

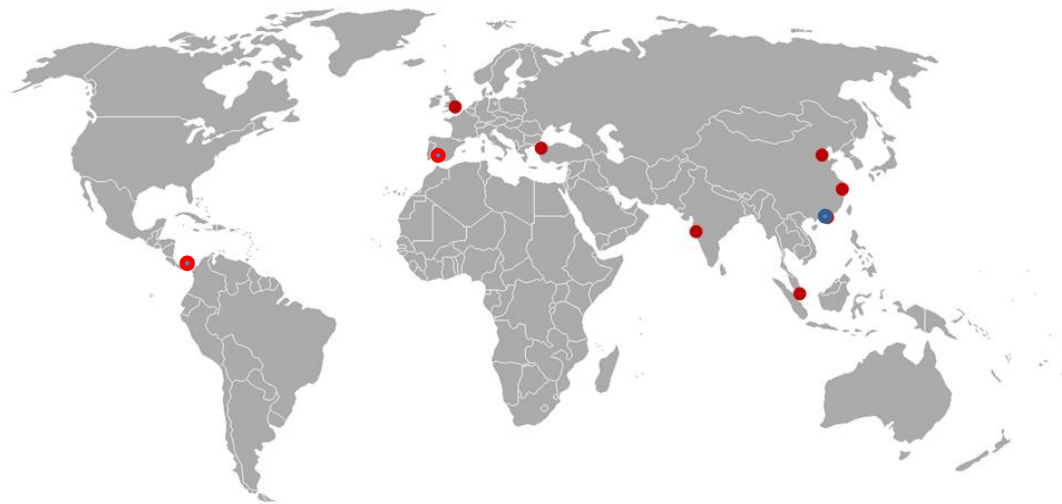
Group A Cargoes that may liquefy

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Consultants, Engineers, Surveyors & Scientists



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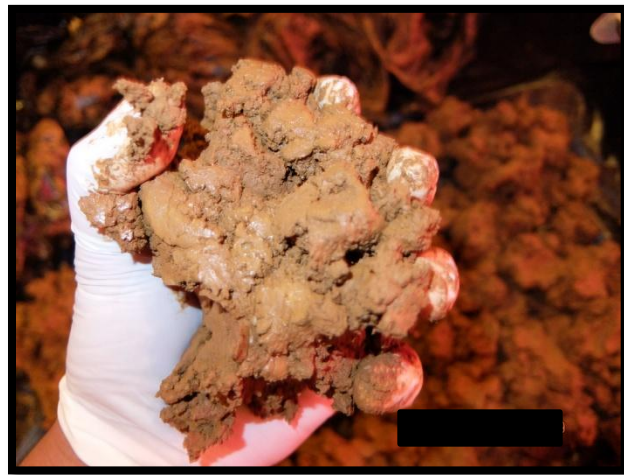
Reactive

Consulting

Proactive / Reactive



Poll: Which of the following is nickel ore?



A.



B.



C.

D. None of the above

Poll: Which of the following is nickel ore?



A. ★



B.



C.

D. None of the above

Group A consists of cargoes which **may liquefy** if shipped at a **moisture content** in excess of their **transportable moisture limit**.



Liquefaction is a phenomenon in which a soil-like material is abruptly transformed from a solid dry state to an almost fluid state.

Moisture Content is the portion of water, expressed as a percentage of the total wet mass of a sample.

Flow Moisture Point is the moisture content at which a flow state develops.

Transportable Moisture Limit is calculated as 90% of the Flow Moisture Point.



Poll: Which of the following may be prone to liquefaction?

A.



C.



B.



D.



Poll: Which of the following may be prone to liquefaction?

A.



B.



C.



D.

