[MSI Report 2021-003]

Marine Safety Investigation Report on Chemical Tanker *Golden Bridge Hana*

– Fatality of a crew member –

Date of Accident: 29 August 2019

Date of Publication: 21 July 2021

Korea Maritime Safety Tribunal
Marine Safety Investigation Team

Note

This marine safety investigation report aims to identify the causes of the marine accidents and prevent similar marine accidents or incidents in the future under Article 18.3 of the Act on the Investigation of and Inquiry into Marine Accidents. It is therefore advised that this report not be used for assigning blame or determining liability.

The names of the relevant acts and agencies described in this report were quoted at the time of writing the report.

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1 Synopsis

1. Synopsis

1.1 A chemical tanker, *Golden Bridge Hana*, berthed at Mailiao Port in Taiwan to load approximately 3,000 tons of vinyl acetate monomer (VAM) at around 04:05 (Korean local time) on 29 August 2019.

1.2 On the same day, purging operations[1)] had been carried out from 06:35 to 12:25 to remove contaminants in cargo pipelines and prevent potential fires or explosions.

1.3 At around 15:30, cargo was first loaded 50cm high in the No. 2 port cargo tank (No. 2 COT (P)), and then loaded in the other cargo tanks only to the level where the bell mouth inside the cargo tanks was submerged.

1.4 After the cargo was partially loaded, one terminal cargo surveyor came on board *Golden Bridge Hana* for cargo sampling operations. The chief officer (C/O) opened a hatch manhole cover to collect a cargo sample as requested by the cargo surveyor.

1.5 On the same day, a sampling device was broken at around 16:00 when the surveyor was collecting samples from No. 2 COT (P). At the same time, a part of the broken device was dropped onto the tank floor along with a glass bottle.

1.6 At around 16:47, the bosun of the vessel went down to the bottom of No. 2 COT (P) to remove the dropped glass bottle and parts of the sampling device. While the bosun was going down to the tank floor, he fell down. He tried to stand up, but fell down again and blacked out. At around 17:00, one able seaman (AB) wearing a chemical protection suit entered the cargo tank with a rope, tied the rope around the bosun's body, and rescued the bosun by pulling him onto the poop deck.

1) It is an operation to prevent cargo contamination and risks, such as explosion, by injecting nitrogen gas (N2) and lowering the level of oxygen concentration.

1.7 At around 17:20, the bosun was conveyed on a stretcher by one of the crane to an ambulance and transported to the hospital. Later that day, however, a local doctor declared that he died from shock and respiratory failure caused by gas poisoning and oxygen deficiency at around 18:32.

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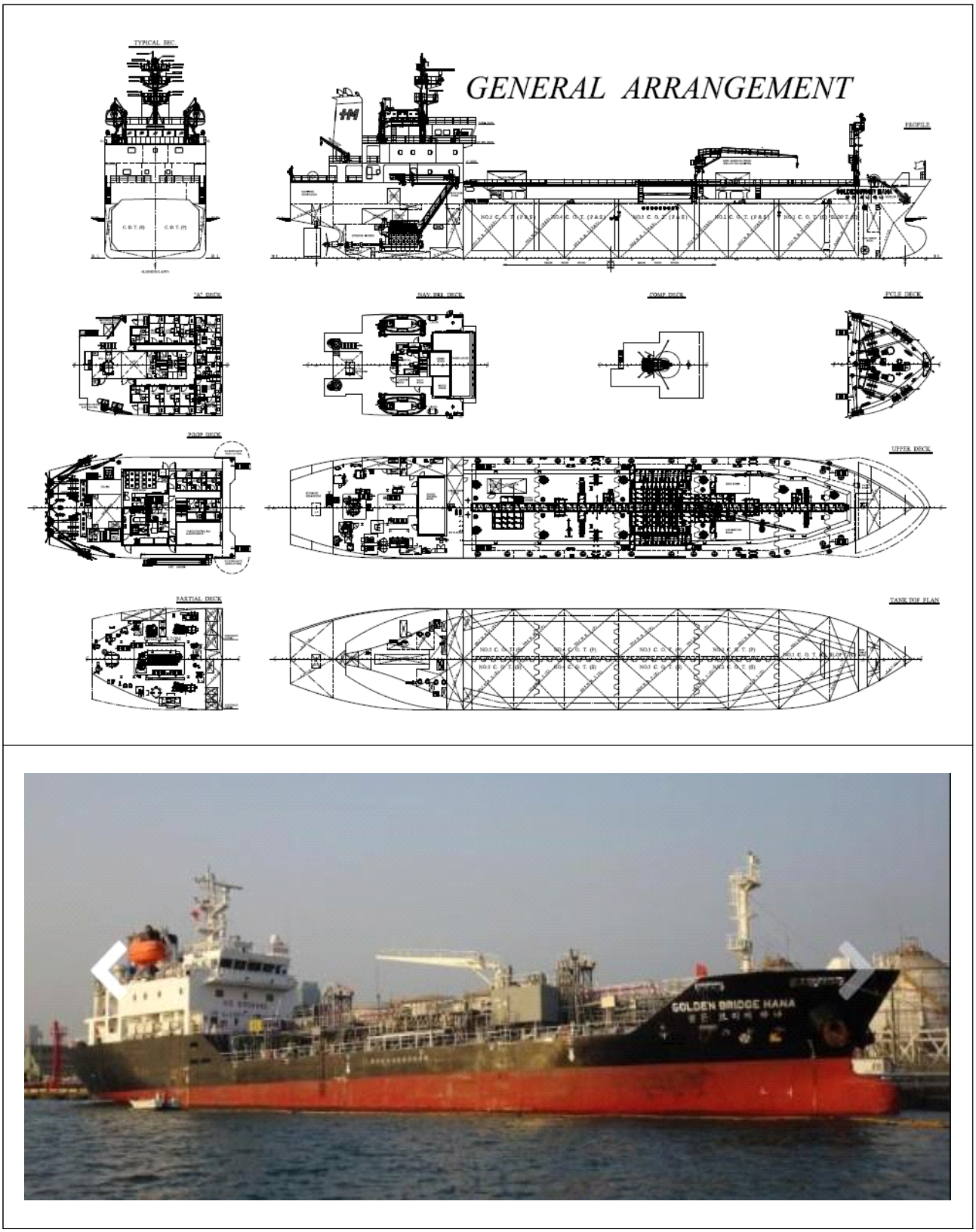
2 Factual Information

