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**Industry Expertise:  
Loss Prevention**

# Guidelines for the safe carriage of Nickel Ore

The Standard Club's loss prevention (LP) department is a multi-disciplinary team which was established in 1989 and has continually evolved in order to meet the needs of members in an ever changing maritime industry. The team includes master mariners, naval architects, ship production engineers and specialist surveyors.



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## Introduction

This handout focuses on the recent trends in the export of nickel ore, including the banning of international exports of nickel ore by Indonesia. We remind members of the general guidelines when loading nickel ore cargoes, and share our correspondents' guidance on the local practices followed at the ports from where nickel ore is generally exported. This follows on from the club's previous publications dated February 2011, November 2011 and June 2018, which are available on the club website.

## Background

Liquefaction is a phenomenon where a soil-like material is abruptly transformed from a solid dry state to an almost liquid state.

Cargoes that are at risk of liquefaction are those containing fine particles and moisture, although they need not be visibly wet in appearance. On ships, liquefaction may happen when the cargo is compacted by the ship's motion and vibration.

As the cargo compacts, the volume between the particles reduces and trapped air is expelled. Eventually, the water pressure resulting from the compaction presses the particles apart, potentially leading to them losing direct contact, resulting in a sudden loss of shear strength and entering a fluid state.

Nickel ore is one such cargo that has a propensity to liquefy and cause loss of ship's stability due to the free surface effect/cargo shift, possibly resulting in capsizing of the vessel. The ship structure may also be damaged due to increased cargo pressures.

There has been a consistent concern regarding the loading and carriage of nickel ore from Indonesia and the Philippines, which are major exporters of this cargo. Most mines in these countries are situated in remote locations and are not easily accessible, thus it is difficult for independent surveyors to attend and take samples of the cargo to be loaded.

Further, due to lack of infrastructure at most ports, the cargo is stored in stockpiles exposed to all weather conditions or, in some cases, transported directly from the mine to the ship. The ore is usually loaded into barges and transhipped to bulk carriers at anchor. Like the stockpiles, the barges are seldom covered and are also exposed to the weather. Moreover, when there is more than one vessel loading in one area, a barge being rejected by one vessel will be presented to another. Although the cargo presented for shipment may appear to be dry, sometimes this is not the case. Some shippers may carry out sun-drying prior to loading, but the effectiveness of this method is questionable.

Under the IMSBC code, as mandated by SOLAS, there is a requirement regarding the procedure in which the shippers need to carry out the test/analysis of the moisture content and transportable moisture limit of the ores.

Section 4.3.2 of the IMSBC code (certificates of test) states that 'when a concentrate or other cargo which may liquefy is carried, the shipper shall provide the ship's master or his representative with a signed certificate of the TML [Transportable Moisture Limit], and a signed certificate or declaration of the moisture content, each **issued by an entity recognized by the competent authority of the port of loading**'.

Section 4.3.3 of the IMSBC code details 'when a concentrate or other cargo which may liquefy is carried, procedures for sampling, testing and controlling moisture content to ensure the moisture content is less than the TML when it is on board the ship shall be established by the shipper, taking account of the provisions of the IMSBC code. Such procedures shall be approved, and their implementation checked by the competent authority of the port of loading. **The document issued by the competent authority stating that the procedures have been approved shall be provided to the master or his representative**'.

The mines generally have their own 'in-house' laboratories and it is not possible to determine whether the correct testing equipment is available and in a satisfactory condition or whether they are following the procedures laid down under the IMSBC code when testing cargo samples. Hence, the documentation containing test results can be of questionable provenance and unreliable. In order to obtain results from an independent/reliable lab, the samples may need to be sent overseas, for example, to the United Kingdom, Hong Kong or Singapore. However, a considerable amount of moisture may be lost from the sample during the course of transportation unless the sample is packed and sealed properly. We have noticed that, in some cases, ziplock bags have been used to transport samples.

A recent [report from Intercargo](#) highlights that cargo failure (liquefaction) continues to be a major concern for dry bulk shipping. Between 2010 and 2019, 106 lives were lost from the eight casualties attributed to cargo failure (liquefaction). These consisted of six bulk carriers carrying nickel ore from Indonesia, one vessel with iron ore fines (assumed to be laterite) loaded with high moisture content from Malaysia and one vessel with bauxite from Malaysia.