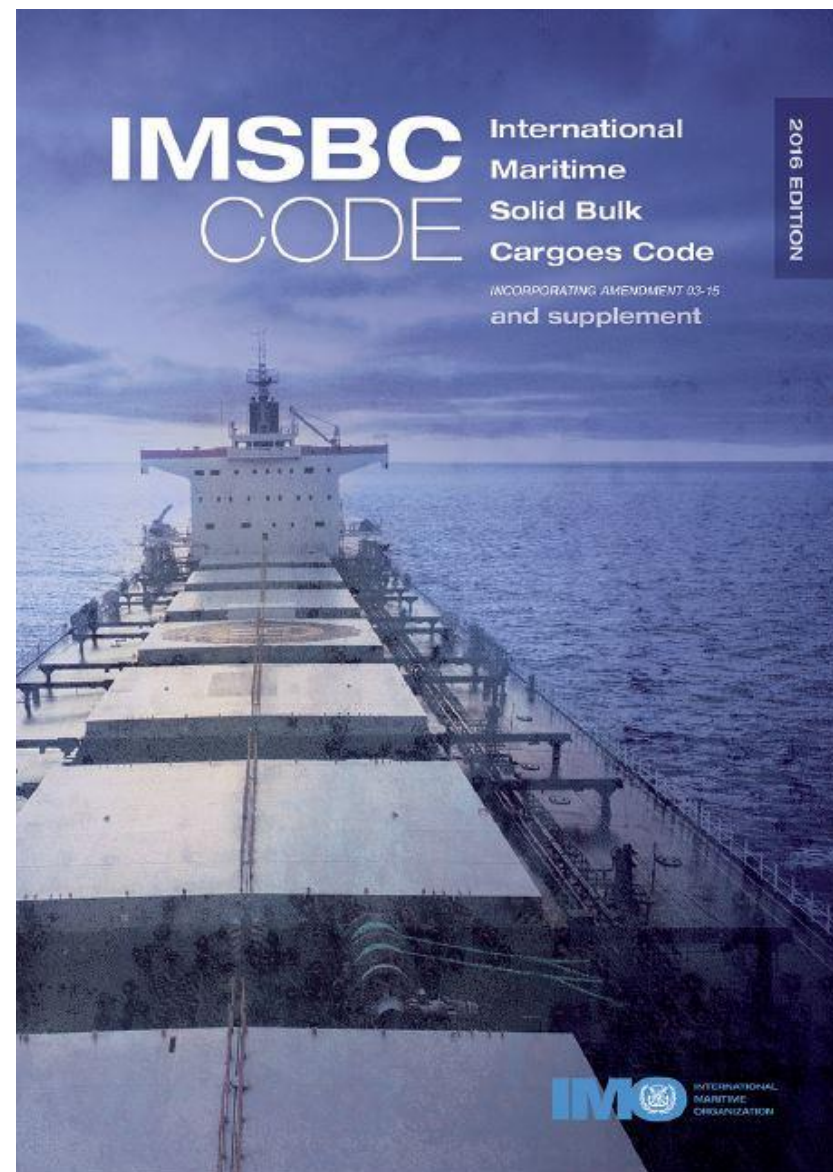




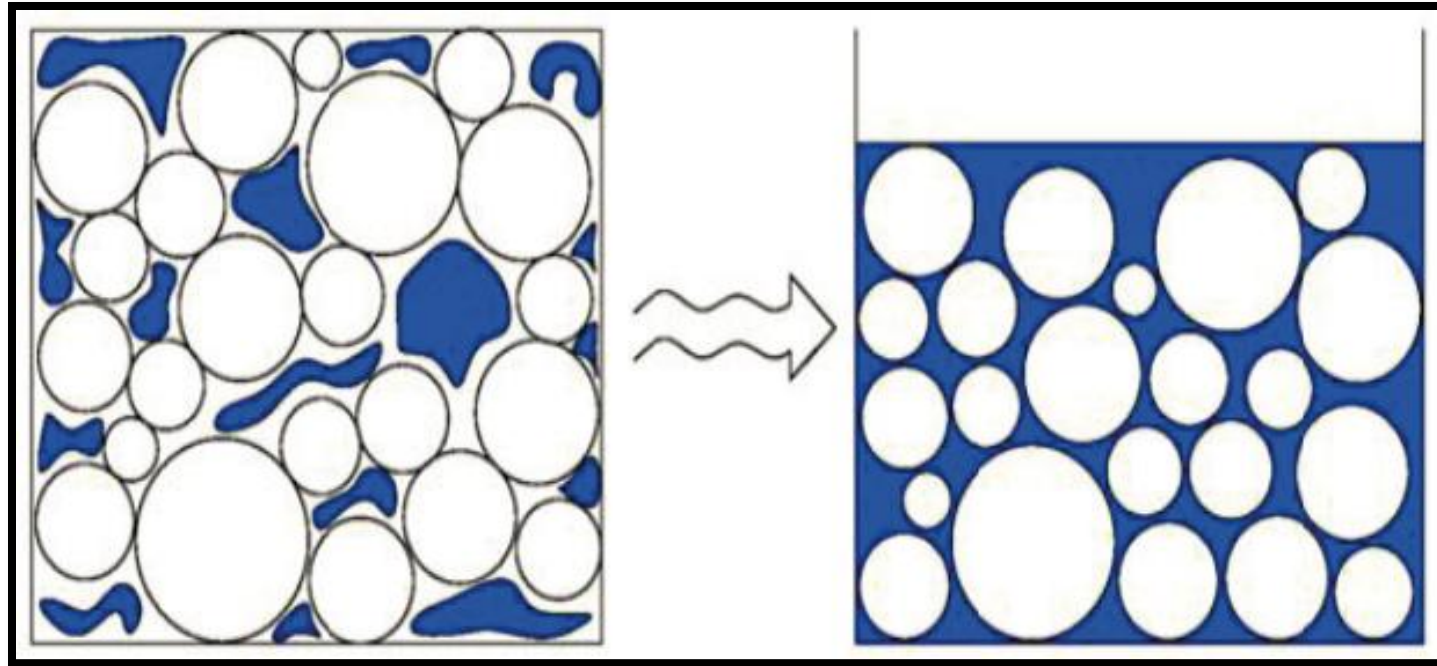
The IMSBC Code

Responsibility of the Shipper

- Provide the Master with a signed certificate of TML and MC, each issued by an entity recognised by the Competent Authority of the port of loading. [Sec 4.3.2]
- Establish procedures for sampling, testing and controlling moisture content to ensure the moisture content is less than the TML when the cargo is on board the ship [Sec 4.3.3]
- Facilitate access to stockpiles for the purpose of inspection, sampling and subsequent testing by the ship's nominated representative [Sec 4.4.3]