2. Factual Information

2.1 Particulars of *Golden Bridge Hana*

Name	*Golden Bridge Hana*
Flag State	Republic of Korea
Port of Registry	Jeju
Ship Type	Chemical/Oil Product Tanker
Owner	Hana Marine Co., Ltd.
Maximum No. of Crew (pers.)	16
Service Routes	Korea, China, Japan, Taiwan, etc.
Builder	DAE SUN Shipbuilding & Engineering Co., Ltd.
Date of Launch	17 November 2017
Classification Society	Korean Register of Shipping (KR)
Length (m)	84.64
Beam (m)	7.80
Depth (m)	14.40
Gross Tonnage (t)	2,688
Main Engine	Marine Diesel Engine (1)
Max. Output	2,427kW
Propeller (Inward)	1 (fixed screw propeller)
Rudder	1



<Figure 1> General arrangement & a photo of *Golden Bridge Hana*

2.2 Ownership and vessel operation of *Golden Bridge Hana*

2.2.1 *Golden Bridge Hana* was launched at DAE SUN Shipbuilding & Engineering Co., Ltd., located in Busan, Korea on 17 November 2017. She is a steel chemical/oil product tanker with a gross tonnage of 2,688 tons, a length of 84.64 meters, a breadth of 14.40 meters, and a depth of 7.80 meters; she is equipped with one set of marine diesel engine with a maximum output of 2,427kW.

2.2.2 After launching, the tanker was delivered to her registered owner, Hana Marine Co., Ltd., and used for transporting various oil and chemical cargoes while sailing on the service routes encompassing Taiwan, China, Korea, and Japan.

2.2.3 Hana Marine Co., Ltd. has its headquarters in Seoul and a regional office in Busan. The company either directly operates or charters a fleet of more than 20 chemical/ oil product tankers, including *Golden Bridge Hana*.

2.3 Vessel surveys and safety management

2.3.1 *Golden Bridge Hana* passed the initial survey, conducted by Korean Register of Shipping (KR) on 8 March 2018, receiving a ship survey certificate valid until 7 March 2023. She underwent and passed the annual survey from the same classification society on 26 March 2019.

2.3.2 The shipowner, Hana Marine Co., Ltd., has taken all duties and responsibilities for *Golden Bridge Hana* as required by the International Safety Management (ISM) Code.

2.3.3 The Document of Compliance (DOC) valid until 21 April 2023 was issued to Hana Marine Co., Ltd. after the renewal verification was completed by KR on 10 May 2018. The Safety Management Certificate (SMC) that expires on 15 August 2023 was issued to *Golden Bridge Hana* after the interim and initial verification on 9 March 2018 and 10 May 2018.