It was with such reasons in mind that the IG clubs issued a [circular in 2012](#) requiring members to notify the club when their ship is fixed or ordered to load nickel ore from Indonesia or the Philippines and, where possible, to provide the information listed in the IG circular regarding the carriage of cargo. The stated purpose behind the notification requirement is to ensure that members engaged in the carriage of nickel ore are aware of the dangers, the IMSBC code requirements and club cover implications, and are provided with information on measures available to mitigate these risks.

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In 2019, nickel prices surged to their highest level due to worries over possible supply curbs. Notwithstanding the current pandemic and anticipated economic crisis, longer-term consumption of the commodity is expected to rise. Further, until recently, the increasing demand for nickel ore, and the political issues surrounding its export from Indonesia and the Philippines, caused countries such as New Caledonia and Guatemala to ramp up exports, but the challenges and risk of cargo liquefaction persist.

## Recommendations

The nickel ore schedule was first introduced in the 2013 edition of the IMSBC Code and became mandatory on 1 January 2015. Despite the numerous circulars on the safe carriage of nickel ore and its entry in the IMSBC Code, liquefaction incidents still occur.

While not exhaustive, the IMSBC guidelines below should assist when loading nickel ore cargoes:

### 1. Preloading criteria

- 1.1 Consider appointing an independent cargo surveyor to assist in determining the suitability of the cargo for loading (IMSBC code, section 4.4.3)
- 1.2 Loading should not commence until the following documentation is received from the shipper:
  - 1.2.1 Cargo Declaration Form stating correct bulk cargo shipping name (BCSN) – (IMSBC code, section 4.2)
  - 1.2.2 Certificate of Transportable Moisture Limit (TML), tested within six months of loading date (IMSBC code, section 4.5.1)
  - 1.2.3 Certificate of Moisture Content (MC), tested within seven days of loading date or after a period of rain (IMSBC code, section 4.5.2)

### 2. Moisture Certificate of the cargo to be loaded

- 2.1 The moisture content certificate must identify the stockpile(s) sampled and clarify the method used to determine MC (IMSBC code, section 4.6 and appendix 2)
- 2.2 The appointed surveyor should check and confirm that the samples which are tested are representative of the ore to be loaded (IMSBC code, section 4.3.6)
- 2.3 The interval between sampling/testing for moisture content and commencement of loading must never be more than seven days (IMSBC code, section 4.5.2)

### 3. TML Certificate

- 3.1 The TML certificate must not be older than six months at the time of loading. If the composition or characteristics of the cargo have changed since the last test, even if it is less than six months old, a new TML certificate must be issued (IMSBC code, section 4.5.1)
- 3.2 Check that the TML is 90% of the flow moisture point (FMP) in the case of the Flow Table Test and the Penetration Test. This 10% safety margin allows for uncertainties in sampling, testing and variation in the moisture content (IMSBC code, appendix 2)

### 4. Loading criteria

- 4.1 The moisture content of the ore to be loaded must be less than the TML, unless carried on a specially constructed or fitted cargo ship for confining cargo shift (IMSBC code, section 7.3)
- 4.2 If the composition or characteristics of the cargo presented for loading does not match the description in the cargo documents, then the master should stop the loading operation and seek further assistance (IMSBC code, section 4.5.1)
- 4.3 The appointed surveyor should check that the stockpile(s) and barges to be loaded are properly covered with tarpaulins. Even when the stockpile(s) are adequately covered with tarpaulins, there is still a risk that the stockpile base may not be sufficiently covered, and rainwater may pool at the bottom of the stockpile(s). The bottom material should be sampled separately and tested for moisture content prior to loading (IMSBC code, section 4.4.5.7)
- 4.4 Section 4.4.3 of the IMSBC code states that '*For a concentrate or other cargo which may liquefy, the shipper shall facilitate access to stockpiles for the purpose of inspection, sampling and subsequent testing by the ship's nominated representative*'. If there is any doubt regarding the validity of the certificates and/or the suitability and safety of the cargo to be loaded, the appointed surveyor should take representative samples from the designated stockpile(s) for testing in an independent accredited laboratory for TML and moisture analysis
- 4.5 The visual inspection of the cargo in each barge shall be carried out, where it is allowed and is safe to do so. If there are any indications of high moisture content, then the cargo of the entire barge shall be rejected (IMSBC code, section 4.3.4)
- 4.6 Crew members must be trained to carry out 'can tests' of cargo samples as per section 8.4 of the IMSBC code. The samples shall be taken from different locations at around 50cm below the surface on the barge when it arrives. Although it is a rudimentary test, if moisture is visible on the surface of the sample at the end of the test, arrangements should be made to have additional laboratory tests conducted on the material. These tests should not be relied upon exclusively. It is not qualitative and only indicates whether the FMP of the cargo has been exceeded. Even if this test is a pass, the moisture content of the material may still exceed the TML (IMSBC code, section 8.4)
- 4.7 If it rains, then loading operations should be suspended and the hatch covers closed. In such a case, the shipper must conduct further laboratory tests to ensure that the moisture content is still below the TML and provide a new moisture certificate prior to resuming loading operations (IMSBC code, section 4.5.2)

