

THE SHIP

The Sapphire is a single screw oil and chemical tanker (type 2) of 9914 grt and 14002 dwt. Built at Cant. Nav. Mario Morini S.p.A. in Ancona Italy and delivered in February 1997. Length overall is 143 metres, breadth of 22.0 meters and a loaded draft of 8.4 metres.

The cargo area consists of 16 wing tanks and 8 centre tanks, plus 2 deck tanks. All tanks and cargo piping are of stainless steel construction and are serviced by hydraulically driven submersible pumps. All tanks have individual venting, and fixed tank cleaning machines that are supplemented by portable machines and hoses. Gas freeing is carried out from a central pipeline that is supplied from 2 fans in the forecabin space and flexible hoses are attached from this line to the appropriate opening on the tank.

The ship is owned and operated by Finbeta S.p.A, of Savona Italy. Since delivery she has been on the chemical parcel trade between US gulf ports and primarily Mediterranean ports and also some NW European ports.

The Isle of Man managers for the ship are:

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At the time of the incident the manning consisted of Italian Master, Chief Officer, Second Engineer and Third Engineer, plus deck and engineer cadets. The Chief Engineer, First Engineer, Electrician, Fitter and the Second Officer were Polish nationals. The Third Officer and the crew were Filipino.

SUMMARY

The Sapphire had loaded sixteen parcels of chemical products at US Gulf ports for discharge at two ports in Turkey and the bulk of the cargo was for discharge in Haifa, Israel.

The ship sailed from Amberli in Turkey on the afternoon of 23rd April 1999, bound for Haifa.

After clearing the port it was planned to clean tank no.2 centre, which had contained Linear Alkyl Benzene, and tank no.6 centre that had contained HMD (Hexamethylenediamine Solid). This was carried out by the pumpman and three crew members from 1645 until dinner at 1800 when those concerned believed the work was finished for the day.

At approx. 1950 the Chief Officer was doing his deck rounds and noticed that the tank lid for 6 centre was open. On investigation he saw the pumpman and the deck boy lying on the first platform inside the tank. The alarm was raised and the bodies recovered by officers and crew wearing breathing apparatus. Unfortunately all attempts to resuscitate the two men were unsuccessful.

1. INQUIRY AND EVIDENCE

- 1.1 The Marine Administration were advised of the accident on 26th April and a Marine Surveyor and the Registrar of Ships (who was carrying out the duties of the Mercantile Marine Superintendent) left for Haifa that evening.
- 1.2 From the 28th April until 1st May on voyages between Ashdod, Haifa and Ashdod a death inquiry was held by the Mercantile Marine Superintendent, and statements taken from all onboard. At the accident investigation carried out by the Marine Surveyor additional voluntary declarations were taken from members of the deck department.
- 1.3 Evidence was also obtained from the ship's safety management system, the official log book entries, familiarisation and training records, and cargo records.
- 1.4 A draft copy of this report was forwarded to the Company and to the Master for any comments, additions or suggested alterations. No alterations or additions were suggested. The Company had already implemented many of the recommendations well in advance of receiving the report.

2. SEQUENCE OF EVENTS

2.1 All times given are ship's time which was UTC + 3 hours.

Friday 23rd April 1999

- 2.2 The ship had arrived in Southern Europe from loading in the US Gulf area and had two discharge ports in Turkey. At Gebze the entire content of No. 6 centre tank was discharged, HMD (Hexamethylenediamine), and at Ambarli the contents of No. 2 centre, (Linear Alkyl Benzene) were discharged.
- 2.3 The next scheduled port was Haifa in Israel where the balance of the cargo was to be discharged. At Haifa and Ashdod it was planned to back load three grades of Phosphoric Acid and a parcel of Calcium Bromide.
- 2.4 The ship departed the berth at Ambarli at 1554, and commenced the sea passage at 1630.
- 2.5 As soon as the ship was clear tank cleaning commenced of 2 centre tank and 6 centre tank, two of the tanks that were to be loaded with Calcium Bromide and White Phosphoric Acid respectively. No.6 centre tank while carrying HMD had the ullage space padded with Nitrogen and while the Nitrogen was not replenished during discharge and gradually diluted, the tank still contained a Nitrogen/Air/Chemical atmosphere. A nitrogen warning placard was attached. The plan was to carry out a 45 minute sea water wash followed by a 20 minute fresh water wash and on completion of washing the tanks were to be ventilated with 2 connections to each tank. This ventilation was to be left on overnight prior to mopping and drying the next morning.



Photograph: looking aft from 6C tank lid. The tank ventilation line, supplied from a fan in the Forecastle, can be seen in the top left. Flexible trunking connected from opening (A) to the opening in the tanktop (B).

- 2.6 The instructions for washing were discussed between the Master and the Chief Officer who passed the agreed plan to the pumpman who was

supervising the operation. Washing commenced in both tanks at 1640 with the 45 minute sea water wash followed by a 20 minute fresh water wash. In 6 centre, the tank where the accident took place, the washing was by the two fixed machines and a portable machine inserted through the main tank entry hatch. The Chief Officer started the washing and after ensuring that all was running correctly went to the bridge to take his watch.



Photograph: Looking forward towards 6c tank lid. The warning notice of a Nitrogen atmosphere is attached to plastic wire on nearest tank hatch dog.

