



SAFETY INVESTIGATION REPORT

201911/010

REPORT NO.: 20/2020

November 2020

MV *FILIA T* **Fire in container** **in position 12° 39' N 109° 44' E,** **11 November 2019**

SUMMARY

On 11 November 2019, *Filia T* was *en route* to Singapore. At around 0900, the bridge received a call from the chief officer, reporting that smoke was emanating from a container on deck.

The master was immediately notified and emergency procedures for fire on board were initiated. The chief officer reported that the container from which smoke was emanating did not contain any dangerous goods. After contacting the charterer, the master verified that the commodity inside the

container was bags of cinnamon leaves.

The safety investigation could not positively determine the cause of the fire, however, it was suspected that sufficient heat could have been generated either by friction or self-heating of the cargo.

The MSIU has issued one recommendation to the flag State Administration, aimed to raise international awareness and propose possible amendments to the IMDG Code.



FACTUAL INFORMATION

The vessel

Filia T (Figure 1) was a container ship of 19,035 gt, 1,800 TEU, owned by Filia T Shipping Limited and operated by Virono Shipping S.A., Greece. The vessel was built by Jiangsu New Yangzi Shipbuilding Co. Ltd., China, in 2019 and was classed with Lloyds Register (LR). The vessel had a length overall of 172.00 m and a moulded breadth of 28.40 m. The vessel's summer draft was 9.50 m, corresponding to a summer deadweight of 23,421 metric tonnes. At the time of the occurrence, the vessel was drawing a maximum draft of 7.70 m.

Propulsive power was provided by an HHM-WinGD 6RT-flex58T-E marine, two-stroke diesel engine, which produced 11,150 kW at 99 rpm. This drove a single, fixed-pitch propeller, enabling the vessel to reach a service speed of 19 knots.

Crew

Filia T's Minimum Safe Manning Certificate required a crew of 14. At the time of the occurrence, there were 20 crew members on board, with the Master being a Croatian national and the rest of the crew from Philippines.

The master had spent 15 years at sea, 11.5 of which were served in the rank of a master. He had obtained his Certificate of Competency 12 years prior to the occurrence and had been sailing with Virono Shipping S.A. for five and a half years in this rank. He joined *Filia T* in Osaka, Japan, on 16 May 2019.

The chief officer joined *Filia T* on 27 October 2019, from Singapore. He had spent 15 years at sea, of which three and a half years were in the rank of a chief officer. He had obtained his Certificate of Competency four years prior to occurrence. The chief officer kept a watch at sea but not in port.