- 4.8 Can tests should be performed at regular intervals throughout loading. The results should be recorded with date/time stamped photographs, including barge name and hold number (IMSBC code, section 8.4)
- 4.9 During loading, look for splatter on the hold bulkheads. Special attention should be paid to cargo loaded during the night shift as it is not without precedent that attempts are made to load suspect cargo during the night
- 4.10 Daily reports with details of weather condition, name of barges, cargo condition (loaded/rejected), results of can tests, with associated pictures, should be documented together with any letter of protest(s) issued
- 4.11 Prior to the vessel's departure, ensure the cargo is trimmed evenly, which reduces the likelihood of the cargo shifting (IMSBC code, section 5)

## Indonesia

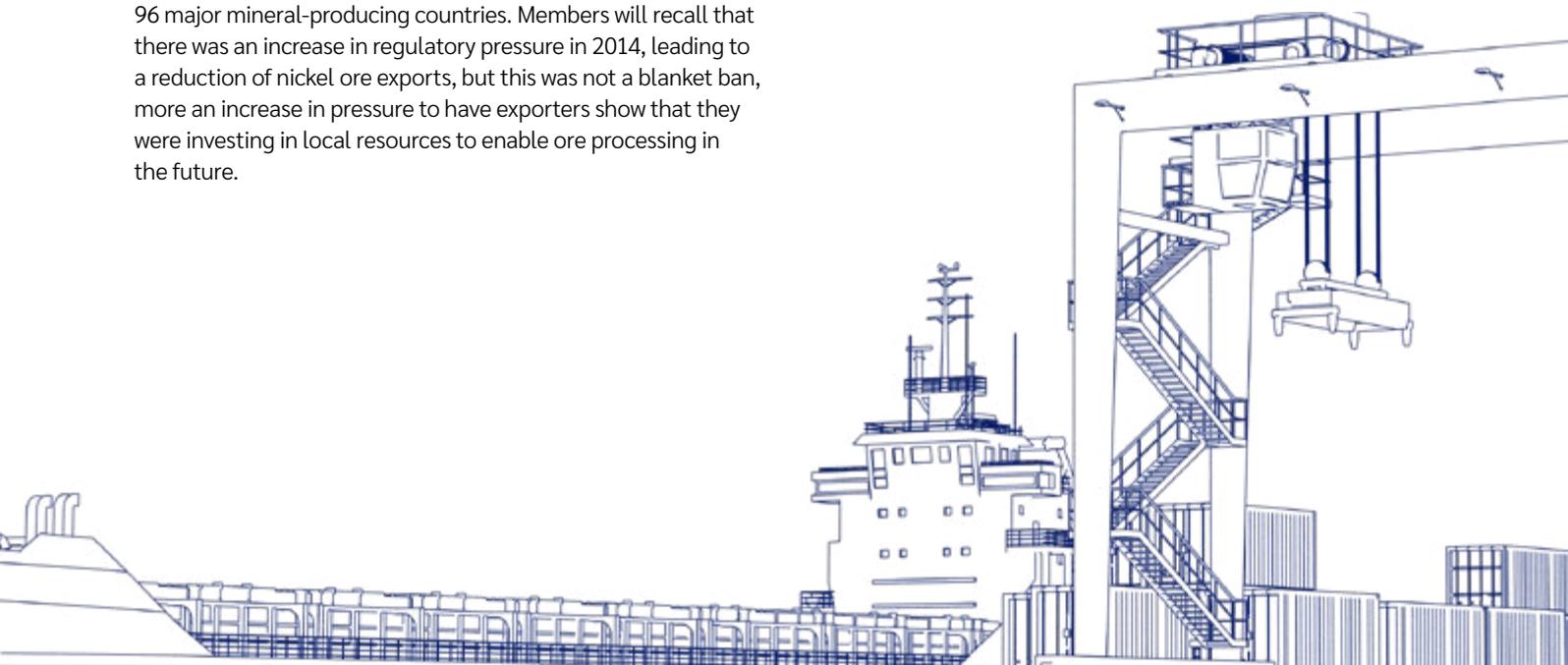
The Government of Indonesia banned the export of nickel ore from 1 January 2020. The policy was in line with the issuance of ESDM Ministerial Regulation No. 11 of 2019 concerning the Second Amendment to ESDM Ministerial Regulation, No. 25 of 2018 which focuses on Mineral and Coal Mining Businesses. This law is not new, the ban on the export of raw minerals having been mandated by Law No. 4 of 2009, concerning Mineral and Coal Mining (Minerba).

