



**NATIONAL TRANSPORTATION SAFETY COMMITTEE
REPUBLIC OF INDONESIA**

FINAL REPORT

KNKT.22.04.14.03

Marine Accident Investigation Report

The Fatality of Fumigation Team Members

On Board China Express

At Balikpapan Port, Indonesia

26 April 2022

2022

FOREWORD

Praise be given to the Almighty God for the completion of the Final Report on the Investigation into the fatality of fumigation team members on board the *China Express* on 23 April 2022 at Balikpapan Port, East Kalimantan, Indonesia.

The Final Report of Marine Accident Investigation was mandated by Indonesian Shipping Act No. 17 of 2008 Articles 256 and 257 as well as Government Regulation of Transport Accident Investigations No. 62 Year of 2013 Article 39 paragraph 2 Letter c which states that "*The report of a transport casualty as referred to the verse (1) consists of the final report.*" This joint investigation was under the request from the Transport Safety Investigation Bureau of Singapore in accordance with the IMO Resolution MSC.255(84) (Casualty Investigation Code).

The report represents the culmination of the entire investigation process, which encompasses factual information, an analysis of the causal factors most likely to have contributed to the casualty, recommendations for prevention and enhancement, and an appendix of other supporting documents. The report examines the marine casualty issues concerning what, how, and why the casualty occurred, presenting findings regarding its cause. The Final Report of Marine Accident Investigation was made so that the interested parties could learn and take lessons from the accident.

Jakarta, February 2022

NATIONAL TRANSPORTATION
SAFETY COMMITTEE
CHAIRMAN

Dr. Ir. SOERJANTO TIAHJONO

The report was published by the **Komite Nasional Keselamatan Transportasi (KNKT)**, located within Transportation Building, 3rd Floor, Ministry of Transportation, Jln. Medan Merdeka Timur No. 5, Jakarta 10110, Indonesia, in 2022.

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GLOSSARY

Aeration refers to the process of dispersing residual fumigant gas from enclosed spaces and commodities that have undergone fumigation, until a safe Threshold Limit Value (TLV) is attained.

Barantan is an abbreviation of ***Badan Karantina Pertanian***, an Indonesian government agency operating under the aegis of the Ministry of Agriculture. Its mandate encompasses the conduct of agricultural quarantine and biosecurity supervision. Constituent elements of the Agricultural Quarantine Agency are currently being amalgamated with the Fish Quarantine Agency, Quality Control and Safety of Fisheries Products, to form the unified Indonesian Quarantine Agency.

Dosage is the amount of fumigant used per unit volume at a specific time and temperature to perform fumigation, for example 48 g/m³ for 24 hours at a temperature of more than 20°C.

Fumigant is a pesticide that, at a given temperature and pressure, exists in a gaseous state. When applied at a certain concentration and for a defined duration, it is capable of eradicating organic pests. The most prevalent fumigants utilised in Balikpapan are Methyl Bromide (MB) and Phosphine (PH).

Fumigation is the treatment process involving the use of a fumigant in a gas-tight enclosure at a specific temperature and pressure.

Fumigation Certificate is a document attesting that the fumigation treatment has been executed in compliance with the stipulated requirements or standards.

Fumigation in the vessel cargo hold refers to the fumigation of carrier media within the cargo hold of a vessel for the purpose of plant quarantine treatment.

Fumigator is a duly certified individual who has successfully completed specific training pertinent to fumigation operations. A fumigator assumes responsibility for several Helpers whilst conducting fumigation.

Fumigator company is an organisation that provides fumigation services. Each fumigator company is required to employ at least one certified fumigator and must be duly registered with the Agricultural Quarantine Agency.

Gas Free Certificate or Gas Clearance Certificate is a document confirming that the vessel's cargo hold is devoid of fumigant residue, rendering it safe.

Gassing is the activity of applying the fumigant gas to quarantine objects, such as cargo.

Helper is an Helper or a person who aids the fumigator in fumigating an object (e.g., a vessel or a building). The helper is guided, trained, and instructed by a fumigator. No certification is required for an helper. Helper is the local name.

KNKT or the National Transport Safety Committee is an independent Indonesian government agency vested with the responsibility for investigating safety deficiencies across aviation, maritime, railway, and road transportation sectors.

Methyl Bromide, also known as **bromomethane (CH₃Br)**, or **MB** is a chemical compound commonly used as a fumigant to control pests in agriculture and for treating imported goods, often fulfilling quarantine requirements. It's a colourless, odourless, and non-flammable gas. It is a gas at room temperature and is used as a fumigant due to its ability to penetrate materials and exterminate pests.

