg)
CONSEQUENCES OF LIQUIFACTION

Four Holds suffer Liquefaction
CONSEQUENCES OF LIQUIFACTION

Five Holds suffer Liquefaction

GZ curve

Righting arm (m)

Heel Angle (deg)

Angle of loll

LOC MARINE & ENGINEERING CONSULTANTS
CONSEQUENCES OF LIQUIFACTION

Where are the Problem Cargoes From?

• India
• Indonesia
• Philippines
• Ukraine
• Brazil
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.
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
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

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<thead>
<tr>
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<th>1</th>
<th>2</th>
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</tbody>
</table>
SAMPLING PROCEDURES

Each 200g sub-sample is drawn 50cm below the surface.
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.
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
Certificate of Test

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 = 30.60%
Moisture Content (MC) - 7 mm of the test material = 27.70%
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

CERTIFICATE OF SAMPLING AND MOISTURE TESTING

CONSIGMENT: NICKEL ORE IN BULK
QUANTITY: SAID TO BE ± 55,000 WMT
SAMPLING DATES: 06/08/2008 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 UK by systematic sampling on a mass basis during the stacking, or in the moving state, not in the stationary state.

All parts of the Ni Ore are of equal opportunity to be sampled, each sample being unique and representative.

Moisture Content Results

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

This certificate refers to the above intentions and procedure and reflects our findings at time and place of sampling.

The Certificate is issued under our General Terms and Conditions.

MKS MIN 00.2008
## 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

<table>
<thead>
<tr>
<th>VESSEL:</th>
<th>PORT OF DEPARTURE: GUAIBA ISLAND TERMINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARGO NAME: LUMP ORE NON-SCREENED GUAIBA</td>
<td>AVERAGE GROSS MASS LOADED ABOUT 160,000,000 METRIC TONS 10 PCT MOLOO</td>
</tr>
<tr>
<td>GENERAL DESCRIPTION OF THE CARGO: IRON ORE RANGING FROM 3 MM TO 50 MM</td>
<td></td>
</tr>
</tbody>
</table>

**BULK CARGO INFORMATION**

**LUMP ORE**

- **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

**Physical Characteristics:**
- Lump Ore specification: Fe₂O₃ = 94.1%; SiO₂ = 1.9%; Al₂O₃ = 1.3%; LOI = 2.9%; Other elements = 1.0%.
- H₂O: estimated moisture content = 3.0%; H₂O maximum = 4.5%.
- Stowage factor: 0.36 m³/t.
- Angle of repose: 38 to 40 degrees.
- Density: 2.770 Kg/m³.
- Loading temperature: room temperature.
- Stowage Plan:
  - Relevant special properties of the cargo and other information:
- Additional Certificates:
  - No additional certificate is required.
INACCURATE CARGO DECLARATIONS

Example 1
Actual Description

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

Example 2
Alleged Description
Iron Oxide Pilha
IMSBC Code - Group B
IMDG Class 4.2

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

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>MOISTURE AS RECEIVED</td>
<td>17.97 %</td>
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<tr>
<td>FLOW MOISTURE POINT</td>
<td>22.35 %</td>
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<td>TRANSPORTABLE MOISTURE LIMIT</td>
<td>20.12 %</td>
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<tr>
<td>STOWAGE FACTOR</td>
<td>0.60 m³ / Ton</td>
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<tr>
<td>ANGLE OF REPOSE</td>
<td>33 +/- 2°</td>
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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

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**CERTIFICATE N° 220611**  
Mesars. 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:

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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