The 2009 law goes on to say in Article 103 that the processing and refining of mining products must be done domestically, and in Article 170, that the purification process must be carried out no later than five years after the regulation is enacted, or by 2014, the mandated deadline. This coincided loosely with the publishing of a report by the Fraser Institute on the Global Survey of Mining Investors (2013), which showed Indonesia as the lowest ranked country in terms of investment climate out of 96 major mineral-producing countries. Members will recall that there was an increase in regulatory pressure in 2014, leading to a reduction of nickel ore exports, but this was not a blanket ban, more an increase in pressure to have exporters show that they were investing in local resources to enable ore processing in the future.

It can therefore be seen that the law is not new, although it has struggled to be implemented due to pressure from mining and exporting interests, both locally and internationally. As late as November 2019, the European Union complained about Indonesia's 'new' policy to the World Trade Organization (WTO). The EU Trade Commissioner accused the ban on nickel ore exports as being part of the Indonesian Government's plan to develop the stainless-steel industry in the country unfairly.

Implementation has now been achieved, with Spica Indonesia not being aware of any nickel ore exports since January 2020. It should be noted, however, that by way of proving the efficacy of the Law of 2009, there are now 27 smelters in Indonesia, more than half of which are smelting nickel ore and thus the inter-island nickel ore trade is thriving, with 60 million tons of ore being absorbed by local smelters between 2016 and 2019. The ore is being shipped from five main locations, two on Sulawesi (Molawe and Kabaena) and three on Halmahera (Subaim, Gebe Island and Tanjung Buli). The shipments are almost exclusively to Sulawesi itself and to Ciwandan on Java.

While the international export of nickel ore has ceased, the domestic carriage of it clearly has not, and the origin of the nickel ore remains the same, with load points such as Gebe Island, Molawe and Tanjung Buli being known to many. As such, risks in the carriage of the cargo remain the same. It is recommended that members that are involved in the trade continue to load the cargo in accordance with the guidelines in the IMSBC code. While, historically, it has been difficult to carry out a full suite of inspections, sampling and analysis in advance of loading, this remains the preferred approach and, pleasingly, as a by-product presumably of there being less time pressure, less foreign involvement in the trade and longer charters, shippers are currently more amenable to allowing inspection and sampling of stockpiles. This was not always the case, however, and care should of course be taken, but requests to undertake inspections, sampling and analysis should always be formally submitted.



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While it remains possible to do this in Indonesia, following the dramatic reduction in the trade in 2014, most internationally recognised local laboratories and inspection companies have diverted resources elsewhere and, as such, Spica Indonesia is currently recommending analysis be undertaken overseas. Members should note that, as a result, the inspection, sampling and analysis process can take up to five days, but with prompt submission of required cargo declarations, this can be comfortably achieved before vessel arrival and the commencement of loading.

In conclusion, while the trade has reduced considerably, care continues to be required.

As recommended above, continuous assessment and can tests of random stockpiles should be carried out prior to accepting cargo for loading. Even though can tests are not a substitute for proper laboratory testing, if there are reasonable doubts based on the appearance of the material at the end of these tests, loading should be stopped, and expert advice sought. The club can assist in appointing a competent surveyor and cargo expert.

## The Philippines

Nickel ore is used to produce stainless steel and is very much a part of modern life. China is the largest importer and the Philippines provides up to 30m WMT (wet metric ton) of this demand a year. Many articles have been written on the danger of liquefaction from nickel ore; however, the practical issue that should be borne in mind with nickel ore cargo loaded from the Philippines is that the cargo is inherently wet. Whatever the reason, the local climate has changed from 25 years ago, when there was a clear distinction between the dry and rainy season. Today, in the areas of the southern Philippines where nickel ore is loaded, it rains all year round.