- 2.7 The pumpman, two AB's and the deck boy continued with the washing and at approx. 1800 the washing was completed, the hoses recovered from the tanks, and the hoses to the fixed machines disconnected. The pumpman advised the AB's and deck boy to go for dinner at 1800 and he would join them shortly.
- 2.8 The AB's and deck boy were in the messroom when the pumpman came for dinner at approx. 1830. He told them that the work on deck was completed and that they were no longer required on deck that day.
- 2.9 The pumpman left the messroom at approx. 1840. The Chief Officer received a call on the bridge from the pumpman at approx. 1850 to tell him the washing was completed and everything shut down. The Chief Officer asked him if the ventilation was started and the pumpman advised that "it was not on yet but he would provide it now."
- 2.10 The last person to have seen the pumpman and the deck boy was the 2nd Engineer. He was on the bridge talking to the Master and the Chief Officer before going for dinner at 1900. He saw the pumpman and the deck boy on the deck near the ladder that led from the aft end of the manifold walkway down to the main deck between No. 6 and No. 7 centre tanks.

6C tanklid
is at fore
end and
below
manifold
platform,
not visible
from
wheelhouse



Pumpman and
Deckboy last
seen from the
wheelhouse in
this area at
approx. 1900.

Photograph: View from wheelhouse

- 2.11 The Second Officer relieved the Chief Officer on the bridge at 1900 to allow him to go for dinner.
- 2.12 The Master and the Chief Officer had just finished dinner when they received a call from the Second Officer on the bridge regarding a fault on the navigation computer display and they both returned to the bridge to investigate.
- 2.13 The fault was rectified almost immediately and the Chief Officer decided that he would take the opportunity to go on his evening deck rounds.
- 2.14 The Chief Officer called into the crew recreation room looking for the pumpman and while nobody was completely sure where he was, the consensus of opinion was that he had gone out with the deck boy to finish securing on deck.
- 2.15 At around 1950 the Chief Officer was walking back from the forecastle to the manifold platform area along the central walkway when he noticed that the main tank lid to no 6 centre tank, which was just under the manifold platform and only visible from forward, was fully open. This was unusual as the lid was usually only partially raised during gas freeing to keep a pressure in the tank, and the fact that there was a nitrogen atmosphere in the tank caused him concern. He went down onto the deck and shouted into the tank.



Photograph: The view the Chief Officer would have had at the time he noticed 6C tank lid open. 6C tank lid is in the shade, underneath the manifold platform.

- 2.16 He saw the deck boy and the pumpman lying on the first platform that was approx. 4 metres inside the tank. The deck boy, who was wearing a filter mask, was lying partly on his back on the platform at the bottom of the entry ladder and slumped against the rails. The pumpman was further inside the tank and slumped over the top safety hoop on the next ladder down, with only his feet being trapped under the platform stopping him falling to the tank bottom.
- 2.17 The Chief Officer immediately came back up on the walkway and ran aft for assistance, waving his torch to attract attention on the bridge, even though it was not yet dark. Both the officer and crew television /recreation rooms are just inside the accommodation on the same level and the Chief Officer ran in shouting that the pumpman was in the tank . This was the only alarm indication. The majority of the officers and crew were in these communal rooms and quickly went to collect breathing apparatus and rescue equipment.



Photograph: View form the Cargo Control Room through to the Officer's TV room, the Crew TV room is to the left of picture. When the Chief Officer entered to raise the alarm nearly all the ships complement were in this area.

- 2.18 The Chief Officer was the first person to enter the tank, though he only had an escape set that he had collected from the manifold safety store. He tried to lift the deck boy but this was not possible though he did check for a pulse but did not feel anything. At this time the Third Engineer, who had taken a SCBA set from the CO₂ room station aft, entered the tank to assist. Unfortunately the Chief Officer's low pressure alarm went off at this moment and he had to exit the tank. The Third Engineer momentarily came out to collect a safety harness and rope to attach to the deck boy, and the Second Engineer who was equipped in a SCBA from No.2 fire station entered the tank with him.
- 2.19 It was quickly apparent that there was not the room for two people to be working together and the Second Engineer exited the tank to stand by outside. The Third Engineer attached the harness and the rope around the deck boy and he was lifted out by the crew on deck. The Engineer Cadet was stationed in a SCBA set on the ladder to guide the body up and prevent the head banging on the ladder. The Third Engineer and the Cadet then used the rope to recover the pumpman from the position over the safety hoop and then guided the body safely out of the tank.
- 2.20 The crew involved in the recovery of the bodies recall a wide span for the time taken to remove the bodies from the tank, from 5 minutes to 30 minutes, but the majority view is that it took approx. 15 to 20 minutes.

- 2.21 Both the bodies were placed on the deck just outside the tank entry hatch and two teams tried mouth to mouth resuscitation, heart massage/chest compression, and used mechanically provided oxygen for approx. forty minutes but there were no signs of life. The Master, who had come down from the bridge sometime earlier, reluctantly suggested that they cease the attempts and remove the bodies up onto the manifold platform area.
- 2.22 As soon as the severity of the accident was realised the Master and the Second Officer on the bridge tried to call for assistance from ashore. From 2015 to 2030 the Second Officer broadcast a PAN message on Channel 16 with no reply. The nearest port authority, Gelibolu in Turkey, was contacted direct on Channel 11 and medical assistance by helicopter or fast launch was requested. The Master also contacted the Owners and the agents in Istanbul by satellite phone to seek their assistance.
- 2.23 At 2130 the ship received a telex from the agent advising that helicopter and launch assistance was not available. Gelibolu traffic advised that they proceed at full speed to Gelibolu anchorage, which they were already doing, where medical assistance would be available.
- 2.24 At 2310 the ship anchored at Gelibolu and at 2350 port officials, including a doctor arrived onboard. The doctor checked the eyes of the two bodies with a small torch and declared them dead. At 0430 the bodies were taken ashore by the port authority and the pilot boarded at 0615 for the departure and transit of the Dardenelles.

