REPUBLIC OF TURKEY
MINISTRY OF TRANSPORT, MARITIME AFFAIRS AND COMMUNICATIONS
Accident Investigation Board

Marine Accident Investigation Report on the Investigation of The Capsizing of Dry Cargo Vessel EROL ŞENKAYA

Off Zakynthos Island / Greece
19th May 2012

Report No: 4/2012

CONTENTS

LIST OF PICTURES PAGE

ABBREVIATIONS AND DEFINITIONS

Center of Gravity	: Center of vertical forces composing the weight of vessel. (Shown by G)
Demurrage	: In case the vessel exceeds the predetermined loading and unloading time, payment made to owner / operator of the vessel by the charterer for extra time spent by the vessel.
Metacenter	: Point at which the force line passing from the geometric center (B') of the new underwater structure formed by the heeling of the vessel intersects the vessel's central line. (Metacenter point shown by M)
G.O.C.	: General Operator Certificate
IMEAK	: İstanbul and Marmara, Aegean, Mediterranean and Black Sea Regions
IMSBC Code	: (International Maritime Solid Bulk Cargoes Code) effective from 01 January 2011, application code directed to the transport of solid bulk loads in international maritime transportation
Metacenter Height	: Distance between the center of gravity and metacenter of the vessel (expressed as GM)
MT	: (Metric Ton) unit of weight corresponding to 1000 kg
P & I	: (Protection & Indemnity) Protection and indemnity insurance
Center of Buoyancy	: Center of vertical forces which float the vessel. Also geometric center of the underwater structure of the vessel. (Shown by B)

SYNOPSIS

Picture 1: Location of the Accident

All times are local time of the region (GMT+3)

M/V EROL ŞENKAYA dropped anchor off Zakynthos Island / Greece at 13 May 2012, 23:00 hours to load 2600 tons of olive cake to be transported to the port of Dikili/İzmir and after berthing at the port, started loading on 14th May 2012, noon hours.

The loader informed the master on 18 May 2012 at 18:00 hours that there was left very little cargo at the warehouse and the completion of remaining cargo might take 3-4 days. The last part of cargo was loaded at 23:00 hours and the loading was completed. Meanwhile, the vessel had loaded 2200 metric tons. A short time after the required port formalities were completed, the vessel left the port at 23:45 to go to the port of discharge, Dikili.

While the vessel was underway at a distance of 8 nautical miles from Zakynthos Island and about 1-1,5 hours after unberthing from the loading port, the vessel started heeling suddenly and quickly towards port side as a result of shifting of the cargo in the hold. The vessel listed totally to its port side in a time shorter than thirty seconds and completely capsized within one or two minutes.

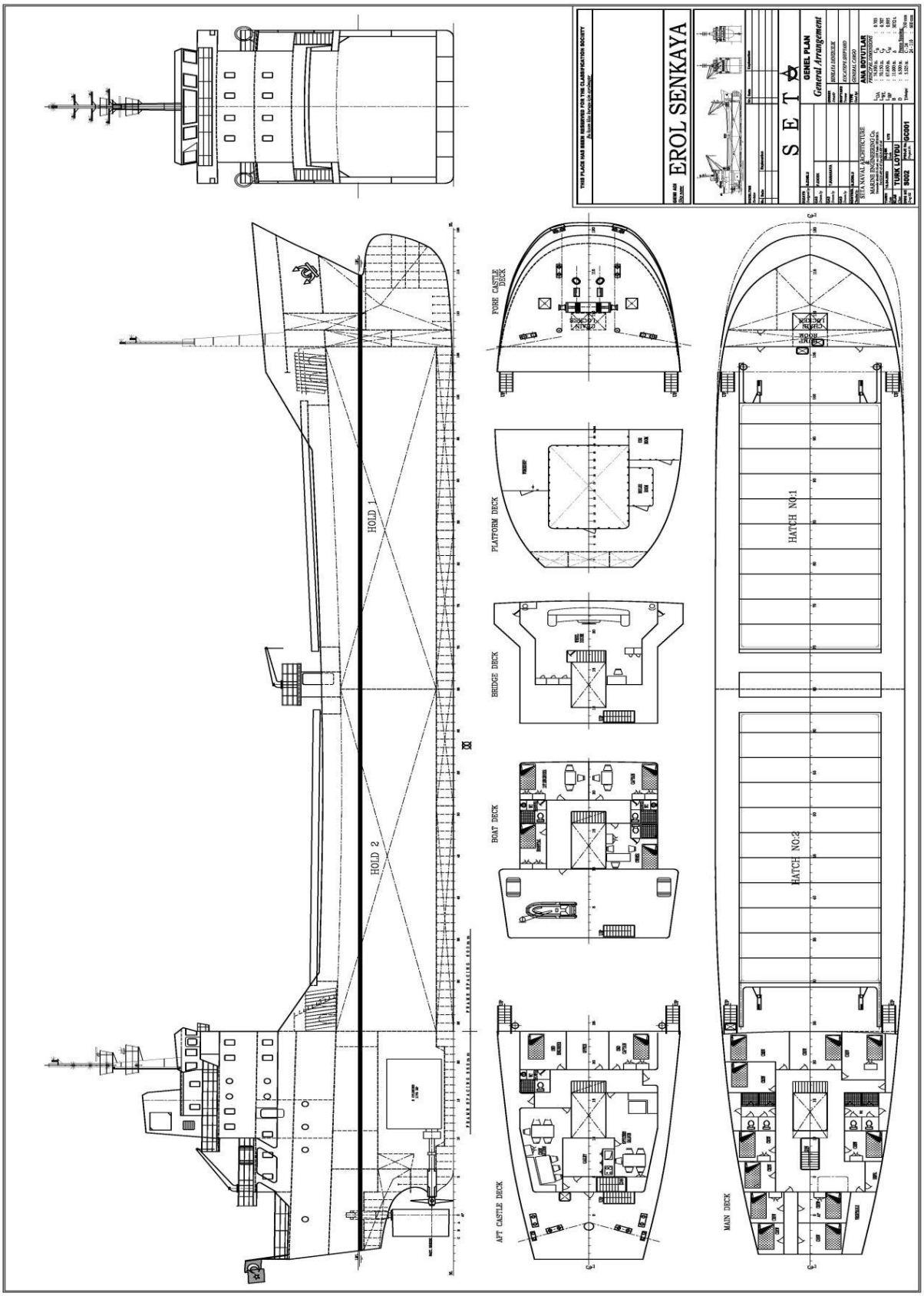
Following the accident, six of ship crew were rescued by Greek Coast Guard teams and body of the master was found following the initial search and rescue operations. At the end of search operations during the following days, chief officer's body was found at the vessel's bridge and cook's body was found at the accomodation area, but the other lost personnel could not be found.