Surigao and the surrounding islands are the most popular locations for loading nickel ore. The port of Surigao, a small provincial port, has no loading facilities. The actual loading will most likely take place at Adlay, Carrascal, over 40 nautical miles away. This can lead to confusion, especially when masters are expecting a port with a pier and loading facilities. The waters around this area are subject to strong rip tides. Several loaded vessels have run aground in Dinagat Sound, so masters of loaded vessels should navigate with extreme caution and consider a more prudent departure to open ocean to the east.

These areas of nickel ore production are in extremely remote areas, where the mining is open cast and the nickel ore is stockpiled on the shore and thereby exposed to the elements. The nickel ore is transferred from the stockpiles by barge to a vessel normally anchored a mile or more offshore. Due to there being no actual facilities, the trade utilises Handymax size vessels, which can self-load the cargo via ship's grabs. A normal shipment is 55,000mt. Two decades ago, in the dry season, this could be loaded in seven days. However, with the change in climate, the average time is now three weeks or more.

It is therefore necessary to ensure that the cargo certificates remain valid throughout the loading process. If rainfall occurs prior to or during loading, the master should request that new moisture content tests are carried out. If there are any concerns or doubts about the validity of the moisture content, the master should ensure that loading operations are suspended until newly updated information about the cargo has been received.



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Length of voyage should never be a defining factor in deciding if a cargo is suitable to carry. It should also be remembered that the IMSBC code clearly states the limitations of the can test, and even a satisfactory can test does not mean that a cargo of nickel ore complies with the IMSBC code and is safe to carry. The human eye is also insufficient in determining whether a cargo complies with the IMSBC code. The only way to ensure that the cargo is compliant is through analysis carried out under correct protocols. Comparisons of certificates issued by the local mines with independent analysis of samples undertaken abroad show a significant difference, with errors of between 8% and 10% in FMP (flow moisture point).

In 2019, nearly half of the 31 registered nickel ore mines in the Philippines were suspended either due to administrative or environmental issues. With the ban on nickel ore export from 1 January 2020 in Indonesia, this will further strain the Philippines to fill demand. Regarding the reliance on certificates issued by local mines, on every occasion when we have sent samples for independent analysis due to concerns about the moisture content, the mines' certificates have failed.

## New Caledonia

All of New Caledonia's soil is nickel ore. The loading places are extremely secluded, and one will see activity in these places only during loading preparations/operations. Loading will usually be by means of one or two conveyor belts, and the cargo is carried by barges to the vessel at anchorage.

The nickel ore industry is a very tricky business in New Caledonia. Stevedores and other workers may exercise their right to strike or withdraw from work, which can cause roadblocks, trade disputes and other serious consequences, notably in and around the mine sites. For example, in 2018, a vessel stayed for 37 days at anchorage due to a strike. The strike in September 2019 lasted for about 15 days and concerned three mining sites, while the one in February 2020 took four days, during which truck drivers (contractors) blocked four mining sites.

On board, the possible slowness of the cranes, closing hatch covers when it drizzles, lack of fresh water or issues surrounding stevedores (ie not being permitted to use onboard toilets or take a shower) may result in delays.

Since November 2010, a special procedure (called Rheolat) has been applied in New Caledonia for determining the 'nickel ore transportability'. This procedure is a result of numerous meetings with all the miners' union, CNRT (Centre National de Recherche Technologique), INERIS (National Institute of Industrial Environment and Risks) and the French Government. It is based on the series of physical and mechanical tests conducted on several nickel ore samples originating from different sites and mines of New Caledonia.

Moreover, the local miners' union, with the public interest group CNRT Nickel and its Environment, whose purpose is to pool and manage the means to carry out research or technological development programmes, and the official French institutes mentioned above currently continue to improve the analysis with new accurate procedures. INERIS visits every year to control the application of the procedures and renew the authorisations for each mining company. The last visit was in September 2019.

There are two main types of nickel ore loaded for export: limonite (poor nickel content) and saprolite (high nickel content). The nickel ore particulars are different from one mine site to another (notably concerning the reaction depending on the water, as saprolite is characterised by its high magnesia and silica content, while limonite is an oxide ore).

For the analysis, either the shipper's laboratory or an independent laboratory is used (depending on the shipper). All laboratories are officially approved. Cargo sampling and analysis is done close to the arrival of the vessel.

The miners generally charter a vessel only if there is a sufficient quantity of cargo on shore to ensure the loading. Shippers provide the cargo declaration form close to the arrival of the vessel.

As mentioned above, barges and tugboats are usually used to load the vessel. A barge can typically carry around 300mt, and so the cargo can be checked with each parcel of 300mt loaded, which encourages safe loading.