ANALYSIS

The sequence of events does not give any firm reason as to why the two men entered an inerted tank, that is something that will never be known for definite. In the following analysis there are many factors that are put together to give what would appear to be a probable reason. They have come from statements given by the crew, and conversations held with the crew members during the investigation on board, from practices and procedures witnessed during the three days sailing on the ship and from the Company's Safety Management System.

The pumpman's actions

With regard to No. 6 centre there were two main jobs to undertake, tank cleaning and gas freeing to remove the nitrogen/chemical atmosphere. The first task was completed at about 1800. It appears that nothing was done about the gas freeing until the Chief Officer asked about it at 1850. The fact that the pumpman then went out, and appears to have taken the deckboy with him suggests that it was his intention at this time to rig ventilation hoses and start the process.

The very fact that the pumpman was -

- (a) working all afternoon with a tank carrying a label warning of a Nitrogen atmosphere.
- (b) in the process of rigging ventilation equipment to gas free the tank all night.
- (c) experienced with this cargo.

suggest that he must have been aware of the nature of the tank atmosphere.

For some reason, which cannot be established, the pumpman appears to have decided to enter the tank and from the position of the bodies the deckboy would seem to have followed, possibly when he saw the pumpman in trouble. The deckboy was wearing a filter mask. There are two possible explanations for this:

- (a) he had this with him as a commonly used piece of apparatus when working with odorous cargoes.
- (b) he recognised the danger inherent in the tank atmosphere and thought the mask would give him protection.

The deckboy had been onboard just over one month and given the training and familiarisation regime it is concluded that:

- (a) The pumpman went in for some inexplicable reason.
- (b) The deckboy followed in the belief that it was the cargo that caused the problem and the filter mask would protect him.

Tank Entry Procedures

Safety Management System Manual

The Company's SMS manual in **Chapter 12.8.8 Accident prevention on board ship. Entry and work permits**, refers to the use of the U.K. D.o.T. publication "**Code of Safe Working Practices for Merchant Seamen**" and that all recommendations in this publication should be adopted.

Chapter 10.3.4. of the Code states "Where the assessment shows that there is no conceivable risk to health or life and that conditions in the space will not change entry may be made without restriction. Similarly an assessment could be made that there is a risk which is then entirely eliminated with no foreseeable chance of it recurring. Entry thereafter could also be made without restriction". **There is however no conceivable situation on any oil tanker or chemical tanker in service where this would apply to a cargo tank.**

Chapter 10.4.3. of the Code states "Depletion of oxygen may occur in cargo spaces when oxygen absorbing cargoes, for example, oil cake and other vegetable and animal oil bearing products are or have been carried."

Chapter 10.4.16. of the Code states "The interaction of vegetable or animal oils or sewage with sea water may lead to the release of hydrogen sulphide which is very toxic."

Atmospheres in tanks were not always tested before entry. While the decision to test or not was made by a responsible officer the decision was on previous experience of the cargo.

With dangerous cargoes the atmosphere was always checked for gas and oxygen but for cargoes that were non hazardous, based on past experience, tanks were entered without checking if there had been ventilation.

This practice was observed at Ashdod in 7 centre tank that had just been discharged of *vegetable acid oil* and crew were in the tank mopping down in port.

Chapter 10.8.3. of the Code states "In all cases rescue and available resuscitation equipment should be positioned ready for use at the entrance to the space."

The Company's Enclosed Space Entry Permit has a check box that asks "is rescue and resuscitation equipment available for immediate use by the entrance to the space."

No rescue and resuscitation equipment was evident at any tank entrances during the time onboard when crew members were in the tanks mopping down.

The Company SMS states that "Entry permits are to be issued every time persons are requested to enter enclosed spaces where there may be a risk (high or low) for their lives".

“In any case when such information on the space to be entered is not certain, the space is to be considered as a high risk space and atmosphere test must be previously performed.”

“Preventive tests must always be made before each daily commencement of work or after any interruption or break in the work.”

Entry permit for mopping of 5C, 7C and 9C was issued with a validity date of 1200 hrs on 30/4/99. Crew members were still in these tanks at 1400 and 1700 with no new entry permit issued.

This was also observed at Ashdod in 7 centre tank that had just been discharged and crew were in the tank mopping down in port.

Tank entry permits were not always issued, this does not educate crew members in the importance of the fact that a tank should not be entered without an entry permit being issued. To sometimes issue one, and at other times not to depending on experience gives confusing signals to crew members.

Taking all these factors into account it is concluded that there was no definitive policy onboard for the testing of the atmosphere prior to tank entry. There was also no strict observance to the issue and observance of the enclosed space entry permit system. The Company has a reliance solely on the entry permit system even though in the SMS they state that “enclosed space entry permits and work permits do not make in itself safe an activity”. There is no policy or emphasis on the fact that entry into an enclosed space that is not proven gas free or life supporting should be prohibited.

