

MA2014-6

**MARINE ACCIDENT
INVESTIGATION REPORT**

June 27, 2014



The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board is to determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

Norihiro Goto
Chairman,
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

MARINE ACCIDENT INVESTIGATION REPORT

May 29, 2014

Adopted by the Japan Transport Safety Board

Chairman	Norihiro Goto
Member	Tetsuo Yokoyama
Member	Kuniaki Shoji
Member	Toshiyuki Ishikawa
Member	Mina Nemoto

Accident type	Fatality of crew members
Date and time	Around 14:20 on July 2nd, 2012 (local time, UTC+9 hours)
Location	Heigun-suido Channel, Yamaguchi Prefecture Around 119° true bearing, 2.3 nautical miles (M) from Shimoninai Island Lighthouse located in the town of Suo-oshima, Yamaguchi Prefecture (approximately 33°49.7'N,132°13.4'E)
Summary of the Accident	While the chemical tanker CHEM HANA was proceeding in the Heigun-suido Channel off the south of Yashiro Island in the town of Suo-oshima after unloading around 960 tons of acetone at Kanmon Port, two of the crew members who were cleaning cargo tanks fell into cardiopulmonary arrest at around 14:20 on July 2nd, 2012, and were confirmed dead at the hospital they were taken to.
Process and Progress of the Investigation	(1) Setup of the Investigation The Japan Transport Safety Board appointed an investigator-in-charge and a marine accident investigator to investigate this accident on July 2nd, 2012. (2) Comments from Parties Relevant to the Cause Comments on the draft report were invited from parties relevant to the cause of accident. (3) Comments from the Flag State Comments on the draft report were invited from the Flag State of CHEM HANA.
Factual Information	
Vessel type and name	Chemical tanker CHEM HANA
Port of registry	Busan, Republic of Korea
Gross tonnage	695 tons
IMO number	9009906
Owner	HANA MARINE Co., LTD. (Republic of Korea) (hereinafter referred to as "Company A")
Operator	Company A
Management company	Company A
Classification society	KOREAN REGISTER OF SHIPPING (KR)
L×B×D	66.01 m × 11.30 m × 5.15 m
Hull material	Steel

Engine, Output
Date of launch, etc.

Diesel engine, 1,324 kw
October, 1990
(See Photo 1)



Photo 1: The Vessel seen from the bow

Cargo Tanks and Pump Room

CHEM HANA was equipped with No.1 to No.4 cargo tanks, divided by a longitudinal bulkhead into eight portions in total, four each on both of the starboard and port sides.

There was a gas-free fan in the boatswain's store, and a cargo pump in the pump room. (See Figure 1 and Photo 2)

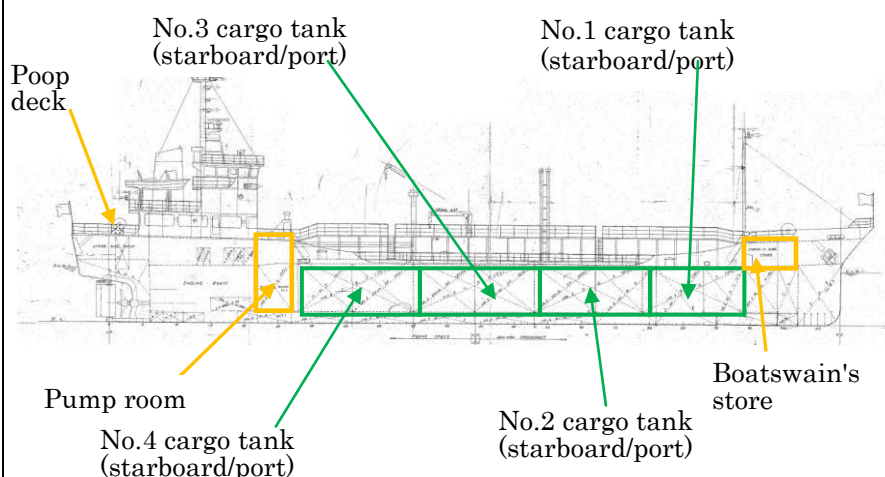


Figure 1: Side view of the Vessel



Photo 2: Bottom of No.2 cargo tank (port side)