Mineral Ores & Concentrates

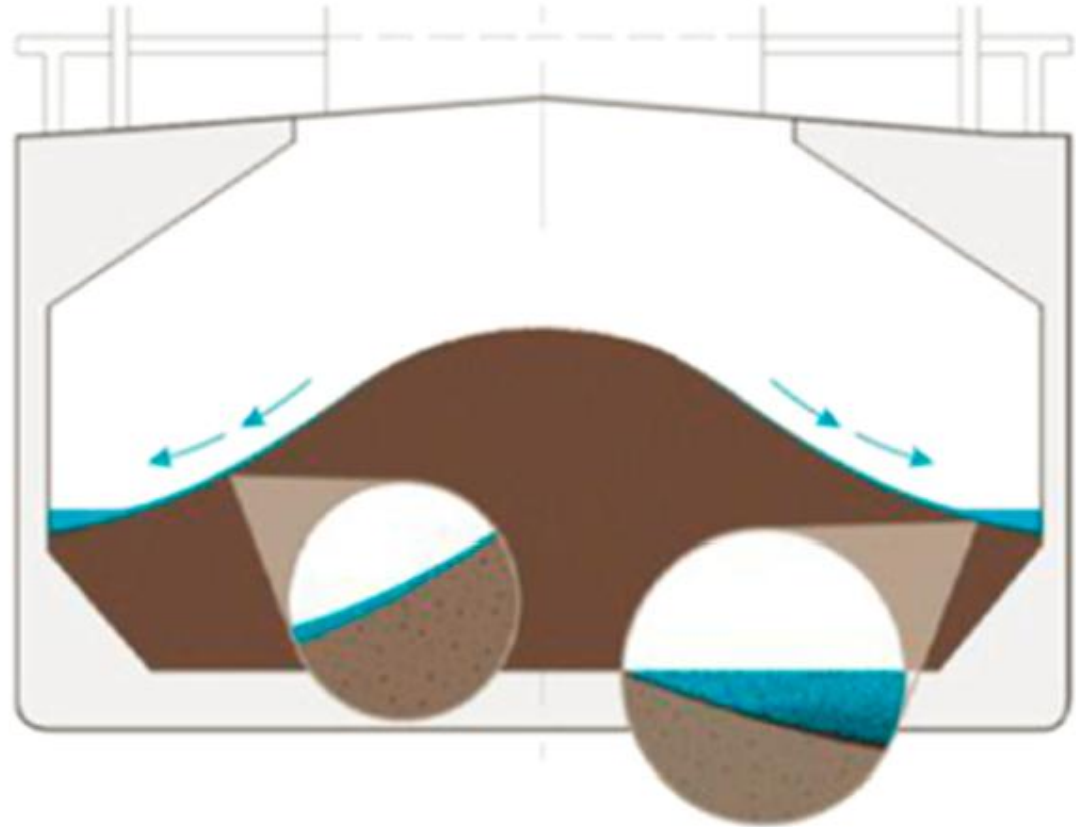


Left: In its solid state the particles are held together by friction.

Right: External agitation can increase water pressure inherent within the material, pushing particles apart.

Mineral Ores & Concentrates

- The cargo can shift in one direction with the ship's rolling and not return to the centre.
- Further rolling can cause permanent listing.



Group A Cargoes

Unprocessed ores

- Nickel ore
- Iron ore fines
- Fluorspar
- Certain types of bauxite

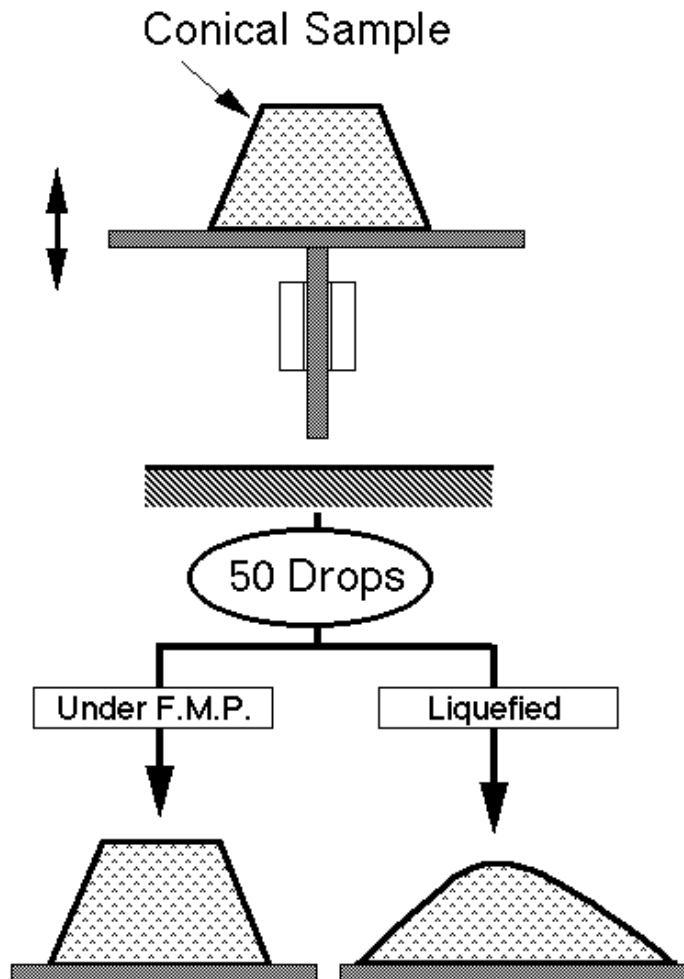
Mineral concentrates

- Pb concentrate / ore residue
- Mn concentrate
- Zn concentrate / sinter / sludge



How is the cargo tested?

Flow Table Test



- Generally suitable for max grain size of 1 mm, may also be applicable up to 7 mm
- Flow characteristics under impact or cyclic forces of the flow table
- Plastic deformation or an increase in diameter by more than 3 mm



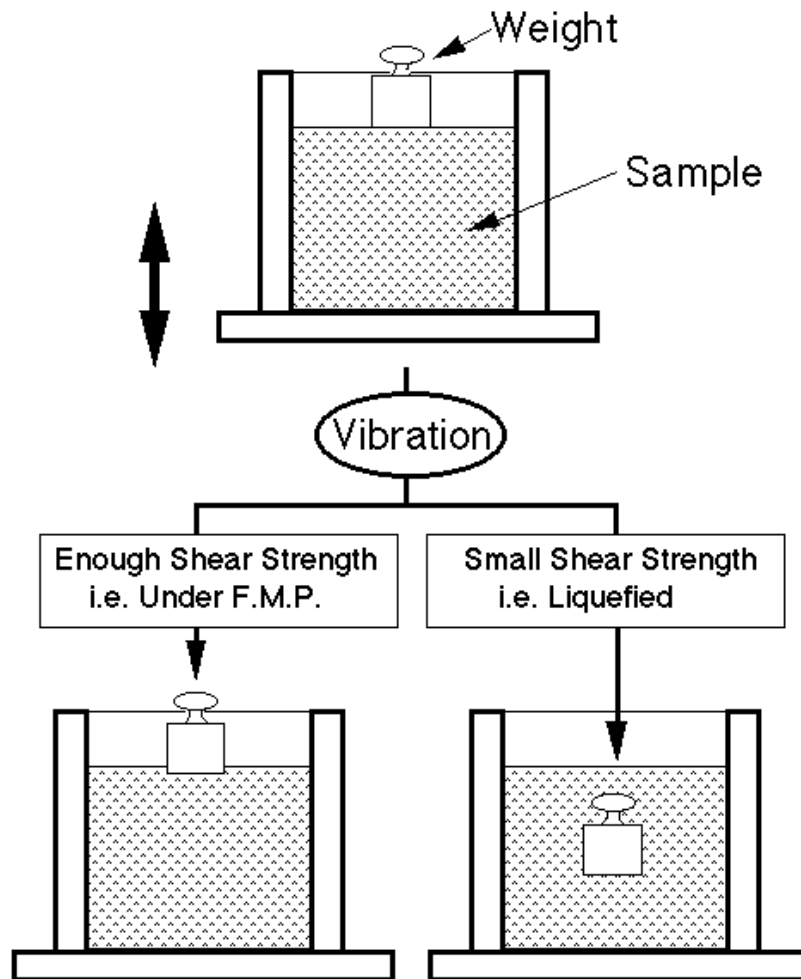
Before



After

How is the cargo tested?