2.4 Vessel structure

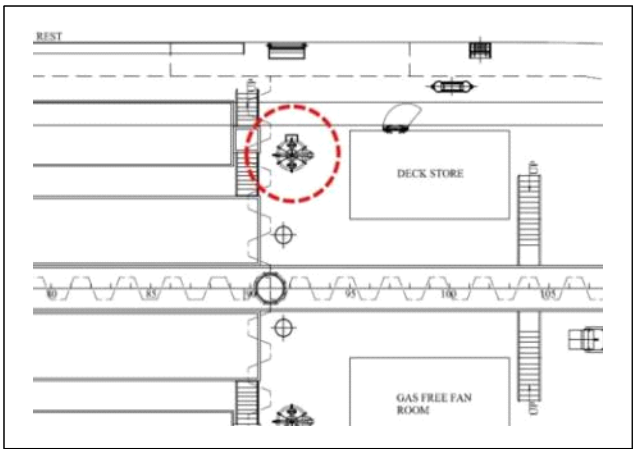
2.4.1 Superstructure of *Golden Bridge Hana* is located in the vicinity of its stern. Antenna for the radar, automatic identification system (AIS), and other navigation equipment are installed on the "Compass Deck" at the top of the superstructure. "A Nav. Bridge Deck" is right below the compass deck, and crew accommodations, called "A-Deck" are on the level below that. The "Poop Deck", on this vessel's first floor, is where offices, a cargo control room, and the mess room are located.

2.4.2 The ship has five cargo tanks, which are located behind the slop tank[2] below the poop deck on the bow. These five cargo tanks constitute nine sections, with cargo tanks Nos. 2 to 5 divided into two sides: port and starboard. The No.1 cargo oil tank has just one section.

<Figure 2> Layout of cargo tanks

2.4.3 Each cargo tank has one hatch cover on its aft part. The hatch covers are in the mode of turning the steering wheel to open and close. In case of entering to a cargo tank, this hatch cover must be opened.

2) It is a multi-purpose storage tank which can be used for retaining cargo residues and the slop generated by tank washings.



<Figure 3> Position of the hatch manhole of No. 2 COT (P)

<Figure 4> The hatch manhole and cover of No. 2 COT (P)

2.5 Crew composition & backgrounds of those involved in the accident

2.5.1 *Golden Bridge Hana* crew may accommodate up to 16 persons onboard under the ship survey certificate issued by Korean Register and a minimum of 12 persons under the safe manning certificate issued by the government of the republic of Korea.

<Table 1> Crew composition of *Golden Bridge Hana*

Dept.	Rank		No. of Crew (Nationality)	Min. No. of Manning
Deck	Officer	Master	1 (ROK)	1
		Chief Officer	1 (ROK)	1
		2nd Officer	1 (ROK)	1
		3rd Officer	2 (ROK)	1
		Apprentice Officer	1 (ROK)	-
	Rating	Bosun	1 (ROK)	3
		Able Seaman	3 (Indonesian)	
		Chief Steward	1 (ROK)	1

Dept.	Rank		No. of Crew (Nationality)	Min. No. of Manning
Engine	Engineer	Chief Engineer	1 (ROK)	1
		1st Engineer	1 (ROK)	1
		2nd Engineer	1 (ROK)	1
		3rd Engineer	1 (ROK)	-
	Rating	Oiler	1 (Indonesian)	1
		Total	16	12

2.5.2 The master of *Golden Bridge Hana* has worked as a master for 15 years, and during that time he has served aboard chemical tankers owned by Hana Marine Co., Ltd. for two years. He had been on board *Golden Bridge Hana* for about three months before the occurrence of the accident.

2.5.3 The C/O of *Golden Bridge Hana* has worked on chemical tankers for six years, and he has served as a C/O about a year. He was on board *Golden Bridge Hana* for about one month before the accident occurred.

2.5.4 The bosun of this tanker has 30 years' experience, mostly working aboard chemical tankers. He has served second time on *Golden Bridge Hana*, spending about 15 months on her.

2.5.5 The cargo surveyor has worked in this position for about 30 years.

2.6 Cargo operation procedures

2.6.1 In general, the cargo loading operations of chemical tankers like *Golden Bridge Hana*, where a variety of liquid chemicals are loaded either simultaneously or alternately, are conducted in the following order: cargo tank cleaning, cargo tank inspection, purging, loading, and cargo sampling.

2.6.2 Purging operation, the step that precedes cargo loading, is the process of lowering oxygen concentration levels inside cargo tanks by injecting nitrogen gas (N2) to prevent fire or explosions during cargo loading.

2.6.3 Cargo sampling is done to check how well the cargo tanks have been washed and how clean the tanker's cargo pipelines are by comparing cargo to be shifted from storage tanks ashore to the tanker and cargo already loaded on the vessel. Once the collected samples pass the analysis test, the loading operations begin.