Crew Information	<p>Master (Nationality: Republic of Korea), male, 57 years old First class deck officer certificate Date of issue: December 23, 2002 Date of revalidation: March 20, 2007 (valid until December 22, 2012)</p> <p>Chief officer (Nationality: Republic of Korea), male, 55 years old Third class deck officer certificate Date of issue: January 27, 2010 (valid until January 26, 2015)</p> <p>Able seaman A (Nationality: Republic of the Union of Myanmar), male, 28 years old Certificate of competence: none</p>
Injuries to Persons	Fatality of two persons (chief officer and able seaman A)
Damage to Vessel (or Other Facilities)	None
Events Leading to the Accident	<p>Boarded by the master, chief officer, able seaman A (hereinafter referred to as “AB-A”) and seven other crew members consisting of four Koreans, one Indonesian and two Burmese, the chemical tanker CHEM HANA (hereinafter referred to as “the Vessel”) completed unloading 960 tons of acetone at Kanmon Port, and departed for Chiba Port, Chiba Prefecture for the loading of methyl ethyl ketone at around 05:45 on July 2nd, 2012.</p> <p>The second officer went on the bridge at around 12:00, and took the bridge watch duty alone as he was told by AB-A on duty that he had some work to do under the chief officer.</p> <p>At around 13:40, the master received a phone call from a person in charge at Company A and was instructed to load the Vessel with 1,000 tons of paraxylene at Matsuyama Port because of the occurrence of a cargo handling trouble at Chiba Port.</p> <p>Calling the chief officer to the cargo handling office, the master told him about the change of the destination and the cargo, and instructed him to revise the cargo stowage plan.</p> <p>The master then decided to proceed south to the Bungo-suido Channel and implement the tank cleaning before arriving in Matsuyama Port as he thought there would not be enough time to implement the tank cleaning if he proceeded direct to the port. He went on the bridge to enter a course line to the Bungo-suido Channel in the chart, and told the second officer on duty about the change of the destination and the cargo. After instructing him to proceed to the Bungo-suido Channel, the master returned to his cabin to prepare documents necessary for arriving in Matsuyama Port.</p> <p>At around 14:00, together with the boatswain, AB-A and AB-B, the chief officer undertook the work for removing acetone remaining inside suction wells in the cargo tanks as well as inside</p>

the strainer in the pump room (hereinafter referred to as “the Tank Cleaning Work”).

When the chief officer instructed AB-A and AB-B to scoop acetone remaining inside the suction well of each cargo tank from No.1 in order, the boatswain suggested that it would be dangerous to do so because the gas-free fan was not in operation. The chief officer, however, replied that there would be no problem.

The boatswain and AB-B also heard the chief officer say that there would not be enough time left because the destination had been changed to Matsuyama Port.

Wearing work clothes, rubber gloves, safety shoes and a canister-type gas mask, and holding a plastic bucket and a ladle, AB-A entered No.1 cargo tank (port side) and AB-B entered No.1 cargo tank (starboard side), almost at the same time.

AB-B immediately went on the upper deck from the cargo tank and reported to the chief officer about the presence of a strong smell.

At around 14:20, looking inside No.1 cargo tank (port side) through the manhole and recognizing AB-A lying in the tank, the chief officer immediately wore a canister-type gas mask and entered No.1 cargo tank (port side), only to fall down within one or two minutes.

Looking at the situation, the boatswain and AB-B took self-contained breathing apparatuses from the poop deck store, and wore them to enter No.1 cargo tank (port side), and carried both the chief officer and AB-A onto the upper deck.

Around that time, the master went on the bridge to fax the documents he prepared, and noticed that the upper deck was noisy. He then instructed the second officer to check the situation, and learned that the Tank Cleaning Work had been implemented inside the cargo tanks and the accident had occurred.

At 15:06, receiving information from the Vessel about the occurrence of an accident as well as request for assistance, the Sixth Regional Coast Guard Headquarters dispatched a patrol boat, which took both the chief officer and AB-A on board at 16:10 and transported them to Agenosho Port in the town of Suo-oshima.

Afterward, the chief officer was hospitalized by ambulance and AB-A by air ambulance (an emergency medical service helicopter with a doctor on board), and both of them were confirmed dead.

As a result of the judicial autopsy to determine the cause of death of the chief officer and AB-A, it was suspected that their direct cause of death was suffocation caused by oxygen deficiency, and acetone poisoning was involved in their death.

(See Figure 1: Estimated navigation route)

Other Matters

(1) Properties of acetone

According to the information contained in a Material Safety Data Sheet (MSDS), the basic properties of acetone are as follows:

Flash points: – 17°C

Explosive limits: 2.2vol% – 13.0vol%

Vapor density (Air = 1): 2.0

Acute toxic effects (Vapor): Inhalation causes eye and respiratory tract irritation, affects the central nervous system as well as the liver, kidney and stomach, and may cause loss of consciousness.

(2) Gas masks worn by the chief officer and AB-A

When the chief officer and AB-A wore their gas masks to enter No.1 cargo tank (port side), they loaded them with a new canister. The canister, filled with an intermediate concentration organic compound, had usage instructions on its surface reading “Must be used in the presence of gas concentration of less than 1% and oxygen concentration of more than 18%.”

(See Photo 3)



Photo 3: Canister-type gas masks

(3) According to the safety management manual of the Company, the working procedures in an enclosed space were prescribed as follows. (excerpts)

A. Permission for entering an enclosed space

- a. Permission should be obtained from the master before entering an enclosed space.
- b. When receiving an application for permission to enter an enclosed space, the master should examine whether the application is consistent with the working procedures.
- c. The watchkeeping officer should be informed of the location of the enclosed space to be entered.