Penetration Test



- Generally suitable to a top size of 25 mm
- Vertical vibration
- Penetration of a bit exceeding 50 mm indicates MC is greater than FMP



Before



After

How is the cargo tested?

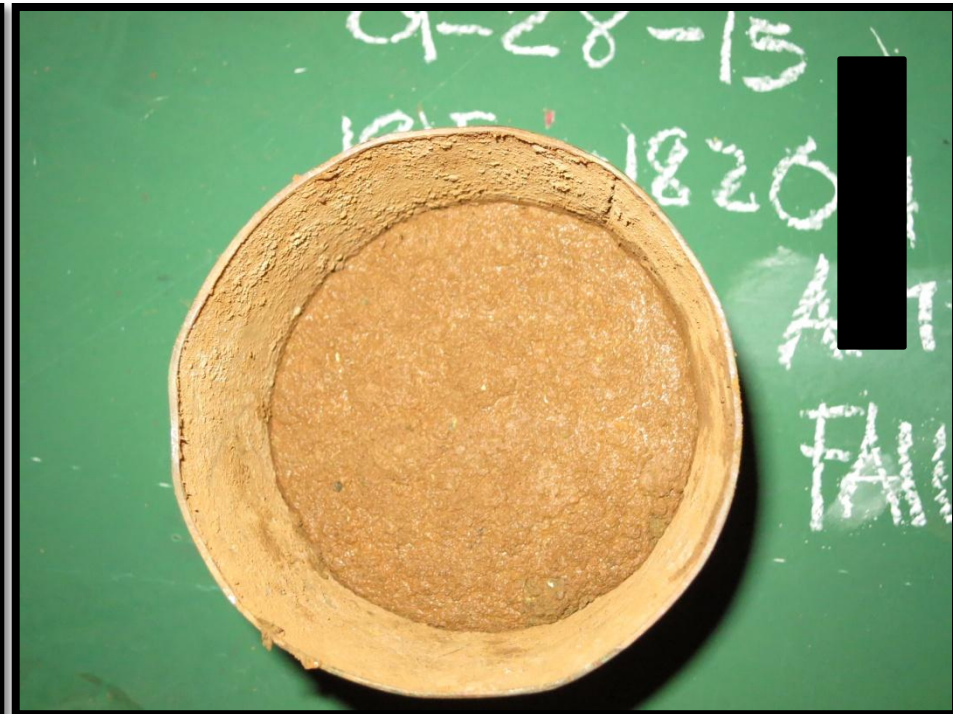
Modified Proctor-Fagerberg Test



- Generally suitable to a top size of 5 mm; should not be used for coal or other porous material
- Compaction test at varying MC
- TML is equal to the critical MC at a certain level of saturation

How is the cargo tested?