The master's decision to commence loading is critical in avoiding the problems associated with cargoes that liquefy. They should be fully satisfied with the characteristics and condition of the cargo presented for loading. The shipboard team should maintain a cautious approach during the entire loading operation. It should be kept in mind that removing unsuitable cargo from the vessel could be highly problematic.

In case of doubt, the barge and its cargo must be rejected. Should the master decide to suspend loading, due to doubt concerning the quality of the cargo, such a decision remains the master's prerogative. Usually, the surveyor checks the cargo in the onshore stockpiles, before reaching the vessel to inform the master about the local situation. Surveyors also participate in establishing a relationship between the shipper and crew members and, most importantly, organise regular cargo tests. They advise the master and crew on the method and interpretation of the can test.



For information, the foreman and stevedores come from tribes who live in the vicinity of these sites and generally do not speak English. Below is further information about the general weather in New Caledonia:

### 1-Rainfall

- Two dry seasons: one large (September to November) and one small (April-May).
- Two rainy seasons: a large (December-March) and a small (June-August).
- But watch out for the simplification of statistics, there are years where it rains during the dry seasons and years where there is not much rain during the rainy seasons.
- It rains mostly at night; however, seasonal variations can be expected.

### 2-Temperature

- New Caledonia is in the intertropical zone, but it is never too hot or too cold.
- The hot season lasts a little more than four months, from December to mid-April (average temperature: 24° to 30°C).

### 3-Wind

- New Caledonia is a country of trade winds.
- In the southern hemisphere, these cool winds blow from the south-east and east. They are often present in New Caledonia (on average, 250 days a year in Noumea) and are at the origin of the mild climate.

### 4-Cyclone

- New Caledonia is located in a zone of tropical cyclones. In 25 years, 6 cyclones have crossed the south of the territory and there have been 12 in the north. Their trajectory is generally from north to south, and often from north-east to south-west (they form between the Solomon Islands and Tuvalu, and cross Vanuatu), but it can be very varied and changing.
- The cyclone season is from December to March, but we have seen some cyclones in October and May.

The two most recent very low-pressure weather systems which passed over the island were:

- Cyclone UESI, from 7 to 14 February 2020.
- Cyclone GRETEL, from 14 to 16 March 2020.

Following each rainy period, it is necessary to wait for the drying of the cargo before starting or resuming the loading operation. In each case, it is prudent to wait for the cargo to dry and to check the stockpiles again before loading resumes.

## Guatemala

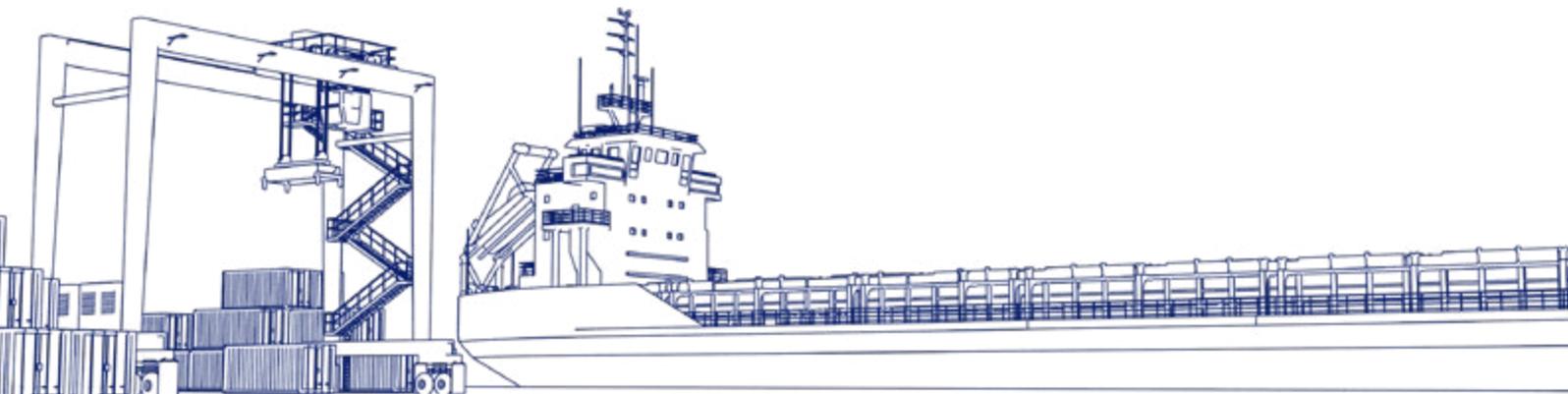
Guatemala has been an exporter of nickel since 1958, following a joint venture between Hanna Mining Company and Inco, which formed Exmibal. In 2005-2006, Exmibal's rights were purchased by CGN (Compañía Guatemalteca de Niquel).