B. Measurement of atmospheric concentration in an enclosed

	<p>space and ventilation</p> <ul style="list-style-type: none"> a. Concentration of oxygen and toxic vapor in the atmospheric constituents in an enclosed space should be measured at different levels. b. Before entering an enclosed space, oxygen concentration should be measured with an oxygen detector or an atmospheric monitor. The oxygen concentration in the enclosed space must be 21%. c. While inside an enclosed space, ventilation should be maintained effectively and continuously. <p>C. Protective equipment</p> <ul style="list-style-type: none"> a. Before entering an enclosed space, any working or watch personnel should wear personal protective equipment (gloves, goggles, safety shoes, a self-contained breathing apparatus and protective clothing). b. Self-contained breathing apparatus (SCBA) No other types than positive pressure SCBAs are recommendable for use in an enclosed space. c. Usage of canister-type gas masks in an enclosed space is not permitted because, according to their specifications, they are unable to protect their users from excessively concentrated hydrocarbon and toxic vapor as well as from oxygen deficiency. <p>D. Rescue work</p> <ul style="list-style-type: none"> a. An alarm shall be sounded first before rescuing personnel from an enclosed space. b. Rescue and resuscitation equipment should be prepared. c. Rescue work shall not be implemented until necessary preparations have been completed, because hasty and insufficiently prepared rescue work may risk the safety of the rescue team. <p>(4) According to the cargo stowage plan, the tank cleaning scheduled before arriving in Chiba Port was supposed to be implemented in the order of washing with sea water, washing with fresh water, steam washing and drying with the gas-free fan, which was to be completed in approximately 22 hours.</p> <p>(5) Although the master usually received an application in advance from a responsible person for permission to implement any work in an enclosed space, he did not receive any application for permission for the Tank Cleaning Work.</p> <p>(6) In the case of the Vessel, instruments such as an oxygen detector, a combustible gas detector, a toxic gas detector and a set of gas-detecting tubes were kept in the cabin of the chief officer. However, neither the boatswain nor AB-B saw the chief</p>
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	officer measure oxygen concentration or gas concentration before starting the work.
Weather and Sea Conditions	Weather conditions / Weather: clear, Wind direction: SE, Wind force: 3, Temperature: 25° C Sea conditions / Wind wave: 3 (Wave height: 0.5 – 1.25 m)
Analysis Involvement of crew members Involvement of vessel, engine, etc. Involvement of weather and sea conditions Analysis of the findings	Applicable Not Applicable Not Applicable (1) It is probable that the destination was changed to Matsuyama Port and the cargo was changed to paraxylene while the Vessel was proceeding in Heigun-suido Channel for the loading of methyl ethyl ketone at Chiba Port after unloading acetone at Kanmon Port. (2) It is somewhat likely that the chief officer started the Tank Cleaning Work before arriving in Matsuyama Port, according to the findings that he had not been informed by the master that the tank cleaning would be implemented while proceeding in the Bungo-suido Channel before arriving in Matsuyama Port. (3) It is somewhat likely that the air near the bottom of the cargo tank was oxygen deficient because of the acetone gas stagnating there, according to the findings that the vapor density of acetone was 2.0 and the cargo tank had not been ventilated before the Cargo Tank Cleaning was started. (4) It is probable that the chief officer was unaware of the possibility that the air near the bottom of the cargo tank was oxygen deficient because of the acetone gas stagnating there, according to the findings that he did not measure oxygen concentration before starting the work. (5) It is somewhat likely that the chief officer and AB-A inhaled an oxygen deficient air and died of suffocation caused by oxygen deficiency, according to the findings that both of them wore canister-type gas masks which they were not permitted to use when entering the cargo tank (port side). (6) It is somewhat likely that the chief officer and AB-A could have avoided death if positive pressure self-contained breathing apparatuses as well as resuscitation equipment had been made ready and available for use at a location near the entrance of the enclosed space. (7) It is probable that the master was unaware of the work implemented inside the cargo tank, according to the findings that although he usually received an application in advance

	<p>from a responsible person for permission to implement any work in an enclosed space, he did not receive any application for permission for the Tank Cleaning Work.</p> <p>(8) Because the chief officer died in this accident, it was not possible to determine why he did not apply for permission from the master before starting the work, why he did not measure oxygen concentration in the cargo tank, and why he did not observe the procedures in the safety management manual of the Company while instructing AB-A and AB-B to wear canister-type gas masks when entering the cargo tank, which he also entered by himself later wearing a gas mask of the same type .</p>
<p>Probable Causes</p>	<p>It is somewhat likely that this accident occurred when the able seaman and the chief officer inhaled an oxygen deficient air, because oxygen concentration was not measured before entering the cargo tank and they entered the cargo tank wearing canister-type gas masks which they were not permitted to use, when the Cargo Tank Cleaning Work was implemented for the loading of a different cargo after unloading acetone, while the Vessel was proceeding in the Heigun-suido Channel.</p>
<p>Safety Actions</p>	<p>The following measures are considered to be effective for preventing recurrence of similar accidents:</p> <ul style="list-style-type: none"> - When there is any change to a cargo stowage plan, the master should share information about such a change with any of the navigation officers, and give them appropriate instructions for cargo handling preparations. - While working in an enclosed space, any crew member should observe without fail the working procedures for ensuring safety as prescribed in the safety management manual. - Any crew member should be prepared in advance for implementing rescue and resuscitation operations to promptly deal with an accident which may occur in an enclosed space.

Figure 1: Estimated navigation route