Organic pests encompass all types of organisms capable of causing damage, interfering with the life cycle, or leading to the demise of a plant.

Phosphine (PH) or **PH** is a colourless, flammable, and highly toxic gas. It has a distinctive, unpleasant odour, often compared to garlic or rotting fish, due to impurities in technical-grade samples.

Phytosanitary requirements are regulations imposed by importing countries to prevent the introduction and spread of harmful plant pests and diseases.

Plant quarantine treatment is a process undertaken to render a carrier medium free from organic pests and to satisfy the phytosanitary requirements of the export destination country or countries.

Verification constitutes a series of activities performed to ascertain whether or not fumigation operations can be effectively carried out.

Wood chips are small to medium-sized pieces of wood, produced by cutting or chipping larger pieces of timber such as trees, branches, logging residues, stumps, roots, and wood waste.

FACTUAL INFORMATION

The Accident



Figure 1: KRN Port in Balikpapan, Indonesia (image: Google Map with annotations by KNKT)

On 23 April 2022, a wood chip carrier *China Express* berthed at the Kutai Refinery Nusantara (KRN) Port (see the map above).

On 25 April 2022 around midday, cargo loading was completed and the fumigation team had sealed all cargo holds, including all openings and ventilation pipes connected to the cargo holds. At approximately 1530 LT¹, the releasing of Methyl Bromide (MB) commenced, concluding at 2025 LT. The fumigation process utilised an electrical equipment to pump the fumigant into the cargo holds (see the photo below). The fumigation team comprised 15 personnel from the fumigation company comprised of two certified fumigators and thirteen Helpers. Each pair of Helpers was assigned responsibility for one cargo hold.

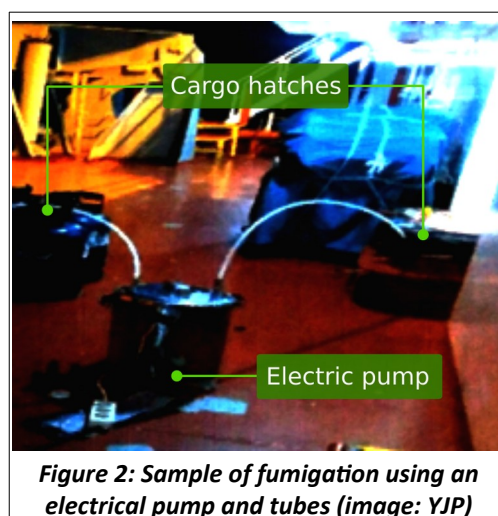


Figure 2: Sample of fumigation using an electrical pump and tubes (image: YJP)

On 26 April 2022, at approximately 19:45 LT, the fumigation team began to measure the gas level in all cargo holds.

¹ Local time is UTC + 08:00.

At around 21:20 LT, the aeration process commenced, involving 24 blower fans. The cargo hatches were also partially opened, in accordance with standard operating procedures. The aeration was planned to run for approximately three hours.

At around 22:45 LT, Helper A descended into cargo hold No. 6 without using any personal protective equipment through the hatch to retrieve a gas detector tube that had fallen into the hold. Helper B, who observed Helper A entering the hold, immediately alerted the others that someone had entered the hold without authorisation or supervision.

Fumigator A, upon hearing Helper B's shout, rushed to the cargo hatch of hold No. 6. A few moments later, Helper A was attempting to retrieve the hose and ascend the ladder back to the deck. Suddenly, Helper A fell from the ladder onto the cargo. Other Helpers who had gathered around cargo hatch No. 6 and witnessed this event shouted that someone had fallen into the cargo hold. Fumigator A then instructed the other Helpers to immediately prepare equipment for hold entry. Moments later, whilst the other team members were gathering their equipment, Fumigator A swiftly entered hold No. 6, wearing the respirator he habitually carried.

However, Fumigator A's attempt to lift Helper A's body proved unsuccessful. Fumigator A then fell onto Helper A. Fumigator A was found face down, whilst Helper A was face up, in a position as if Fumigator A was about to lift Helper A. No body outline or photograph of this situation was available because, shortly thereafter, Fumigator A's body slipped and rolled to the lower part of the pyramid-shaped wood chips within the hold.