Can Test





Before



After

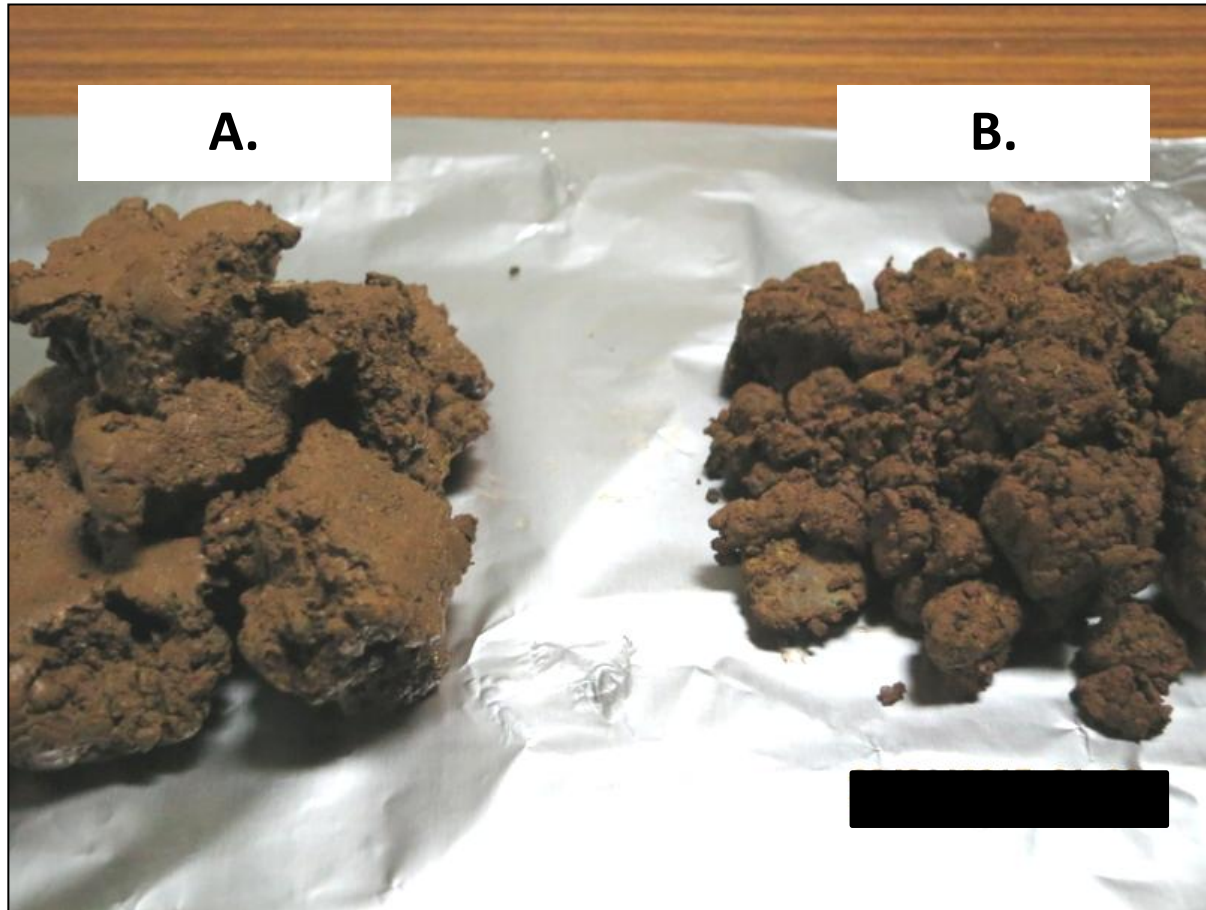


Before



After

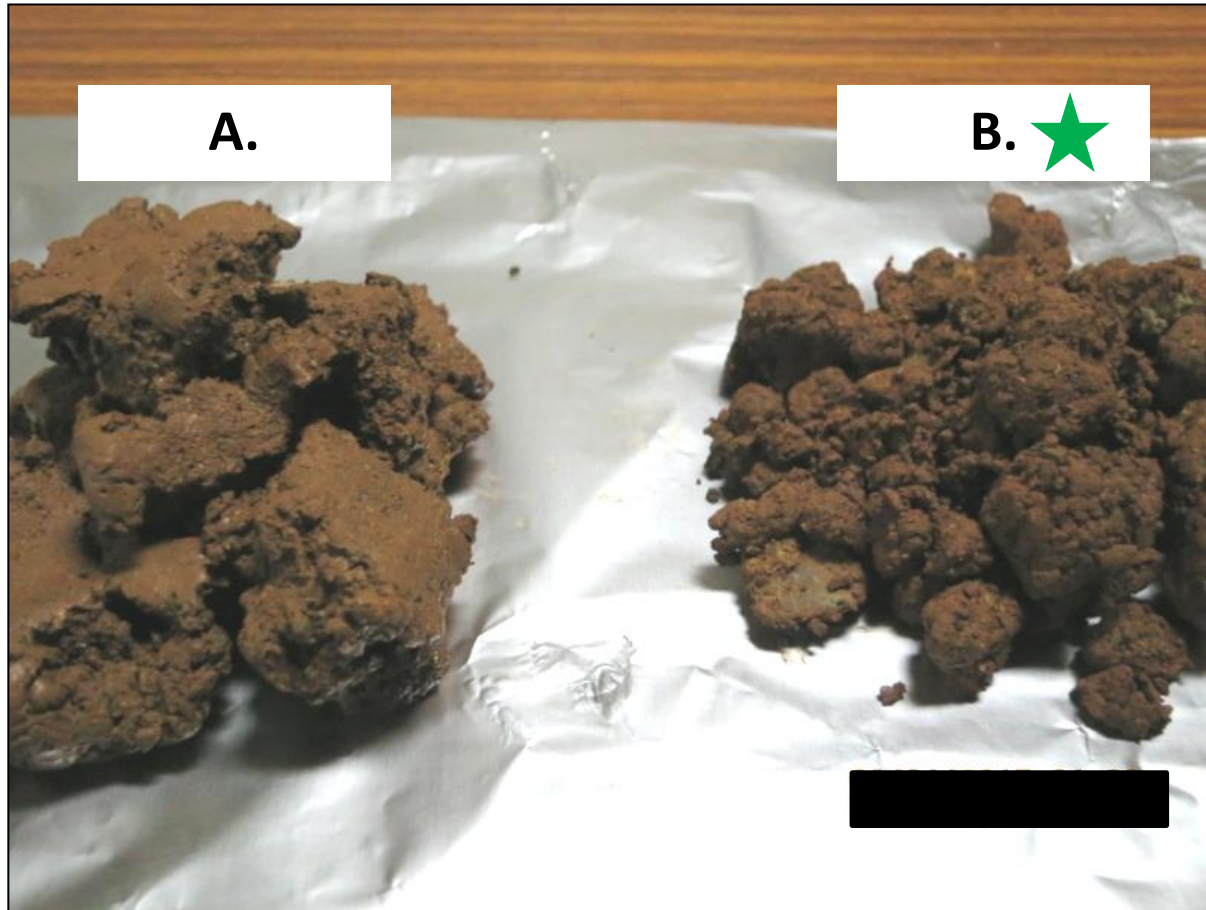
Poll: Which of the following passed a can test?



C. Both

D. None

Poll: Which of the following passed a can test?



C. Both

D. None

Certificates

Flow Moisture Point/Transportable Moisture Limit

- To be established at regular intervals at source or whenever changes have occurred to the material.
- Should be available before the ship arrives in port, and reluctance to provide this at an early stage usually indicates that it may not be available.

Moisture Content

- Cargo sampled as close as possible to time of loading or if it has been wet by rain, snow or spray.
- Certificate given to Master before loading commences.
- Maximum 7 days old.