2.7 Cargo sampling methods

2.7.1 The "Cargo Handling Procedures" of *Golden Bridge Hana* describes three different cargo sampling methods: (1) opened sampling entails collecting samples by opening a gauging hole or a hatch cover without controlling the gas release; (2) restricted sampling uses MMC or UTI measurement devices to collect samples through a gauging hole without allowing gas to escape; and (3) closed sampling collects samples in onboard devices such as the Level Master.

2.7.2 Opened sampling is fundamentally prohibited among the three methods described. When a shore office requests a ship to apply opened sampling, the ship's crew should inform their company of the request and follow the company's instructions.

2.8 Cargo characteristics

2.8.1 At the time of the accident, vinyl acetate monomer (VAM) was loaded in No. 2 COT (P) of *Golden Bridge Hana*. The chemical name was written as "vinyl acetate" on the material safety data sheet (MSDS).

2.8.2 VAM is a clear and colorless chemical product used as a thickening agent for low-viscosity liquids during the production of plastics or adhesives.

2.8.3 According to the classification prescribed in Article 4 of the Classification of Chemical Substances, Etc. in the "Standards for Classification and Labeling of Chemical Substances and Material Safety Data Sheet," VAM becomes hazardous after a certain amount[3] is absorbed into a human body through inhalation or oral/dermal contact. Some studies show vinyl acetate monomer has carcinogenic effects, and the chemical can cause a person to develop a respiratory stimulation (cough, pain, suffocation and symptoms with difficulty in breathing) after shot-term exposure to internal organs. VAM is also known to be hazardous to aquatic organisms because of its long-term effects.

3) ① Oral: 50 < Acute Toxicity Estimate (ATE) ≦ 50 (mg/kg, Body Weight)
② Dermal: 50 < ATE ≦ 200 (mg/kg, BW)
③ Inhalation
- Gas: 100 < ATE ≦ 500 (ppm)
- Vapor: 0.5 < ATE ≦ 2.0 (mg/L)
- Dust or Mist: 0.05 < ATE ≦ 0.5 (mg/L)

section

3 Development of Accident

3. Development of Accident

3.1 Cargo loading works

3.1.1 *Golden Bridge Hana* berthed at Mailiao Port in Taiwan to load about 3,000 tons of VAM at around 04:05 on 29 August 2019.

3.1.2 On the same day, a cargo surveyor, who came on board the vessel on behalf of the shipper, checked the cleanliness of each cargo tank between 04:30 and 06:10.

3.1.3 The purging operation was carried out from 06:35 to 12:25, during which the tanker received nitrogen gas from the shore-side terminal and lowered the oxygen concentrations inside her cargo tanks to between 7% and 8%. When the C/O measured the oxygen level inside the cargo tank, it was about 8.2%.

3.1.4 The tanker was ready for loading cargo, as an appropriate oxygen concentration was being maintained, and thus the Notice of Readiness was accepted at around 13:30.

3.1.5 The VAM started to be loaded into No. 2 COT (P) at around 15:30. By around 16:00, just 270-300 tons of VAM had been loaded, reaching about 50cm high in the cargo tank, to collect cargo samples. In the other cargo tanks, VAM was loaded to just above the bell mouth.

3.2 Cargo sampling works

3.2.1 After loading part of cargo to draw a sample from No. 2 COT (P), the cargo surveyor told the C/O, "In this terminal where the tanker berths, we have always used our own devices to collect cargo samples."

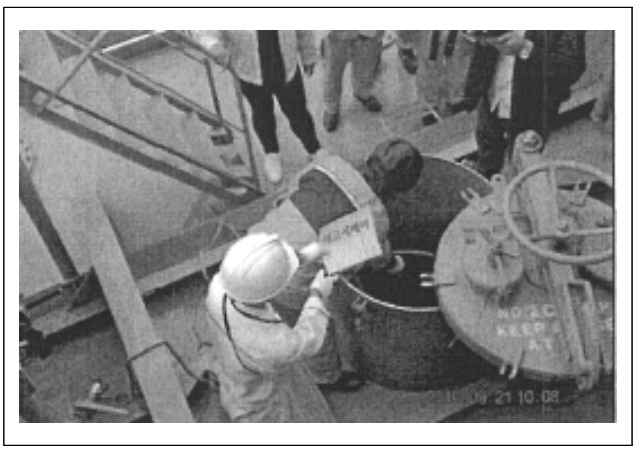
3.2.2 The surveyor added, "I am not sure whether the device on this tanker is clean. So, I will use my own sampling device[4] and collect the cargo sample through this hatch manhole cover on the deck."

3.2.3 The C/O worried that the loading operation would be delayed from a close inspection if he opposed the surveyor's request. Therefore, he decided to collect the cargo sample from No. 2 COT (P) by using the sampling device as the surveyor had requested.