The Local Search and Rescue Agency subsequently recovered them using personal protective equipment (PPE) with breathing apparatus. Both Fumigator A and Helper A showed no signs of life after they were examined on the deck.



Figure 3: Rescue operation by the local SAR
(image: JPNN.com)

The Aftermath

Helper A and Fumigator A succumbed to this accident. Helper A's head showed signs of severe impact, as if it had struck a hard object, whilst the Fumigator A had some wounds on the lips and forehead, consistent with a forceful impact against the wood chips. No autopsy was conducted to ascertain the precise cause of their deaths.

Vessel Information

The *China Express*² (IMO 9861237) is a Singaporean wood chip carrier, constructed in September 2020 by Chengxi Shipyard Co., Ltd., China. The vessel is owned by China Express Pte. Ltd. and managed by Nova Shipping & Logistics Pte. Ltd. She is classed with the American Bureau of Shipping. She is a Panamax-class vessel with a length overall

² Referring to the ABS classification, her type is general cargo carrier and her type is wood chips carrier.

(LOA) of 215.4 metres, a beam of 37 metres, a gross tonnage (GT) of 57,934, and a dead-weight tonnage (DWT) of 69,787 tonnes.

The vessel is powered by a single main engine, a WinGD 6X52 model, designed by Winterthur Gas & Diesel Ltd. (WinGD), delivering a maximum power output of 8,780 kW. The WinGD 6X52 engine installed on the China Express is a low-speed, two-stroke marine diesel engine designed for high efficiency and compliance with IMO Tier III emission standards. Propulsion is achieved through a direct-drive oil engine, enabling the vessel to maintain a service speed of approximately 13.2 knots.

Fumigation Company

Yedija Jaya Pratama Indonesia (YJP) is a fumigation company appointed by the shipper. YJP is one of two fumigation companies registered with Barantan for the East Kalimantan area. This company has provided numerous fumigation services for buildings, warehouses, and marine vessels. YJP's involvement in the fumigation aligned with Article 3.1.2.2 of MSC.1/Circ.1264, which outlines the Recommendations on The Safe Use of Pesticides In Ships Applicable to The Fumigation of Cargo Holds.

This casualty was the first to occur since YJP commenced its operations a considerable time ago. YJP remains part of a larger group that includes another fumigation company in North Sumatra Province.

Fumigation Team

Fumigator A possessed nine months of experience with YJP, in addition to extensive prior experience with other fumigation companies. Fumigator A also held the position of technical manager at YJP. Meanwhile, Helper A had approximately six months of experience working at YJP. The appearance of the fumigator was consistent with the article 3.1.2.2 of MSC.1/Circ.1264, which outlines the Recommendations on The Safe Use of Pesticides In Ships Applicable to The Fumigation of Cargo Holds.

Referring to the explanation from YJP, the assistants typically receive a safety briefing from their supervisor (a certified fumigator). However, this information is difficult for the KNKT to verify due to the absence of documentation for this activity.

Regarding the procedure for retrieving fallen equipment from a cargo hold, YJP explained that they typically request assistance from the ship's crew. The ship's crew would then provide aid, even though YJP possesses its own breathing apparatus. Unfortunately, the KNKT team could not verify this statement, and this procedure does not appear in any documentation from YJP.

Helper A's decision to enter the cargo hold before it was declared safe for human entry was made without any consultation or discussion with a supervisor, in this instance, the Fumigator. At the time, the "danger zone" banner was still displayed on the deck.

Fumigation Process³

The time needed in fumigation on a vessel depends on factors as follows.

1. The number and size of cargo holds.
2. The type of fumigant and cargo (commodities).
3. The number of equipment and human resources.
4. The complexity of the fumigation process.

³ Based on the YJP's internal procedures.

Compared to Phosphine (PH), Methyl Bromide (MB) is the most commonly used fumigant due to several advantages. MB requires a shorter fumigation period. If pre- and post-fumigation each require one day, the total time needed for fumigation using MB is typically no more than 72 hours. Additionally, pre- and post-fumigation usually take around three hours. Conversely, PH requires at least 6 × 24 hours from commencement until completion. If insufficient time is available, fumigation must be continued during the voyage (in-transit fumigation). These factors made PH less favourable among stakeholders involved in chip export.

The fumigation process is carried out by a fumigator company registered by the Ministry of Agriculture. The fumigator company can be contracted by the port operator, shipper, or cargo owner. At the time of the casualty, two active fumigator companies served the East Kalimantan province. Balikpapan and Samarinda are port cities in East Kalimantan.