Tank Cleaning Practices

The ship carried a copy of the publication “Tank Cleaning Guide” by Dr. A. Verwey. Tank cleaning decisions regarding types of washes and times for washing were generally made on past experience for that cargo and the next cargo to be carried. The majority of the cargoes were frequently carried as the ship was on regular round trips between US Gulf ports and Mediterranean/ NW Europe ports.

The plan of work decided for 6 centre tank was different from the normal washing cycle. The sea water wash was reduced from 1 hour to 45 minutes, and the fresh water wash reduced from 40 minutes to 20 minutes. This was done for two reasons, firstly from experience they believed that the tank would be sufficiently cleaned after this time. Secondly the intention was by completing the washing within the normal working day on Friday that the tank could be gas freed overnight and then mopped out on the Saturday morning. While it was a three day passage to the next port and there were no time pressures to complete the washing quickly, this would have allowed the crew time off on the Saturday and Sunday.

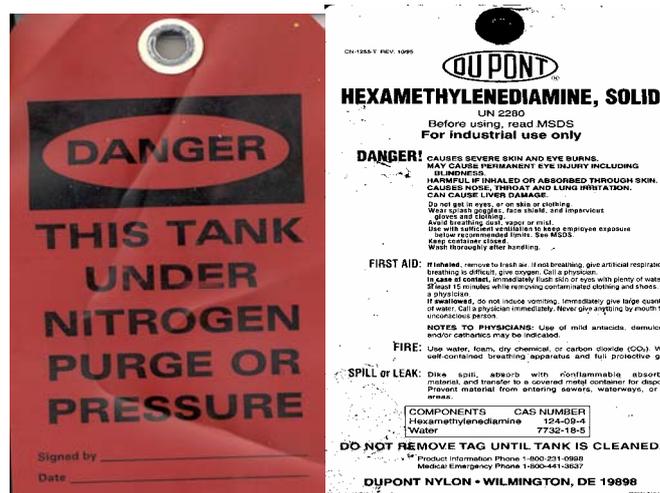
It was stated from different people on board that the pumpman was always worried that the tanks would be clean after washing even to the extent that the Chief officer had to assure him that they would still be friends even if a tank was not clean after washing.

A serious concern regarding tank cleaning practices, which is also related to tank entry procedures, is with regard to the following dangerous practice that was commented on by the Captain, Chief Officer and the Third Officer, who had previously served on the ship as pumpman.

On completion of washing often the tank lid would be opened, someone would then go down the ladder far enough to see under the deck head and onto the bulkheads with a torch to check if they were clean. This practice generally required a deep breath to be taken before entry as the atmosphere was not checked.

It is concluded that for the Master and Chief Officer to talk openly of having seen this practice, and not have taken steps to immediately stop it would appear to condone its use which is against all tank entry and safety procedures. Also it does not seem to have been an isolated case as the Third Officer had done this while onboard the ship on a previous tour when he was pumpman. The cargo at that time was also HMD.

HMD (Hexamethylenediamine) in itself is not a particularly dangerous cargo from an exposure point of view. In the US Coastguard CHRIS Code its vapour causes irritation of the eyes and respiratory tract if present in high concentrations. Due to the danger of cargo contamination if it mixes with air, HMD is loaded, carried and discharged in a nitrogen atmosphere. On loading in Houston Texas 6 centre tank was tagged by DuPont with a Chemical data tag and a notice "Danger this tank under nitrogen purge or pressure" and this tag was still on the tank when cleaning commenced. While the autopsy results are not available it is probable that a combination of the diluted nitrogen atmosphere and chemical content at the expense of life supporting O₂ levels was the cause of death of the pumpman and the deckboy.



Photograph: The two tags that were fitted onto 6C tanklid on completion of loading, and were still in place after the incident.

It will never be known why the pumpman and deckboy entered a tank that had not been checked as safe for entry but the following may go some way to trying to explain the actions they took.

- The practice mentioned of holding one's breath before quickly entering into tanks to check if they were clean.

- b) His perceived need to ensure it was properly drained to avoid wasting time on Saturday.
- c) The tanks do not have sumps around the pump well which can give rise to build up of water during washing. If this happens then a Wilden Pump needs to be lowered down one of the butterworth openings and placed in the aft end of the tank to lift the water out prior to mopping.
- d) The tank entry hatch is under the manifold walkway, this combined with the time of day and no direct light getting into the tank made inspection difficult without entry.
- e) The pumpman's anxiety regarding the cleanliness of the tanks.

Tank entry and rescue.

Those who saw the bodies in the tank prior to their recovery reported that the bodies were lying on the first platform that was approx. 3 to 4 metres down inside the tank. The pump man was inside the tank at the far end of the first platform and slumped over the top safety hoop on the next ladder down, with only his feet being trapped under the platform stopping him falling to the tank bottom.

It is concluded that the pump man entered the tank for reasons unknown and was overcome by the non life supporting atmosphere. (Nitrogen or chemical)

The deck boy, who was wearing a filter mask, was lying partly on his back on the platform at the bottom of the entry ladder and slumped against the rails.

The deck boy, on seeing the pump man in difficulties, put on a filter mask and entered the tank to assist. It is concluded that he was also quickly overcome by the non life supporting atmosphere.