3.2.4 At around 16:00, the surveyor finished collecting a cargo sample from No. 2 COT (S) by using his own sampling device with two ABs in attendance.

3.2.5 At around 16:17, the surveyor moved to No. 2 COT (P) and lowered his sampling device into the cargo tank to collect a sample. In the process, the lower part of the sampling device was damaged; its stainless steel bottom plate and a glass bottle dropped onto the bottom of the tank, and the glass bottle broke.

<Figure 5> A glass sampling bottle



<Figure 6> Reenactment of the cargo sampling by the cargo surveyor

3.2.6 On the same day, the AB, who witnessed the situation, reported to the C/O that the glass bottle had dropped onto the bottom of the tank, and then, the C/O reported the fact to the master.

4) It consists of a case for a glass bottle with its bottom diameter of approx. 12cm and a stainless steel tool connected to the case with chains.

3.2.7 The master contacted Hana Marine Co., Ltd. to report that a part of a sampling device had fallen into the cargo tank. The company then ordered him to ensure that the "cargo surveyor submitted a report about it." However, no instructions, such as the crew safety instructions, were given.

3.2.8 At around 16:30, the bosun brought a scoop net from the mess room after being informed that the sampling device had dropped into the cargo tank. While carrying it to the deck, he said to the C/O, who was writing a report in the cargo control room, "The cargo pump can be damaged when we discharge cargo at the port of discharge. I will get into the cargo tank and remove the bottle."

3.2.9 Therefore, the C/O went after the bosun, who was going out to the deck, and said, "It is dangerous. Just wait, and do not enter into the cargo tank. We need an approval from the shore-side terminal, too."

3.2.10 Later, the master came across the bosun carrying the scoop net at the entrance of the accommodation area. The master asked, "What are you going to do?" The bosun answered, "I will scoop up something." Then, the master just said "Ah, is that right?" without asking what was to be scooped.

<Figure 7> The type of the scoop net used by the bosun

<Figure 8> Cargo tank stairs

3.3 Entry into the cargo tank

3.3.1 At around 16:45, the bosun wore a chemical protection suit and a self-contained breathing apparatus (SCBA) and entered No. 2 COT (P) through the open hatch cover, without notifying his superiors.

3.3.2 At the time, the C/O was discussing with the cargo surveyor how to remove the device and the glass bottle that had fallen to the tank bottom[5].

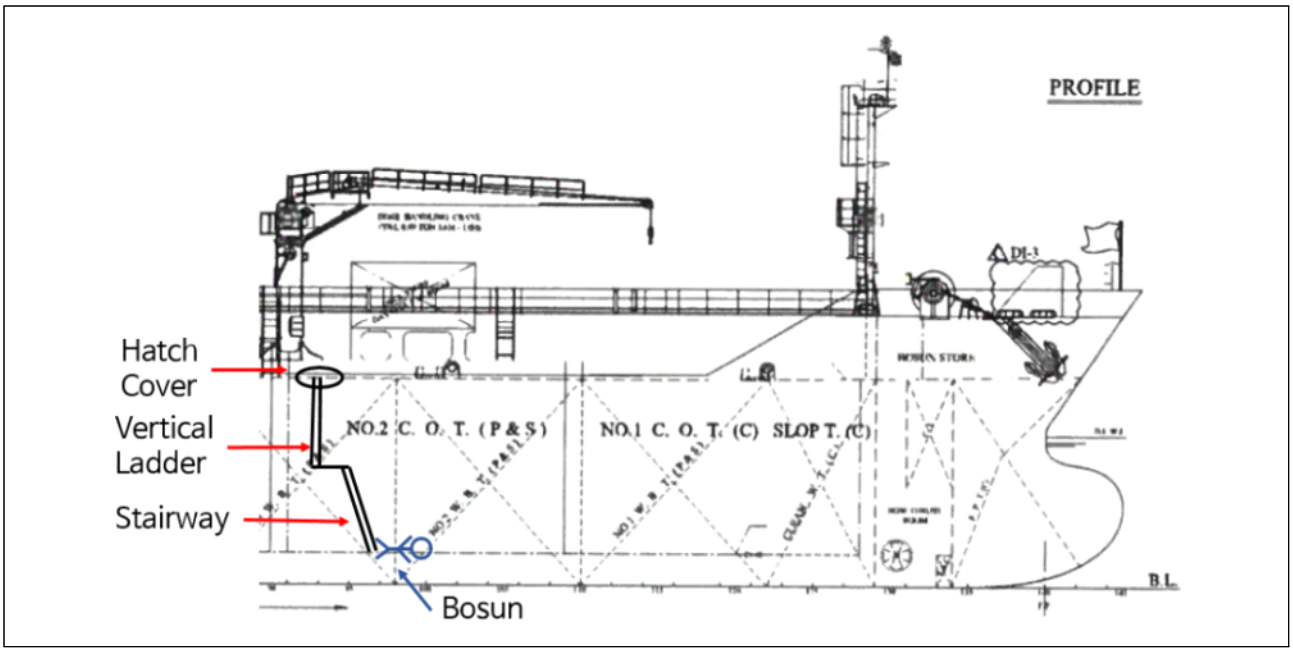
<Figure 9> The chemical protection suit worn by the bosun