Case Studies



Nickel Ore



Bauxite



Iron Ore Fines

Nickel ore



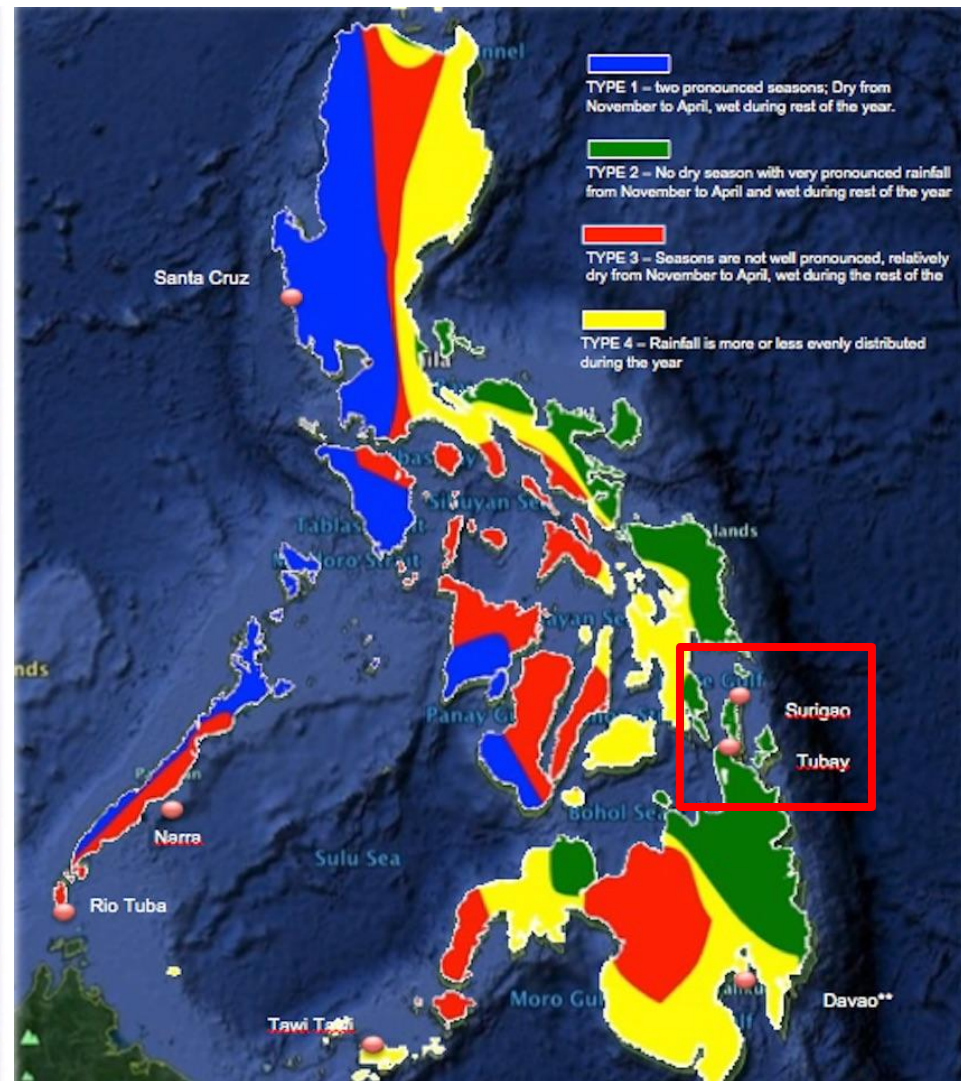


Image: Pandiman Philippines Inc

Image: <https://www.skuld.com/topics/cargo/solid-bulk/cargo-liquefaction/philippines-nickel-ore-risks-from-mindanao/>



Open cast mine

Exposed stockpiles





Open cast mine

Loading into barges



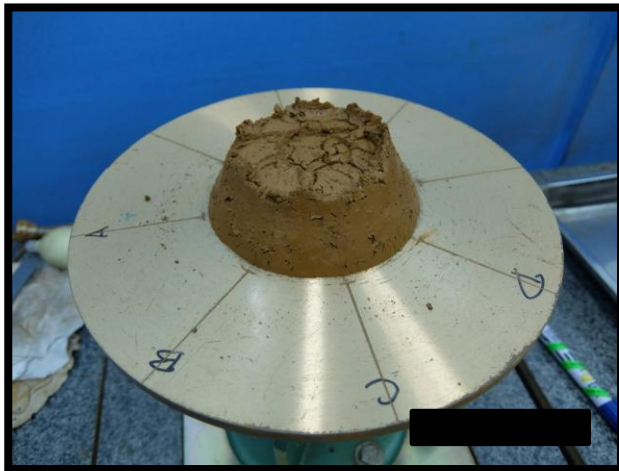


Limited access to the nominated cargo



Cargo Declaration: FMP/TML/MC

Parameters	Cargo Declaration	Independent Laboratory
FMP	40.10 %	34.28 %
TML	36.09 %	30.85 %
MC	34.45 %	37.88 %



How is testing carried out on site?



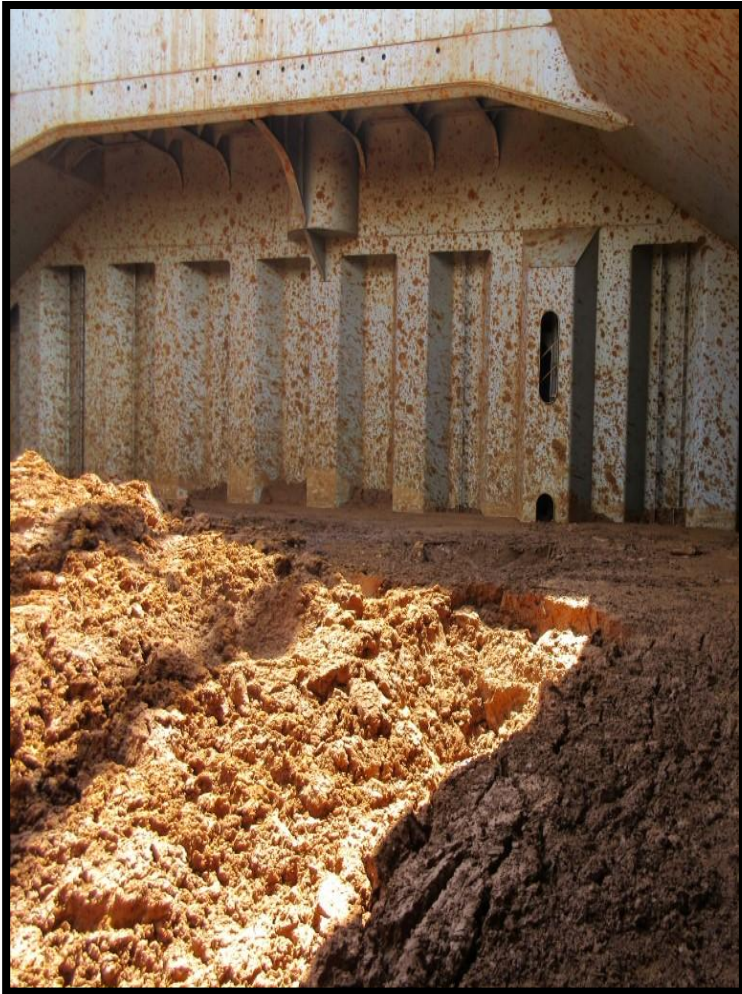
How is testing carried out on site?

- Inadequate facilities
- Incorrect interpretation of the IMSBC Codes
- Incorrect moisture declaration (due to time or rain)
- Unsatisfactory sampling techniques



Interpretation of results

The point at which FMP is reached is way beyond that which is found acceptable at independent labs.