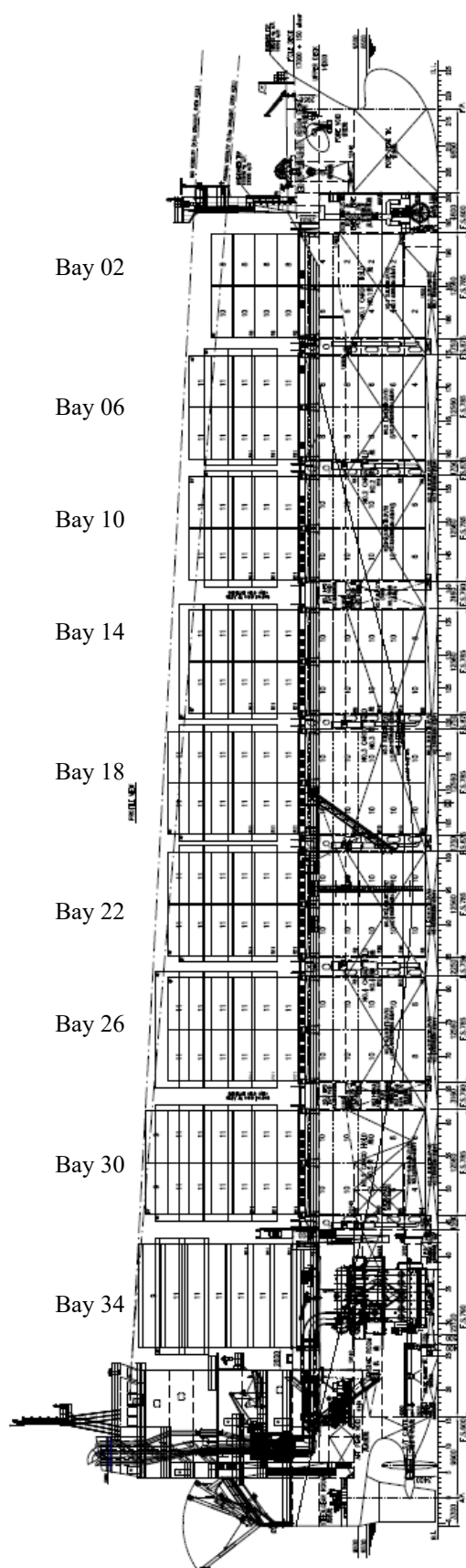


Figure 1: General Arrangement plan of *Filia T*, indicating the vessel's bays

The bosun joined *Filia T* on 19 February 2019 at Jingjiang, China. He had one year of experience as a bosun with the Company. The bosun did not have any watchkeeping duties.

Environment

At the time of the occurrence, the weather was clear with a visibility of 10 nautical miles (nm). The wind was from South-southwest, with a speed of 20 knots. Swell of about 1.5 m high was coming from a Southerly direction. The air and sea temperatures were 27 °C and 26 °C, respectively.

Earlier during the day, between 0200 LT and 0400 LT, Easterly near-gale winds were recorded in the deck logbook.

Narrative¹

On the morning of 11 November 2019, *Filia T* was about 20 nm off the coast of Vietnam, on a Southerly course from the port of Hai Phong, Vietnam, towards Singapore. At 0800, the bosun was on deck retightening the deck container lashings, starting from the forward-most bay 02.

At around 0900, as soon as the bosun reached bay 22, he noticed smell of burning material and observed smoke billowing from one container stowed in that bay (Figure 2). He immediately alerted the chief officer about the smoke which was coming from the container door's rubber seals (top and bottom), who in turn alerted the bridge.

The bosun immediately started preparing the fire hoses for boundary cooling. At 0906, after the fire pump was started, boundary cooling was commenced with one fire hose from forward and another from aft. Several minutes later, the smoke was reported to have been billowing with the same intensity.

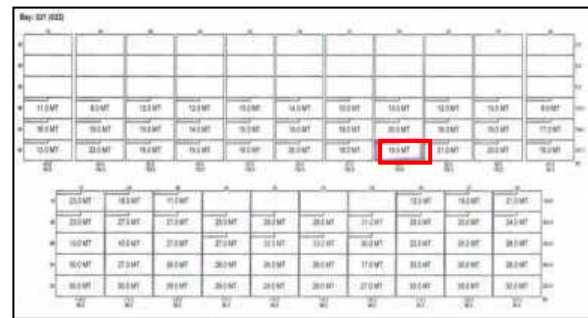


Figure 2: Stowage plan for bay 22, indicating the position of the container which was emitting smoke

By 0925, as the chief officer confirmed that the container was not listed as dangerous goods, the master resorted to contact the container charterers. The charterers reverted, stating that the commodity of the container was cinnamon leaves in bags. The chief officer then cross-checked this cargo with the IMDG Code²; however, neither cinnamon nor cinnamon leaves were listed in this Code.

At 1026, the first temperature readings were taken at the door area, which gave the following temperatures: top 30 °C, middle 31 °C and bottom 41 °C. Despite the consistent boundary cooling carried out by the crew, by 1206, the smoke intensity was reported to have increased.

Two hours later, the temperature at the bottom of the door had reached 84 °C. At this time, the master instructed the crew to pierce a hole in the upper part of the container door and to flood the container with water, using the water mist lance (Figure 3).

Once this was done, the crew observed water running out of the container together with carbonized parts of the cargo. Burnt/charred pieces of cinnamon leaves were reportedly observed flowing out from the bottom of this container. A few minutes later, the chief officer reported that the temperature of the container was dropping.

¹ Unless otherwise stated, all times in this safety investigation report are local times (UTC + 7).

² International Maritime Dangerous Goods Code (as amended).



Figure 3: Water mist lance inserted in container and secured with rope

As a precaution, the container was flooded with a continuous flow of water until 0755 of the next day. During this time, the container was also kept under continuous supervision. Temperature readings were taken again at 0830, which gave the following readings: top 27 °C, middle 27 °C and bottom 28 °C.

On 13 November 2019, the container was unloaded at Singapore (Figure 4).