<Figure 10> The SCBA worn by the bosun

3.3.3 After seeing the bosun going out to the deck with a scoop net, the master went after him. The master was on the metal passage (catwalk) of the deck when he saw the bosun enter the cargo tank. However, the master did not stop him but just watched him go down the stairs into the cargo tank.

3.3.4 At around 16:47, the master witnessed that the bosun, who was descending the stepladder after climbing down the vertical ladder, fell from the last two or three steps onto the floor of the tank that was being loaded.

5) At that time, the C/O and the cargo surveyor were discussing such issues as the need to ventilate the cargo tank and when and how to enter the cargo tank.



<Figure 11> Structures of the stairways inside the cargo tank

3.3.5 The master immediately told the crew members near him about the accident, then checked on the bosun again. He saw the bosun fall again after trying to stand up with his hands on the floor while twisting his body.

3.4 Rescue operations

3.4.1 Later, the C/O directed the 2nd officer (2/O) and the AB to wear chemical protection suits. The 2/O who had been ordered to rescue the bosun by the C/O put on the suit and entered the cargo tank.

3.4.2 The 2/O pulled the collapsed bosun up two steps of stairs from the floor. However, he felt gas leaking into the facepiece (mask) of his SCBA. Therefore, the 2/O left the bosun at the scene and rushed out from the cargo tank.

3.4.3 At around 17:00, after the 2/O had reached up to the deck, the AB, who had been standing by in a chemical protection suit, entered the cargo tank with a rope. He tied the rope around the bosun's body and pulled him out of the cargo tank with the assistance of other crew members.

3.4.4 Then, the C/O removed the bosun's facepiece, and the 2/O and the AB cut off his chemical protection suit and working uniform with scissors.

3.4.5 The master performed cardiopulmonary resuscitation (CPR) after finding that the bosun was not breathing and in cardiac arrest. The C/O asked shore personnel nearby to call an ambulance and ordered the 3/O to send an emergency signal.

3.4.6 At around 17:10, most of the crew were mustered at the scene near No. 2 COT (P). The master, the C/O, and the 3/O washed the VAM off the bosun's body while performing CPR. And, the master reported the accident to the company.

3.4.7 At around 17:20, the ambulance arrived on the scene and transported the bosun to the hospital. The bosun was declared dead by a local doctor at around 18:32 on the same day.

3.4.8 The tanker was originally scheduled to depart from the port on 30 August 2019 when her loading operations were scheduled to be completed. However, the rescue operations and accident investigation by the local police set back the departure date by six days, and the tanker finally left Mailiao Port in Taiwan on 6 September 2019.

section

4 Analysis

4. Analysis

4.1 Causes of the fall and fatality of the bosun

4.1.1 The bosun entered the cargo tank by first climbing down a vertical ladder and then down a step ladder. When he reached two or three steps from the bottom, he fell forward onto the tank floor.

4.1.2 His fall inside the cargo tank may have been due to sudden confusion or fainting after inhaling toxic gas through gaps between his face and a loosened facepiece.

4.1.3 The possibility also exists that the bosun lost his footing or slipped on the stair treads as he approached the top of the liquid cargo, which was 50cm deep in the bottom of the tank. He may have been changing his position on the step ladder as he sought to remove the bottle or some other item that had been dropped, or to spot them inside the dark cargo tank. The heavy air cylinder he was carrying would have made it hard for him to keep his balance on the ladder. In addition, the facepiece of the SCBA (Self-Contained Breathing Apparatus) restricted his visibility, and he may have lost his footing or slipped as he tried to look closely beneath him while standing on the step in the darkness.

4.1.4 Given that the bosun tried to turn his body and stand up immediately after falling down, he had not fully lost consciousness the moment he fell. A person normally falls backward when slipping, but the bosun fell forward. This fact suggests he fell after becoming confused due to gas inhalation or losing footing.

4.1.5 It has been proven that the bosun died from "shock and respiratory failure caused by gas poisoning and oxygen deficiency." The forensic chemistry analysis report released by the National Forensic Service Busan Institute of the National Scientific, Criminal and Investigation Laboratory states that the bosun seemed to have inhaled

the air outside his chemical protection suit. Also, the report quoted a statement given by a crew member that the bosun's breath smelled strongly like chemicals and that liquid came out of his mouth while he was receiving first-aid treatments on the deck.