Based on the document from YJP, the steps for conducting fumigation are as follows:

- a. The YJP receives and verifies an order from a client. This step also covers the decision of which fumigant will be used.
- b. The work plan and a team for a vessel is established. Each cargo hold normally needs around two or three workers.
- c. Preparing the equipment and fumigant.
- d. Asking for the fumigation permit from the Barantan. If it is deemed necessary, the Barantan will deploy a supervisor.
- e. The fumigation team don the safety gear.
- f. Checking the ventilations and openings. Initial fumigation using spray (liquid) on the decks area is involved here.
- g. Installation of the gassing hose.
- h. Sealing the ventilations and openings on the vessel.
- i. Installing the “danger zone” banner.
- j. Heating up the fumigant to convert it into a gas state.
- k. Final checking.
- l. Gassing all cargo holds.
- m. Initial checking of gassing.
- n. Final checking of gassing.
- o. Topping up the fumigant to increase the concentration of fumigant in all cargo holds. The MB fumigant is usually kept for at least 24 hours.
- p. Aeration. The air quality should be safe for humans.
- q. Packing up the equipment.
- r. Issuing fumigation and gas free certificates and making a report.

The investigation team could not verify whether this procedure is applied for all fumigation activities, regardless the location (on board a cargo hold of a vessel or in a building).

Sample of the “danger zone” banner is shown below.



Figure 4: Danger banner on board China Express

Fumigation processes in Balikpapan area consistently involve the Balikpapan Harbour Master and the Balikpapan Agricultural Quarantine Agency (Barantan). Together, these agencies form a coordinated framework that ensures fumigation at Indonesian ports is conducted safely, effectively, and in compliance with both national and international standards.

The Balikpapan Harbour Master, operating under the Ministry of Transport, is primarily responsible for ensuring the safety, security, and orderly operation of maritime activities within the port. In relation to fumigation, the Harbour Master (KSOP) plays a regulatory and supervisory role. They authorise fumigation activities on vessels or within port facilities, particularly when hazardous substances are involved. The KSOP ensures that such operations do not compromise maritime safety or disrupt port operations. They also coordinate with other agencies, such as KKP and Barantan, to ensure that fumigation is conducted in accordance with national maritime regulations and safety protocols.

The Balikpapan Agricultural Quarantine Agency (Barantan), under the Ministry of Agriculture, is tasked with protecting Indonesia's agricultural sector from the introduction and spread of pests and diseases. Barantan's role in fumigation is focused on phytosanitary control. They determine whether fumigation is necessary for agricultural commodities, especially for imports and exports. Barantan approves fumigation treatment plans, supervises their implementation, and ensures compliance with international standards for wood packaging. Upon successful fumigation, Barantan issues phytosanitary certificates that are essential for the movement of agricultural goods across borders.

Fumigation on board a vessel does not normally involve a Port Health Office. The Balikpapan Port Health Office, operating under the Ministry of Health, is responsible for safeguarding public health at ports. However, in the fumigation process, this agency assesses the health risks posed by pests (such as rodents and insects, particularly those that may carry diseases) to the vehicle, rather than to the cargo. If the fumigation is for the purpose of eliminating pests (e.g., in this operation), it falls under the authority of the Port Health Office, rather than Barantan.

This agency issues Ship Sanitation Certificates, which are required for vessels to demonstrate compliance with international health regulations.

Protective Equipment

Based on the interview with YJP, the assistants and fumigators typically use a mask with a single canister at all times whilst working, as shown in the image below. The brand they commonly use is Dräger. They acknowledged that the mask is usually fogged when used in the cargo hold.

LESSONS LEARNT

The death of the Helper A was likely due to poisonous gas of fumigant (MB). His action was likely due to lack of understanding the danger of fumigant, despite he already been given a short training by the certified Fumigators.

The death of the Fumigator A was due to fumigant as well. The fumigant gas ingress into his respiratory system because the mask is not designed to be used in high concentration of toxic gas.

KOMITE NASIONAL KESELAMATAN TRANSPORTASI REPUBLIK INDONESIA

Jl. Medan Merdeka Timur No.5 Jakarta 10110 INDONESIA

Phone : (021) 351 7606 / 384 7601 Fax : (021) 351 7606 Call Center : 0812 12 655 155

website 1 : <http://knkt.dephub.go.id/webknkt/> website 2 : <http://knkt.dephub.go.id/knkt/>

email : knkt@dephub.go.id

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