Figure 4: The fire-stricken container being discharged in Singapore

Inspection of the container after the fire

After being unloaded at Singapore, the container was made available for inspection to surveyors representing the Company and the container charterers, later that same evening. The intact bolt, which was locking the door, was broken with the consent of the charterers. It was reported that as soon as the

right side of the door was opened, a very strong/pungent smell of burnt cinnamon leaves was noticed (Figure 5).



Figure 5: Right rear door open, showing burnt bags

Several bags on the bottom stow, located near the rear doorway, were noted to be missing. Additionally, a hole (approximately 200 mm in diameter) was observed on the bottom wooden floorboard. The location of this hole was above the first bottom cross-member, located approximately 500 mm length-wise into the container from the rear end (Figure 6).



Figure 6: Hole located on the container's bottom

Reportedly, it appeared that most of the bags stowed in way of the rear door were affected by the fire. It was also reported that some of the bags from the other adjacent row, further

into the stow, may have been affected by the fire. It was estimated that 32 bags of cinnamon leaves were affected by the fire and another 16 bags were affected by the water used for fire-fighting purposes. From the surveyors' observation, it was deduced that the total consignment had been affected because of the smoke, fire and/or water.

The report compiled by the Company concluded that it was likely that the fire within the container had started due to heat generated from rubbing/friction of the dried cinnamon leaves.

Information received from the container charterers suggested that the fire was caused by the nature of the cargo, *i.e.* dry, crisp and/or brittle cinnamon leaves in polypropylene bags. It was also suggested that since the bags were stowed from panel-to-panel, thus exposing them to the effects of the weather, spontaneous combustion of the cinnamon leaves may have occurred.

Figure 7 gives an indication of how the cinnamon leaves in bags were packed and stowed inside the container.



Figure 7: Indication of how the cinnamon leaves in bags were stowed inside the container

The container

The container was loaded on board *Filia T* in Hai Phong, Vietnam, on 07 November 2019, in position Bay 22 Row 03 Tier 82 (220382). Its final port of unloading, as listed in the container's bill of lading, was Nhava Sheva, India. This container was meant to be unloaded at Singapore from *Filia T*, and then transhipped via another vessel to its final destination.

The container used was a 40-foot-high cube³ container, packed with 479 polypropylene bags of cinnamon leaves that occupied 60 m³ of space, with a gross weight of 14,417.90 kg.

No material safety data sheet was issued with this cargo.

Transport information for cinnamon

The safety investigation attempted to contact the charterer of the container, to inquire the packaging and stowage procedures adopted by them, for the transport of dry cinnamon leaves. The safety investigation also attempted to contact the shipper of the cargo to seek information on the cargo hazards, and the methods used for processing the cargo, prior to transportation.

As no such information was made available by either of these parties, the safety investigation referred to the transport information of cinnamon, as publically provided by the Transport Information Service from the German Insurance Association (GDV e.V.). While noting that this transport information specifically addressed cinnamon bark⁴, it was the only document found by the safety investigation which related to the transport of any part of the cinnamon tree.

³ Internal dimensions: 12,032 mm * 2,350 mm * 2,700 mm, having a capacity of 76.3 m³.

⁴ Only the internal bark is used to produce the spice.

The transport information gave a background on the product which included its description, the quality and duration of storage, its intended use, and the most common countries of origin. It was noted that cinnamon contains cinnamaldehyde, which gives cinnamon its flavour that makes it hot and pungent, and that cinnamon bark generally has an oil content of between 1.0 – 3.5 % of essential oils, in particular cinnamaldehyde.

When it came to the transportation of cinnamon in containers, the transport information indicated that the most suitable containers were those with passive ventilation, subject to compliance with lower limits for water content of goods, packaging and container flooring. Since closed standard containers cannot be ventilated sufficiently, the information stated that it would result in elevated relative levels of humidity.

The transport information listed several risk factors relating to the transport of cinnamon. Temperature was a risk factor. At temperatures higher than 20°C - 35°C, there is a risk that the essential oils would be lost and, in the presence of high levels of humidity/moisture, styrene⁵ may be formed. The favourable transport temperature was said to be in the range of 15 °C to 19 °C. Transport in containers placed on the uppermost tier on deck, must be avoided as the container would be strongly heated by the intense tropical sun.

Another risk factor considered by the transport information, was that of self-heating. It warned that an elevated moisture content combined with excessive high temperatures may create a risk of self-heating.