4.1.6 These circumstances collectively suggest that the facepiece of the SCBA lost its firm seal on the bosun's face as he fell forward onto the floor, which had 50cm of VAM on it. Lethal gas and liquid VAM appear to have leaked into the facepiece, and the bosun inhaled them.

4.2 Appropriateness of the cargo sampling method

4.2.1 The company that operates *Golden Bridge Hana* prohibits the use of the opened sampling method pursuant to the Cargo Handling Procedures. Should shore personnel request samples be taken in open condition, the vessel is required to report that fact to the company first and follow the instructions given by the company.

4.2.2 The cargo surveyor, however, who had boarded *Golden Bridge Hana*, opened a hatch cover and tried to collect cargo samples directly by using his own glass bottle and stainless steel sampling device despite the Cargo Handling Procedures.

4.2.3 The C/O, who worried that the cargo surveyor might request additional surveys if his suggestion was refused, agreed to collect samples in a way the surveyor wanted. Cargo sampling was performed under the open condition.

4.2.4 Because of the sampling method suggested by the surveyor, the sampling device was partially damaged and then dropped into the cargo tank, leading to a situation where the debris had to be removed. This resulted in the accident.

4.2.5 Also, the C/O neither refused the cargo surveyor's request to use the opened sampling method nor reported it to the company under the ship's Cargo Handling Procedures. Instead, he arbitrarily decided to proceed with the sampling in open condition, which made impossible to remove the risk of an accident in advance.

4.2.6 In the statement, the C/O said he had accepted the request of the cargo surveyor as he worried the cargo surveyor would otherwise have conducted additional close-up checks on cleanliness of the cargo tank. And, if any deficiency had been found, he stated there would have been disadvantages such as a delay in loading operations.

4.2.7 In general, the C/O, who is responsible for cargo loading and discharging, is reluctant to face delays in loading for any reason. Thus, despite the Cargo Handling Procedures set by the shipping company, the C/O cannot easily refuse the informal procedures being practiced in certain ports.

4.2.8 Therefore, the current practice of cargo sampling needs to be revised in the following ways: For exceptional circumstances, the shipping company should directly consult with the shore offices and shippers, instead of depending upon the vessels to make the call. They should thoroughly investigate cargo sampling practices which have long been performed differently from the ones defined by the Cargo Handling Procedures. They should also reach a consensus on the practices through consultation, and the company should require vessels to perform cargo sampling only through the agreed procedures. However, such revisions have apparently not been made.

4.3 Implementation of the safety procedures before entering the cargo tank

4.3.1 According to the Safety Operation Instruction and the Shipboard Safety Instruction of this tanker, the crew should pay special attention to the hazards of each cargo, health risks, and oxygen-deficient atmosphere inside the tanks, checking to ensure safety with oxygen meters and gas detectors. Then, they must receive an entry permission from the person in charge (C/O) before entering the tanks.

4.3.2 As for cargo tank entry in particular, the company Safety Management System (SMS) prescribes that safety instructions, such as checking protection suits and preparing breathing apparatus and oxygen resuscitators, should be reviewed, and then, the master should give his final approval prior to entry.

4.3.3 In this particular case, such risk assessment and safety instructions before being allowed entry into the enclosed space had not been carried out. The master and the C/O simply told the bosun to not enter the cargo tank; they did not adamantly stop him from doing so.

4.3.4 As a result, the bosun entered the cargo tank without the master's authorization, and while going down the stairs, he fell into the cargo tank unexpectedly, winding up in 50cm of liquid cargo.

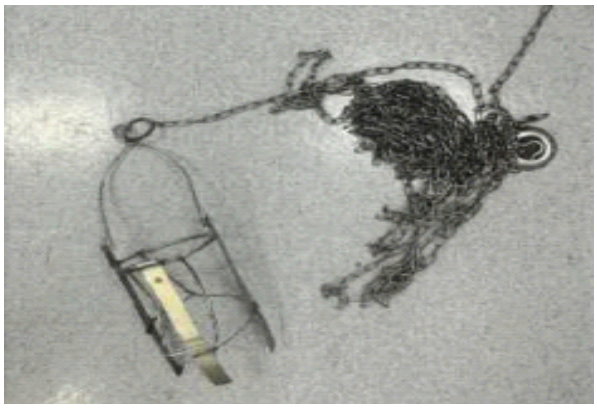
4.3.5 Both the master and the C/O are considered to have been negligent in managing operational safety as they failed to insist actively that the bosun was not to get into the cargo tank without following the proper procedures for entering an enclosed space pursuant to SMS.