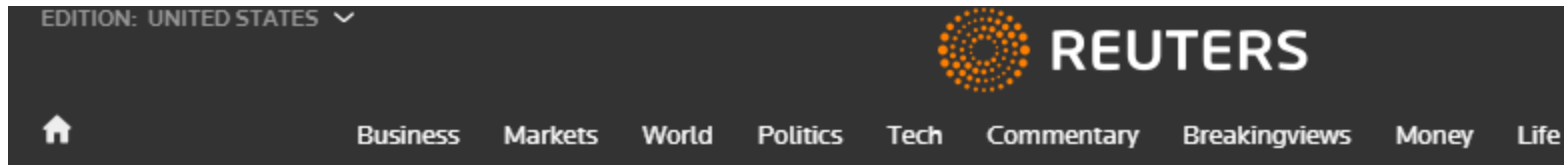






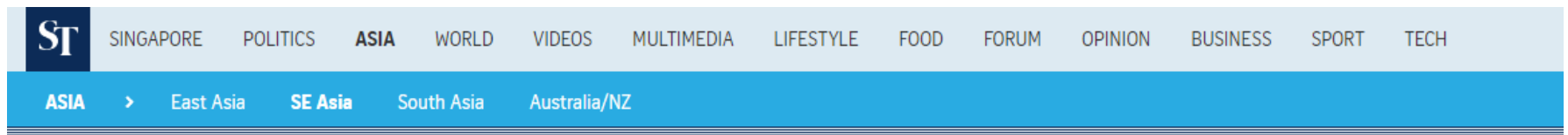


Mining in the Philippines: Current situation



COMMODITIES | Thu Feb 2, 2017 | 5:53am EST

Philippines to shut half of mines, mostly nickel, in environmental clampdown



Philippines to shut mines, suspend others as clampdown deepens



Bauxite



Loading bauxite in Malaysia

BAUXITE

Description

A brownish-yellow clay-like and earthy mineral. Moisture content: 0% to 10%. Insoluble in water.

Characteristics

Angle of Repose	Bulk Density (kg/m³)	Stowage Factor (m³/t)
Not Applicable	1,190 to 1,389	0.72 to 0.84
Size	Class	Group
70% to 90% lumps; 2.5 mm to 500 mm 10% to 30% powder	Not Applicable	C

Extract from IMSBC 2016 Edition



Group A or Group C?

	Flow Moisture Point (FMP) %	Transportable Moisture Limit (TML) %	Moisture Content (MC) %
Laboratory A*	15.9	14.3	17.0
Laboratory B*	15.4	13.8	17.04

* Owners and Charterers appointed their own preferred laboratory

Extract from cargo declaration

Total Moisture : 8 % Sulphur : NIL Size : 2 mm - 75 mm

Physical Properties:

Transportable Moisture Limit : 10 %

Group A or Group C?

Extract from a cargo declaration for Bauxite

Flow moisture point (FMP):	20.54	%(m/m)
Transportable moisture limit (TML = 90% x FMP):	18.48	%(m/m)
Moisture in the test portions just above FMP:	20.77	%(m/m)
Moisture in the test portions just below FMP:	20.31	%(m/m)
Tamping pressure used or simulated conditions attempted:	116	Kpa
Sieve aperture size +7 mm, size fraction:	20.21	%(m/m)
Sieve aperture size -7 mm used for test purposes:	79.79	%(m/m)

Size-Above 25mm%	Size-25mm to 7mm%	Size-7mm to 1mm%	Size-Below 1mm%
3.02	17.20	18.18	61.60



Iron Ore Fines



IRON ORE FINES

The provisions of this schedule shall apply to iron ore cargoes containing both:

- .1 10% or more fine particles less than 1 mm ($D_{10} \leq 1$ mm); and
- .2 50% or more particles less than 10 mm ($D_{50} \leq 10$ mm),.

Notwithstanding the above provision, iron ore fines where the total goethite content is 35% or more by mass may be carried in accordance with the individual schedule for "IRON ORE", provided the master receives from the shipper a declaration of the goethite content of the cargo which has been determined according to internationally accepted standard procedures.

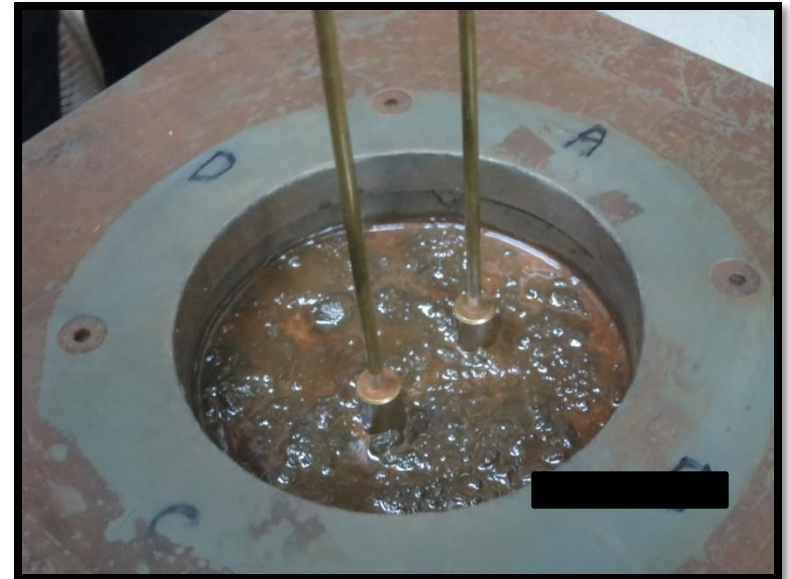
Characteristics

Angle of Repose	Bulk Density (kg/m³)	Stowage Factor (m³/t)
Not Applicable	1,500 to 3,500	0.29 to 0.67
Size	Class	Group
10% or more of fine particles less than 1 mm and 50% or more of particles less than 10 mm	Not Applicable	A

Which test to use?