Comparison of cinnamon bark with cinnamon leaf

Like cinnamon bark, cinnamon leaf is also used in cooking. The leaf is used for flavouring dishes and is used in a dry state. Essential oils, having medicinal and therapeutic effects, can be extracted from both, the bark and the leaf. Literature indicated that the essential oils extracted from the leaf also contain cinnamaldehyde (around 2%), albeit in a lesser quantity than that from the bark (around 75%). The major constituent of the leaf oil is eugenol (around 70%), which is present in a comparatively lesser quantity in the bark oil (around 2%). Both, eugenol and cinnamaldehyde are combustible⁶.

Transport information for cloves

As eugenol is also the major constituent of clove oil (89%), the safety investigation also referred to the transport information of cloves contained in the Transport Information Service, mentioned earlier. It was noted that this document included guidance similar to the guidance for cinnamon. It recommended that ventilated containers were to be used, subject to compliance with lower limits for water contents of goods, packaging and flooring.

Here, too, temperature was considered as a risk factor, and it was recommended that the containers should not be stowed on the uppermost tier on deck. The favourable transport temperature was said to be in the range of 5 °C and 25 °C and that above 25 °C, essential oils may be lost and there could be a risk of self-heating. Furthermore, if the moisture content is elevated, the risk of self-heating would increase.

⁵ Styrene is primarily a synthetic chemical. It is also known as cinnamene or styrene monomer.

⁶ Eugenol has a flash point of 103 °C, while cinnamaldehyde has a flash point of 71 °C.

Styrene in cinnamon leaves

Research has shown that styrene is present in all parts of the cinnamon tree. Mature cinnamon leaves were found to have a higher concentration of styrene than young leaves and withered leaves, and even the cinnamon internal bark. However, after drying in an oven at 60 °C, for 48 hours, the styrene concentration in the mature leaves was observed to have decreased.

In the case of *Filia T*, the process followed for drying the cinnamon leaves was not made available to the safety investigation.

ANALYSIS

Aim

The purpose of a marine safety investigation is to determine the circumstances and safety factors of the accident as a basis for making recommendations, and to prevent further marine casualties or incidents from occurring in the future.

Probable cause of the fire

Four elements are required to start a fire – a sufficient supply of oxygen, a combustible material, sufficient heat to raise the temperature of the combustible material to its ignition temperature, and a subsequent exothermic chain reaction within the material.

Although closed, a dry cargo container is not gas-tight; therefore, air would have been able to enter the container, albeit not sufficient for the required ventilation, but enough to start and sustain a fire, as the dynamics of the events have shown.

The bags of dry cinnamon leaves, including the chemical constituents of the leaves, formed the combustible material and also provided for the subsequent exothermic chain reaction.

Heat was probably provided by either friction or self-heating of the cargo. As the condition of the cargo was not made available to the safety investigation, spontaneous combustion of the cargo, due to its inherent properties, was not excluded as another probable cause of the fire.

Probable source of heat – Friction

It was reported that the fire within the container had probably started due to the heat generated from rubbing/friction of the reportedly dry, crisp and/or brittle cinnamon leaves.

Furthermore, the vessel had experienced winds of Beaufort force seven, between 0200 and 0400 on 11 November 2019, which subsided into force five winds. The rough weather encountered may have caused the leaves as well as some bags to rub against one another during the passage, thereby generating heat.

Other probable source of heat – Self-heating

In the case of *Filia T*, the cargo of cinnamon leaves in bags was transported in a standard container. This suggested that an adequate level of ventilation was not present. Adequate ventilation was required so that the relative humidity in the container could be kept as low as possible. The vessel was transiting through a tropical area with the air temperature reaching 27°C on the day of occurrence. It is highly likely that the high temperature, coupled with the direct sunlight heating the deck, increased the temperature within the closed, steel, standard-type container.

Furthermore, as mentioned earlier in this safety investigation report, the bags were stowed from panel-to-panel. Therefore, it was hypothesized that the high temperature coupled with high relative humidity further

led to self-heating of the cargo, probably followed by self-combustion.

Chemical constituents of the cargo

As mentioned earlier in this safety investigation report, cinnamon leaves contain eugenol and cinnamaldehyde, both of which are combustible. The generation of heat in the bags of cinnamon leaves, either by friction or by self-heating, was most probably sufficient to result in the combustion of these chemicals.