It was mentioned during interviews that the deck boy was often seen to be carrying a filter mask, indeed they were kept in the same manifold storeroom as the emergency equipment, including SCBA sets.

There are certain situations, taking of samples of pungent cargo for example, where there is a need for a filter mask. However the use of filter masks was reported by the Chief Officer as being common with the Filipino crew when mopping tanks etc. when there was still an odour.

It is concluded that the ready availability of filter masks could lead crew members into a false sense of security unless their limitations are constantly stressed. There was no evidence of this during the time onboard.



Reproduction of the type of filter mask used onboard.

There is no conclusive data to indicate how long the two men were in the tank before being discovered. They were last seen on deck near the tank shortly before 1900, and were discovered by the Chief Officer at approx. 1950 therefore the time in the tank could have been between 40 minutes and just a few minutes.

The Chief Officer took the correct action when faced with the sight of two of his crew members collapsed in the tank. He returned aft and raised the alarm as quickly as possible by being aware that most of the crew were in the recreation rooms at that time of the evening.

There was no attempt made to sound the general alarm, in fact the Second Officer on watch was first aware of an incident when he sighted the crew rushing out on deck, though he had seen the Chief Officer coming quickly aft shining his torch. Everyone onboard bar two were immediately aware of the situation and responded by collecting the necessary equipment and proceeding to the tank.

It is concluded that the sounding of the general alarm would not have speeded up the response in this situation. Indeed by the time that people reported to the assembly station and were made aware of the situation then the response would have been delayed.

The entry into the tank by the officers in breathing apparatus was quickly carried out though there were some areas highlighted.

- a) While the Chief Officer was first to enter the tank the fact that he entered only wearing a 10 minute escape set was not the correct approach.

While his early exit from the tank when his low pressure alarm went off did not hinder the rescue, it could have had more serious consequences had the incident been further into the tank.

- b) The Third Engineer stated that they had great difficulty in trying to fit the safety harness onto the deck boy. The harness had buckles to adjust it tighter and these were extremely difficult to see to manipulate while wearing a breathing apparatus face mask.

The Company should investigate the supply of a model of safety harness that is easier and quicker to fit.

- c) It also became apparent that the restricted space on the walkway made it very difficult for more than one man at a time to be on the walkway while in breathing apparatus.

The SMS has an emergency drill schedule, **to be performed at least every month**. The following are the list of drills that the Company has devised:

- Fire in accommodation
- Fire in Galley
- Fire in Engine room
- Cargo fire on deck
- Fire on deck
- Break away from jetty during cargo transfer
- Abandon ship
- Man overboard
- Major flooding

The Company has operated tankers since its formation in 1969, and chemical tankers since 1979.

During the investigation the lack of a tank rescue/enclosed space rescue drill was discussed and even the basic practice of rescuing a dummy from a gas free tank, pumproom or enclosed space has never been carried out.

Paragraph 8 of the ISM Code (Emergency Preparedness) requires that a Company should establish programmes for drills and exercises to prepare for emergency actions. The practice rescue from enclosed spaces is common even on dry cargo and container ships.

It is concluded that for this programme of drills not to be included in the drill schedule of an oil and chemical tanker operator is a serious omission from the Safety Management System.

The practices and procedures in place to prevent accidents.

Safety committee meetings are conducted by the Shipboard Emergency team, though their only reporting would appear to be on the minutes of monthly emergency drill.

The Code of Safe Working practices for Merchant Seamen in Chapter 4.4.8. states that the frequency of Safety Committee Meetings should be every 4 to 6 weeks. An interval of longer than 6 weeks may suggest inertia and an ineffective safety committee.

The SMS states that in cases where the shipboard Emergency Team meets outside of Emergency Drills to deal with matters relevant to safety and pollution prevention a Minute of the meeting is to be kept.

The minutes of meetings held over the last 12 months were examined. They are produced on a standard format, though there is no indication if this is produced by the Company or the ship. The first paragraph of each Minute states " Shipboard Emergency Team will meet at least once every 3 months to deal with all matters relevant to safety and pollution prevention and decide what action may be necessary to cope with emergencies."

Date of Meeting	Content of Meeting
04/04/99	To discuss the cargo fire drill also carried out that day
10/01/99	To discuss the pollution and fire drill carried out that day. All crew members asked to work towards improving the safety standard onboard and follow safe working practices.
02/08/98	To discuss the chemical spill drill to be carried out that day. Briefing on SOPEP requirements, protective clothing, hazards of benzene and first aid required, (though this cargo not carried).
27/05/98	To discuss actions to take if excessive list during cargo operations. Drill carried out.
23/05/98	Actions to take to minimise chemical spill in case of grounding or collision. SOPEP requirements, protective clothing, first aid required for MTBE.
20/05/98 (SMC Initial Audit)	Safety meeting called by Terminal to discuss drills in event of fire from spillage.
17/05/98	Drill regarding spillage due to hull fracture. Use of permits, SOPEP checklists, sounding tanks.

16/05/98	Implementing safe practices, general problems faced on board, "All equipment onboard and paper work is being carried out as per ISM Code"
03/05/98	Discussion prior to boat drill regarding launching in rough weather, launching and recovery of rescue boat, use of SCBA

Casualty and Accident reporting.