Since 1988, the nickel extract operation has been undertaken by five major companies: Mayaniquel, CGN, Jaguar, Codico and Cominco. They are all located in Izabal, where the mines run along Lake Izabal's margins and shores. These companies have obtained the government's exclusive concessions and permits since the richness in subsoil land is by law owned by the government and the companies are required to pay taxes and dues accordingly.

Some mines are located 65 miles away from the Port of Santo Tomás de Castilla, others are about 45 miles away. There are a total of four mines being exploited at this time. Although the land is privately owned by independent farmers, the mining companies pay them upon extraction and for transit of the roads.

Therefore, the mining companies can open new mines and close old ones, depending on the guidance of their research exploration teams. All of the mines are in the same region, since this area is rich in deposits.

CGN, based in El Estor, Izabal, is the only certified company with its own lab capability to ensure it maintains strict control of the humidity (in transit) of the ore it exports.



Two miles away, within the Port of Santo Tomás de Castilla's berth, all export companies keep stockpiles of about 120,000 tons weekly. These are properly covered with tarpaulins and strict control is maintained over the humidity of the nickel ore.

The ore is loaded at the mines into bucket trucks with tarpaulin covers and transported to the stockpiles within the port. These are later loaded back into loose buckets within the circuit that runs back and forth alongside the ship. Normal ships take from 45,000mt to 65,000mt. They typically use the ship's cranes to lift the buckets onto the ship and turn them upside down to dump the cargo into the holds. Trimming is regularly affected to properly distribute the cargo on board.

Cargo is strictly loaded during good weather. If it rains, all cargo operations are stopped.

A relatively faster loading rate means that the ship can have thousands of tons of cargo loaded in just a few hours. For the safety of the ship and its crew, and to avoid any delays/disputes, it is recommended that the suitability of the cargo is verified prior to its loading. It is therefore recommended to appoint an independent surveyor to inspect and sample the cargo and to assist the master throughout the loading process.

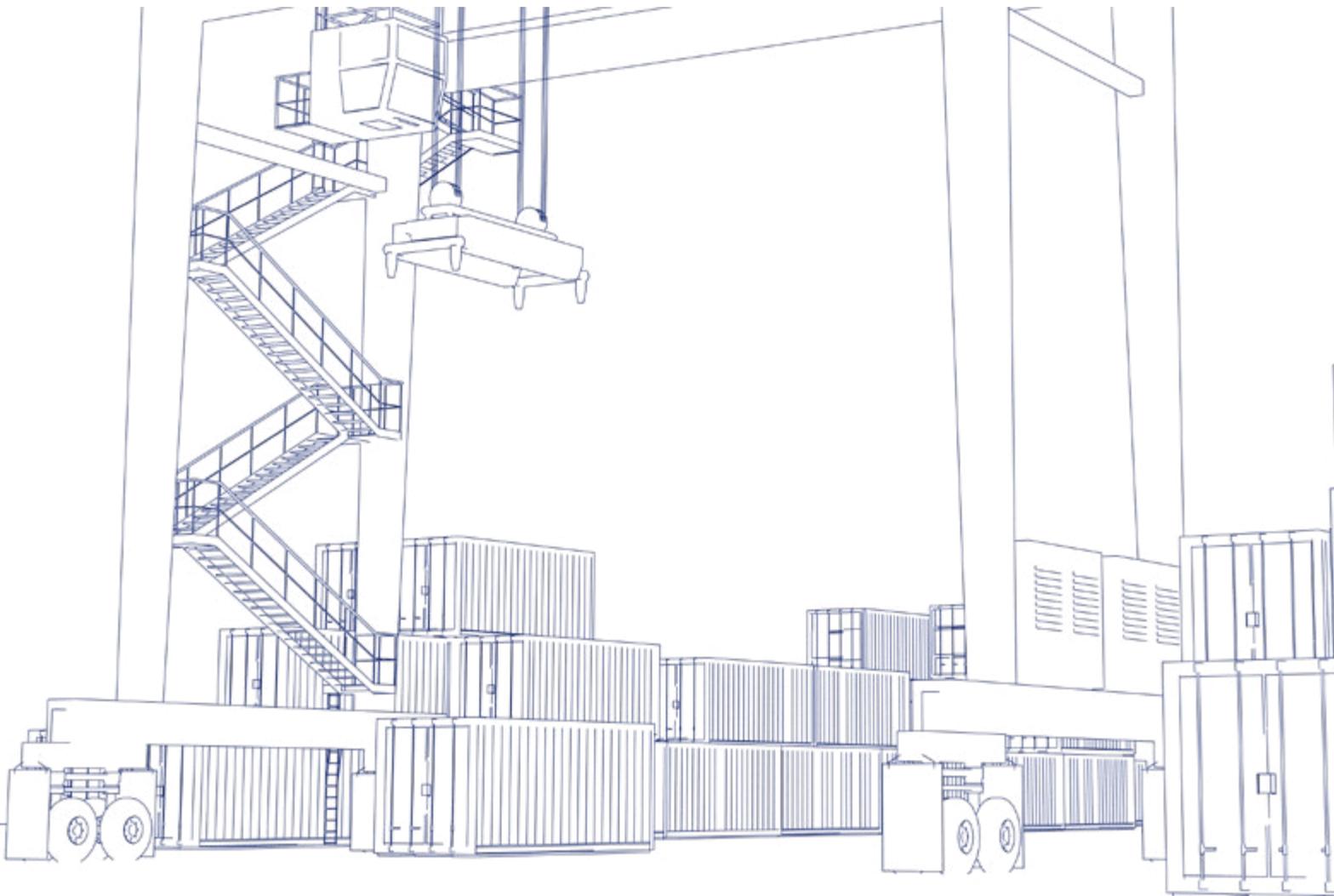
Average estimated loading time:

- During dry season, 33 to 36 hours
- During rainy season: 45 to 65 hours.

The biggest challenge for shipowners is to assure the quality of cargo and amount of transport humidity within the ore in order to guarantee a safe transport during the sea passage. For this, certified surveyors include pre-loading checks like can tests in accordance with IMSBC code.

The second biggest challenge is to find proper labs around the world that can conduct the testing of the samples taken from all ships that depart out of Guatemala's Port of Santo Tomás de Castilla.

Recently, the Port of Santo Tomás de Castilla granted a concession for a floating berth, which has been under operation for over a year, exclusively to load nickel ore. The berth barge is 200m long, with a draft of approximately 12.5m, exclusively used for nickel ore.



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## Conclusion

Members planning to load nickel ore should notify the club at their earliest opportunity and, where possible, provide information mentioned below, so that a local surveyor can be appointed to check cargo stockpiles, and assist the master with random sampling and can testing prior to accepting cargo for loading on board:

- Ship name
- Port/anchorage of loading and estimated time of arrival
- Date of intended loading
- Charterer's/shipper's details
- Agent's details
- Copy of the shipper's cargo declaration and supporting certificates.

In the event of any concerns regarding the reliability of the test certificates or doubts about the safety of the cargo, the club may decide to appoint a cargo expert and test cargo samples at a trusted laboratory, where test figures will be determined with accuracy.

The Standard Club and our local correspondents are always on hand to assist and advise our members.

The club would like to thank the following contributors for providing their valuable insights in preparation of this article:

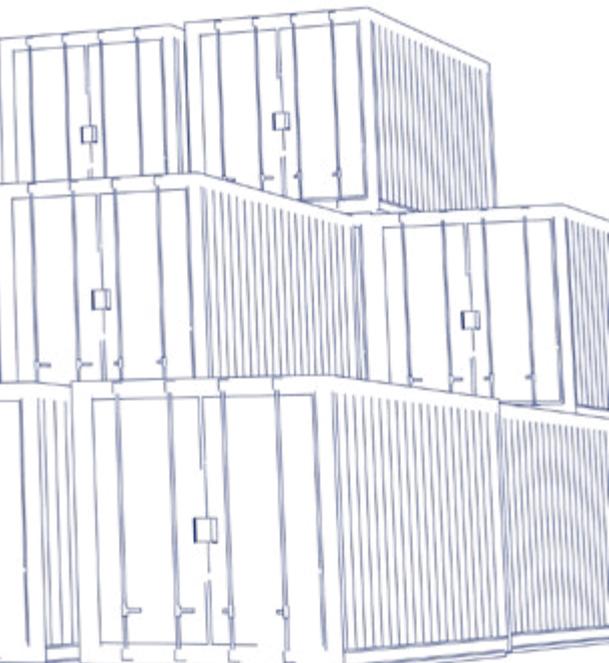
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