As the process for drying the cinnamon leaves was not known to the safety investigation, it was not excluded that a considerable concentration of styrene could have still been present in the cargo. Styrene is a flammable substance, having a flashpoint of 31 °C and 34.4°C (closed cup method) and is classified under Class 3⁷ dangerous goods. The safety investigation concluded that it was highly likely that this temperature was reached inside the container in question.

Fire-fighting activities

A fire is a hazardous situation to have on board any vessel and fires in containers present significant challenges. This has been highlighted by several other accident investigation bodies in their safety investigations into container fires. These fires are normally detected by smoke, not temperature, which requires the watchful eyes of the crew to be observed while on deck.

The crew members were able to identify and analyse the situation on time. They had responded to the situation effectively, significantly limiting the damages and their own exposure to the hazard.

Preparation for boundary cooling with fire hoses was immediately started by the crew members, as soon as the smoke was detected

and reported. The boundary cooling of the container, from both forward and aft, was commenced shortly after the fire pump was started.

Since the container was not declared as a dangerous goods cargo, the charterer had to be contacted to obtain information on the container's commodity. Once known, the crew monitored the container's temperature until the master deemed it necessary to take additional fire fighting measures and flood the container with water. The container had other containers adjacent to it and above it. These were also not declared as dangerous goods. However, heat from the container on fire, could have easily conducted to these containers and thus cause the fire to spread.

CONCLUSIONS

1. Although the immediate cause of the fire was not positively established, the safety investigation hypothesized that sufficient heat could have been generated either by friction or self-heating of the cargo, leading to its combustion.
2. The chemical constituents of the cargo were combustible.
3. As the process of drying of the cargo was not made available, the safety investigation did not exclude the possibility that an adequate concentration of styrene was available to start a fire at a lower temperature.
4. Guidelines for the transport of cinnamon leaves were not available, due to which the hazards of the cargo and the necessary precautions to be taken were not known.
5. The container which caught fire was stowed on the vessel's hatch cover, while the vessel was passing through a tropical area, where the temperatures and humidity levels were high.

⁷ Dangerous Goods – Flammable Liquids.

6. As the container used was a standard-type container, due to which adequate ventilation was not available, it is highly likely that the relative humidity and temperature within the container rose during the voyage, subsequently increasing the risk of self-heating of the cargo.
7. The fire fighting carried out by the crew members was timely and effective to keep the fire under control.

SAFETY ACTIONS TAKEN DURING THE COURSE OF THE SAFETY INVESTIGATION⁸

Following this occurrence, the Company had carried out the following safety actions:

- Crew members were instructed to carry out frequent checks on containers which include temperature control. Any unjustifiable increase in temperature is to be reported to the Master and the Company.
- A safety alert was circulated to all interested parties to draw attention to this accident and to the flammable characteristics of cinnamon and the proper handling and stowage of similar types of cargo.

RECOMMENDATIONS

The flag State Administration is recommended to:

20/2020_R1 review the findings of this safety investigation report with the aim of submitting a paper to the relevant IMO Sub-Committee for consideration to classify this cargo either as a Class 4.1 or Class 4.2 of the IMDG Code.

⁸ Safety actions and recommendations shall not create a presumption of blame and / or liability.

SHIP PARTICULARS

Vessel Name:	<i>Filia T</i>
Flag:	Malta
Classification Society:	Lloyds Register
IMO Number:	9817901
Type:	Container vessel
Registered Owner:	Filia T Shipping Limited
Managers:	Virono Shipping S.A.
Construction:	Steel
Length Overall:	172.00m
Registered Length:	164.76m
Gross Tonnage:	19,035
Minimum Safe Manning:	14
Authorised Cargo:	Containers

VOYAGE PARTICULARS

Port of Departure:	Hai Phong, Vietnam
Port of Arrival:	Singapore
Type of Voyage:	International Voyage
Cargo Information:	11,367 mt of containers
Manning:	20

MARINE OCCURRENCE INFORMATION

Date and Time:	11 th November 2019 at 0900 (LT)
Classification of Occurrence:	Less Serious Marine Casualty
Location of Occurrence:	12° 39' N 109° 44' E
Place on Board	Main deck
Injuries / Fatalities:	None reported
Damage / Environmental Impact:	Cargo damage
Ship Operation:	In passage
Voyage Segment:	Transit
External & Internal Environment:	Weather was clear and visibility was good. A fresh breeze was blowing from a South Southeasterly direction. Air and sea temperatures were recorded at 27 °C and 26 °C respectively.
Persons on board:	20