The ship was requested to supply to the investigation records of accidents, lost time or first aid, to ship's personnel in the last 6 months. Two reports were received, one relating to this investigation, and the other one two a sprained ankle to the Second Engineer on 01/04/1998. Neither contained any immediate corrective action as required on the Company form.

It is concluded that the use of a Shipboard Emergency Team as a Safety Committee without elected members, the frequency and format of the Safety Committee Meetings are both contrary to the requirements of the Code of Safe Working Practices for Merchant Seaman, and also contravene the requirements of GC 176/83 Merchant Shipping (Masters and Seamen)(Application) Order 1983 that applies SI 1982 No.876 The Merchant Shipping (Safety Officials and Reporting of Accidents and Dangerous Occurrences) Regulations 1982.

Training and familiarisation

The Company has a familiarisation training programme for persons joining, in which paragraph 2.7 states that the Safety Officer will illustrate to the embarking person the Entry and Work Permits in use in the Safety Management System of the Company and will take care that he assists by the projection of the video "Entering into Enclosed Space". When new joiners have completed the familiarisation they then complete a Yes/No questionnaire and this is filed onboard. In the Deck Instruction Book File there were completed questionnaires for the following crew members:

Pumpman	Joined 19/11/1998
Third Officer	Joined 08/12/1998
Third Engineer	Joined 25/12/1998
Chief Officer	Joined 19/01/1999
Chief Engineer	Joined 24/01/1999

(This date is on the Chief Engineers questionnaire, though he did join the ship 24/03/99).

These were the latest questionnaires in the file, there were no questionnaires sighted for the following;

First Engineer	Joined 06/02/1999
Second Engineer	Joined 06/02/1999
AB	Joined 08/02/1999
Deck Boy	Joined 07/03/1999
Fitter	Joined 16/02/1999

It is conclude that the Company has failed to meet their statutory duties in respect to proper familiarisation training in accordance with regulations and their own procedures.

Onboard training

The ship has a safety video library on various topics and these are shown either as part of the familiarisation or as part of a rolling programme during drills. The two videos relevant to this investigation are “Entering into Enclosed Spaces” that is part of the familiarisation covered above, and “Safe Air to Breathe”. The last record of these videos being shown at a drill was on 06/12/1998. The record is signed by those who attended the drill and it is signed by the Pumpman.

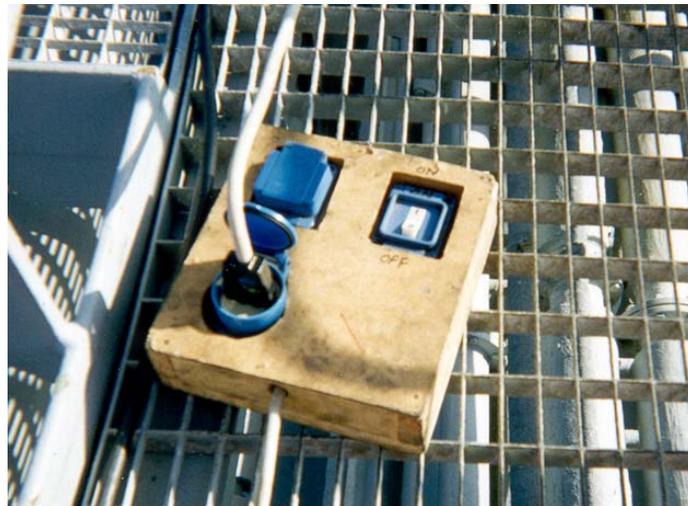
It is concluded that the Company must ensure that the onboard training and familiarisation is undertaken by all crew members and supernumeraries in line with the Safety Management System.

OTHER ISSUES AND OBSERVATIONS

The inquiry was conducted on voyages from Ashdod to Haifa and back to Ashdod. This gave the opportunity to have a full inquiry and also to observe some of the operations carried out on the ship. The following points are raised as matters of concern, though with different degrees of severity.

On the voyage from Haifa returning to Ashdod electrical cables were observed being laid out along the walkway from the accommodation to forward of the manifold platform. These cables terminated at the tank entrance to No.5 centre tank where the fitter was waiting with an electrically powered grinder. He stated that they were preparing to carry out a welding repair in the tank. The welding cable appeared to be standard electric arc welding cable and ran round the port side of the accommodation and into the Engine Room through the cross alleyway.

The electric cable for the grinder was standard 220v domestic cable used in any wandering/extension lead. None of the connections were either gas tight or water proof and were standard domestic connections with a total of three connections along the length of the walkway from the tank entrance to the port side of the accommodation. The cable then lead down to through an open porthole in an empty changing room on main deck level and was intended to be plugged into a normal two pin socket in the alleyway.



Photograph: One of the connections on the walkway above tank 7C

There was onboard proper armoured cable capable of running the full length of the ship and fitted with plug and screw in connections. The power for this was supplied from the emergency equipment store on poop deck level through a bank of screw in sockets taking their power from cabling from the engine room. This cable was permanently connected to a high pressure washing machine out on the walkway. There is no evidence that the high pressure washer is suitable for use in hazardous atmospheres or that the cable connections are suitable.

When the Master and new Chief Officer were questioned on the planned work it was stated that there was a crack approx. 6cm long situated 1.5m up from the tank bottom on the bulkhead between 5 centre and 4 centre. Even though 4 centre was full of Calcium Bromide and 5 centre was empty there was no seepage but the Charterer's requested the repair be done prior to loading 5 centre with green phosphoric acid as a precaution in case the crack opened up under movement at sea and there was cargo contamination. When the Master was asked what the Owners advice was it was clear that at that time, with all the equipment being prepared, that they had not been advised.