- Penetration Test
- Modified Proctor-Fagerberg Test

Parameters	Penetration Test	Modified Proctor-Fagerberg Test
TML	8.9 %	10.7 %





Exposed stockpiles

Loading wet cargo





Risk and loss prevention

- Check the shipper's cargo declaration and stated moisture content.
- Request for new moisture content tests to be carried out, if rainfall occurred in the days prior loading.
- Ensure any document seeking confirmation that the cargo is safe to carry is signed by the shipper, not the master or his appointed surveyor
- Check cargo to be loaded in each barge or stockpile for excessive water content

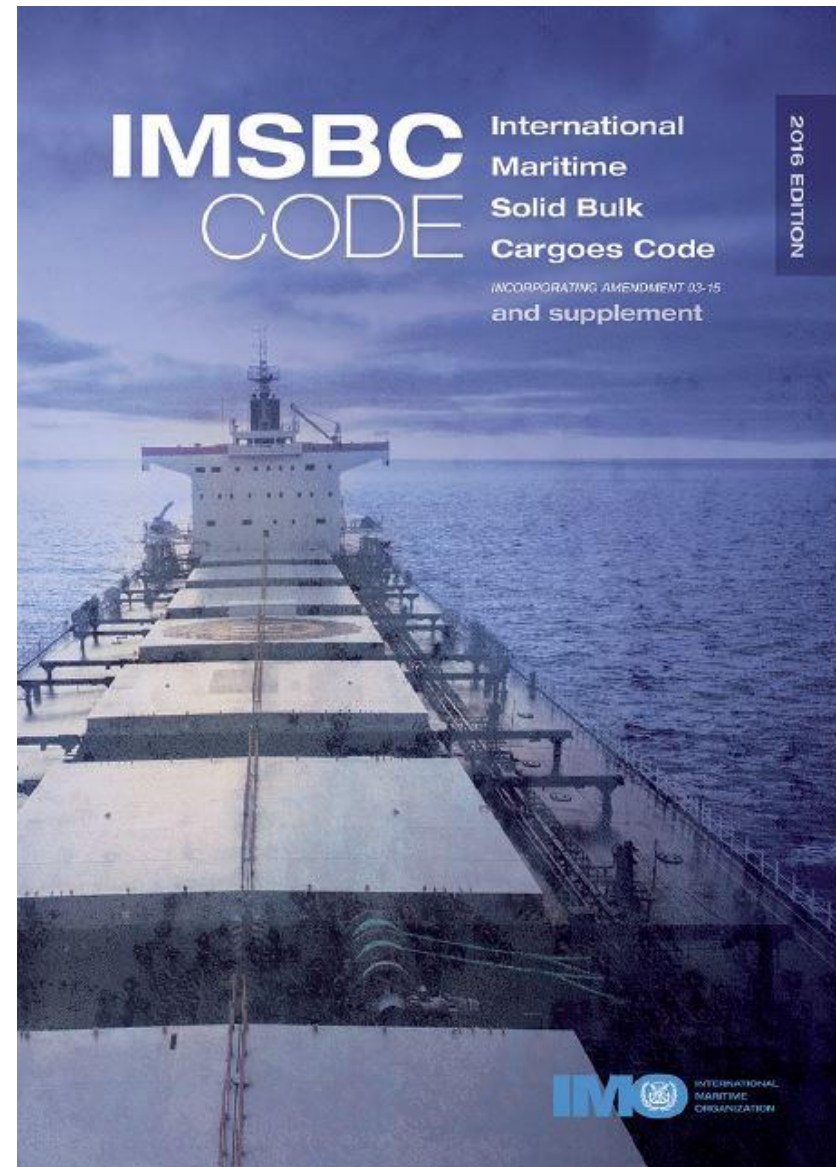
Risk and loss prevention

- Should there be any concerns or doubts about the moisture levels in the nominated cargoes, further advice and assistance can be obtained from an independent reputable cargo expert
- Moisture testing can be carried out on site .



Developments in the Code

- Clarification of duties of the Shipper;
access to stockpiles.
- New Schedules for Group A cargoes
 - Alumina Hydrate
 - Clinker Ash, Wet
 - Ilmenite (Upgraded)
 - Nickel Ore
 - Sand, Heavy Mineral
- Revised schedule for iron ores, and an individual schedule for iron ore fines.



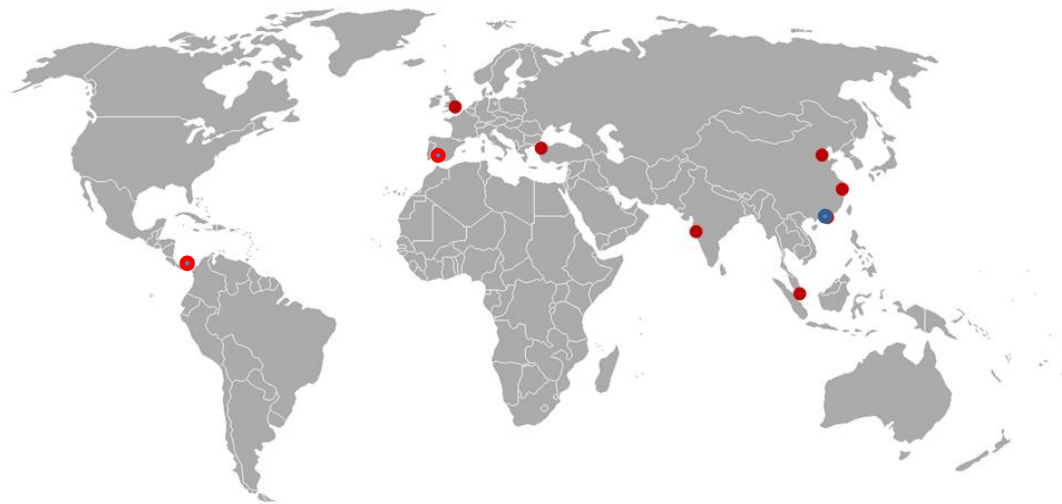
Summary

- Ensure that proper IMBSC Code Documentation, including shipper's declaration and certificate of moisture content, is provided in advance of loading.
- Master should ensure that he is fully satisfied with the condition of the cargo before accepting it for loading; and that all conditions in accordance with the IMSBC Code are duly met at all times.
- Loading should be stopped if there is a possible problem, and expert help sought.



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Thank You!

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