4.4 Causes for damage to the sampling device

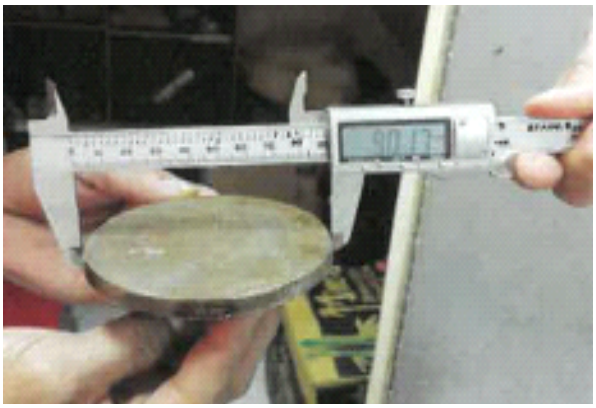
4.4.1 The cargo surveyor collected cargo samples with his own sampling device, and its bottom plate was detached from the body. The plate and the glass bottle on top of the plate both fell to the bottom of the cargo tank.

4.4.2 This sampling device consists of a stainless steel case, which can accommodate a glass bottle with a diameter of 12cm, a bottom plate, and chains connected to the plate, as described in [Figure 12]. The case and the bottom plate are made separately, and the plate is attached to the case at three points.

4.4.3 This tool lacks a sophisticated design, given its structure and the way each part is attached. Also, the bottom plate could possibly have come loose because of its own defect or a weakening of the attached points after long exposure to chemicals and etc.



<Figure 12> The sampling device



<Figure 13> The bottom plate of the sampling device

section

5 Conclusions

5. Conclusions

5.1 Failure to observe work safety procedures and a lack of safety awareness

5.1.1 This is a fatal accident onboard *Golden Bridge Hana*, where the bosun died from shock and respiratory failure caused by gas poisoning and oxygen deficiency after entering a tank containing VAM.

5.1.2 Before entering an enclosed space aboard a ship, the person responsible for carrying out the work must check to ensure its safety, conduct a risk assessment for enclosed space entry, and obtain permission from the master to enter, as prescribed in the ship's procedures. Nonetheless, such procedures were not observed in the case of *Golden Bridge Hana*.

5.1.3 The bosun arbitrarily entered the cargo tank, which is an enclosed space. And, the master and the C/O, who were fully aware that the bosun was entering the cargo tank without observing the rules, did not strongly stop him from doing so. This led to the fatal accident.

5.2 Inappropriateness of the cargo sampling method

5.2.1 The Cargo Handling Procedures of *Golden Bridge Hana* requires the use of a closed sampling method and prohibits an opened sampling method in principle.

5.2.2 However, the cargo surveyor suggested collecting samples in open condition, which is prohibited, and the C/O failed to refuse the surveyor’s suggestion and just overlooked the situation. Therefore, the cargo was sampled inappropriately.

5.2.3 Also, the bottom plate of the sampling device and the glass bottle placed inside the device fell to the bottom of the cargo tank while the surveyor was taking samples. It is presumed that those parts were dropped because the sampling device had been originally defective or the connections between the device body and its bottom plate had weakened over time after having been exposed to chemicals and etc.

section

6 Lessons learned

6. Lessons learned

6.1 Strict observance of safety rules for cargo operations

6.1.1 When entering enclosed and dangerous spaces, including cargo tanks, the crew should follow the procedures which include reviewing checklists, conducting a risk assessment, and receiving permission to enter from the master.

6.2 Strengthening supervision over the crew

6.2.1 The master and the person in charge should rigorously supervise their crew to ensure the crew members follow instructions and do not act on their own decisions.

6.3 Creation of safety culture through strict observance of work safety rules

6.3.1 Shipping companies should make proactive efforts to raise safety awareness of the ship's crew, such as compliance with safety procedures, by providing training programs periodically so that their crews are not under pressure to observe safety rules.

6.4 Appropriate cargo sampling method

6.4.1 The master and the C/O should apply a suitable method for sampling cargo as described in the vessel's procedures. Should a cargo surveyor or others make any inappropriate request for sampling cargo, the master and the C/O should report the incident to their company in advance and follow their company's instructions to ensure that cargo sampling is always properly carried out.

6.5 Strict maintenance of cargo sampling devices in good condition

6.5.1 Cargo surveyors and other relevant persons should maintain their sampling devices so that they function properly at all times.

6.5.2 In case it becomes necessary to use sampling devices owned by a cargo surveyor, not the ones maintained by a vessel, the master or the C/O should check their conditions thoroughly before using them for cargo sampling.

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