When challenged on using domestic electrical leads over such a large distance and with only "domestic" connections within the hazardous area the Chief Officer advised that there were no flammable vapours on board. When asked if this had been checked he said "it had not been but their experience told them that none of the present cargo was flammable." Even when challenged on the contents of the slop tanks, where one of the tied together connections was situated above, they were confident that in their experience it did not require checking.



Photograph: The standard of electrical connection above tanks 9c and slop tanks.

The Master and Chief Officer were advised that while they have the experience in the chemical trade, to make that decision on the use of this cabling and connections within the hazardous area once again gives the wrong signals to the crew onboard. Assumptions may be made that if domestic electrical wiring and connections are used on deck at this time then it will be safe in future, with possible disastrous consequences.

The Chief Engineer was in agreement that the electrical leads and connections were not best suited for this purpose and would order appropriate cables and connections for this purpose.

This repair did not appear to be a one off as it was stated that the brackets securing heating coils had required welding back on at various times, and

one assumes that the electrical equipment used this time was used in the other repairs.

On the plus side the ship did ensure that the surrounding empty tanks were washed and gas free, enclosed space entry permits and hot work permits were issued. In the end the welding was not carried out, or electric cabling used, as it was agreed that with both tanks loaded that the static head would be sufficiently balanced to avoid any flow through what was not a full crack. Full repairs would be carried out later, probably Amsterdam when the ship's superintendent was in attendance.

The Safety Management System Manual Chapter 10.2 Casualties and accidents describes the "procedure to be adopted in case of casualty and accidents which result in personnel injury or loss of lives".. It describes the information to be supplied to the DPA and the actions to be taken by the Designated Person Ashore (DPA).

Para. 10.2.(iv) states "Depending on the consequence of the accident, the Designated Person Ashore is responsible for immediately notifying the events to the Classification Societies and to the Port Authorities."

There is no mention in this Chapter of a responsibility to inform the Flag State. This is also borne out by the fact that the deaths occurred at approx. 2000 on the 23rd April, and this Administration was first advised by telephone at approx. 1000 on the 26th April.

In addition to these points it was also apparent that the Master, who had served many times on the Sapphire, had a very limited knowledge of what is required under Manx legislation, or that the Manx Shipping Notices carried on board contained advice and guidance. The GMDSS log book only contained basic entries on the daily tests. The articles had just been re-opened the previous week while the ship was in Turkey and the new Official Log Book contained no details of the present crew. The only entries on the articles were the crew who had joined the ship in Turkey, with none of the existing crew having signed on the new articles.

While the above points do not hold particularly serious consequences in the overall findings of this inquiry they do show that there was a relaxed attitude towards the understanding that a Master requires under the ISM Code and Isle of Man Regulations.

The final observation is probably the most important in trying to understand the safety culture within the Company, its importance to the Company, and the impression that this gives to their employees and outside parties.

As stated earlier the deaths occurred at approx. 2000 on the 23rd April, and this Administration was first advised by telephone at approx. 1000 on the 26th April. A fax received in this office at 1300 from the DPA stated that the ship was arriving in Haifa that day, remaining in Israel until the 30th April. It was decided that the Mercantile Marine Superintendent and a Marine Surveyor were to travel immediately to conduct the death inquiry and a casualty investigation, and they flew out that evening. The Company was advised of this and assurances given that while the DPA was busy in the office and could not attend, the Master had been advised to give every assistance, which he duly did.

The Mercantile Marine Superintendent and Marine Surveyor conducted the appropriate inquiries from boarding at 0900 on 28th April until the morning of 1st May. Neither before or during this period was there a representative from the Company onboard, the staff on the ship believed that a Company Superintendent would visit the ship in Amsterdam. The Company DPA arrived onboard on the morning of the 1st May, and discussions were held with the DPA and Master that evening. The Mercantile Marine Superintendent and Marine Surveyor left the ship on the morning of 2nd May.

It was stated by the Company that in all their years of trading this was the first fatality that that they suffered. It is hard to reconcile this with the lack of urgency and importance that the Company appeared to place on this tragic loss of life by only attending the ship five days after it was first accessible, and on the day it was finishing its coastal passage.

When a Company wants to implement change, be it minor or major, for the changes to have affect then they must be implemented from above. The International Safety Management Code is the classic case where if the management of a Company are not seen to be committed to its purpose and promote this message throughout the Company, then it will not be adopted by those who the Code is designed to help and protect. It is difficult to see how this action by the Company can give confidence to its employees that they are committed to safety, and the implementation of the ISM Code.

CONCLUSIONS

On the basis of the sequence of events and the analysis within this report the following conclusions are reached:

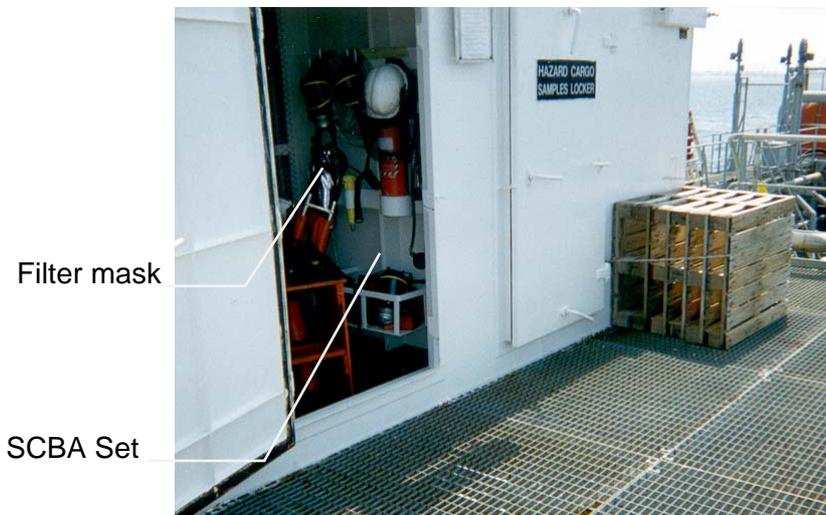
The tank contained a non life supporting atmosphere, almost certainly composed mainly of nitrogen and chemical vapours.

The pump man and deck boy were engaged in rigging ventilation to gas free the tank.

During this operation the pumpman entered the tank for reasons unknown and was overcome by the non life supporting atmosphere.

The deck boy, on seeing the pump man in difficulties, put on a filter mask and entered the tank to assist. He was also quickly overcome by the non life supporting atmosphere.

The ready availability of filter masks and the common practice of using filter masks without firm guidance and training in their limitations led crew members into a false sense of security and contributes to this accident.



Photograph: Manifold platform store room. Note SCBA and filter masks stowed in close proximity

The Company failed to provide proper familiarisation training to the deckboy as required by Isle of Man regulations and Company procedures.

Atmospheres in tanks were not always tested before entry. While the decision to test or not was made by a responsible officer the decision was on previous experience of the cargo. This practice is unacceptable.

Tank entry permits were not always issued. Again this practice is unacceptable.

On completion of washing often the tank lid would be opened, someone would then go down the ladder far enough to see under the deck head and onto the bulkheads with a torch to check if they were clean. This practice generally required a deep breath to be taken before entry as the atmosphere was not checked. For the Master, Chief Officer and Third Officer to talk openly of having seen this practice, and not have taken steps to immediately stop it is contrary to all advice, training and procedures.

The Company was wrong on their priorities regarding this tragic loss of life by only attending the ship five days after it was first accessible, and on the day it was finishing its coastal passage. This is not an effective implementation of the ISM Code.

It is concluded that the lack of a tank rescue/enclosed space rescue drill schedule on an oil and chemical tanker is a serious omission from the Safety Management System.

The Safety Committee system used onboard was ineffective.

There was no definitive policy onboard for the testing of the atmosphere prior to tank entry. There was also no strict observance to the issue and observance of the enclosed space entry permit system. The Company has a reliance solely on the entry permit system with no emphasis on the fact that entry into an enclosed space that is not proven gas free should be prohibited.

No rescue and resuscitation equipment was evident at any tank entrances during the time onboard when crew members were in the tanks mopping down which is contrary to the Company's enclosed space entry permits, and safe working practices.

The sounding of the general alarm would not have speeded up the response in this situation. Indeed by the time that people reported to the assembly station and were made aware of the situation then the response would have been delayed.

To enter into the cargo tank with an escape set could have had more serious consequences and entry should not be attempted until the correct rescue equipment is available.

The use of domestic cabling and connections within the hazardous area is unacceptable and an extremely dangerous practice that must be stopped.

RECOMMENDATIONS

Every time there is a fatal accident involving entry into an enclosed space and personnel being overcome in a non life supporting atmosphere the question is

asked as to “how does this keep happening?”. Unfortunately it does keep happening and countless enquiries and recommendations from investigations seem unable to provide a definitive method to prevent them occurring. Even before the introduction of the ISM Code, with Company’s requirements for operating procedures, Companies have used tank and enclosed space entry procedures, yet these have been undermined in a split second of reckless human behaviour. Training and familiarisation requirements to meet the needs of the ISM Code and STCW95 should ensure that all crew members are aware of the dangers in entering a space without first checking the atmosphere. Unfortunately it would appear that education is still needed to get the message through.

The following recommendations are applicable to the Company who should:

1. Ensure tank atmospheres are always tested prior to entry.
2. Ensure entry permit system is rigidly enforced.
3. Ensure dangerous practices are immediately stopped.
4. Make failure to follow 1,2 or 3 a serious disciplinary offence and rigorously enforce this.
5. Ensure that tank rescue drills are included in the drill programme and practised regularly.
6. Review crew familiarisation procedures to avoid the possibility of crew members being omitted.
7. Continually remind and educate the crew on tank entry procedures and permits to work by all means at their disposal to ensure that entry into an enclosed space, no matter how brief, must never be undertaken without proper tank entry procedures being in place. The Company should assign a priority to this that is at least as high as its Drugs and Alcohol policy.
8. Severely restrict the use of respiratory masks onboard, keeping their use entirely under the control of a responsible officer who is fully aware of their limitations and dangers.

The Marine Administration should:

1. Carry out additional SMC audits on Isle of Man flag ships operated by the Company to ensure effective implementation of the recommendations.
2. Carry out an additional DOC audit on the Company to ensure the effective operation of the Safety Management System and the implementation of the recommendations.