SECTION 1 – ACCIDENT FINDINGS

1.1 Particulars of Vessel and Accident

Particulars of Vessel

Name of Vessel	: EROL ŞENKAYA
Flag	: Turkish
Port of Registry	: İstanbul
Vessel Type	: Dry Cargo
Owner	: Yakamoz Denizcilik Taşımacılık San. ve Tic. Ltd. Şti.
Class	: Turkish Lloyd
Date and Place of Construction	: 2002 / Tuzla – İstanbul
Gross Tonnage	: 1419
Net Tonnage	: 878
DWT	: 2762
IMO No	: 9296365
Call Sign	: TCCD9
Overall Length	: 74,5 m.
Width	: 11 m.
Depth	: 6,5 m.
Main Engine	: 1160 BHP (SKL 8NVD 48A)
Service Speed	: 9,5 knots
Number of Crew	: 10
Port of Departure	: Zakynthos Island / Greece
Port of Destination	: Dikili / İzmir



Picture 2: General Plan of EROL ŞENKAYA

Particulars of Accident

Date and Time	: 19 May 2012 / 01:30
Location of Incident	: 7,5 nautical miles east of Zakynthos Island
Coordinates	: 37° 51.6 N, 020° 59.1 E
Fatalities / Injuries / Missing	: 3 fatalities / 1 missing
Damage	: Vessel capsized (semi-submerged) Completely sank during towing, on 16th June 2012.
Pollution	: None

1.2 History of Vessel

Construction of the vessel started in April 2002 and was completed at June 2003. Name and owner did not change since the vessel was put into service and the vessel was operated by Yakamoz Denizcilik. The vessel did not undergo any modification[1] or important repair. As a result of underwater survey conducted on 29th July 2011 and the sea survey conducted on 04th August 2011, a Seaworthiness Certificate was issued by the Administration[2] on 05th August 2011. In addition, as a result of annual / interim survey conducted on 05th August 2011 by Turkish Lloyd which was the authorized classification society of the vessel, the class certificate in effect until 30th June 2013 was issued.

Last 5 voyages of the vessel is as follows.

Port of Loading	**Port of Discharge**	**Cargo**
Sfax (Tunisia)	Misurata (Libya)	Iron Ore / 2500 mt.
Gabès (Tunisia)	Sète (France)	Zinc / 2500 mt.
Chioggia (Italy)	Bejaïa (Algeria)	Wire rod / 2000 mt.
Novorossiysk (Russia)	Trieste (Italy)	Fertilizer / 2600 mt.
Novorossiysk (Russia)	Kerch (Ukraine)	Sodium Sulfate (in bags) / 2650 mt.

1.3 Environmental Conditions

Moderate weather conditions were prevailing in the region at the time of the accident. Wind was blowing with a force of 3-4 Beaufort from starboard bow (south / south west direction) (according to the statement of crew member at bridge shift) and sea surface was lightly choppy and there existed rather weak swells from starboard side. The sky was partly cloudy, and visibility was quite clear.

[1] Modification: Structural change which will cause the alteration of at least one or a few of three main dimensions and either one of gross and net tonnage of vessels or the alteration of the vessel type to maket he vessel available for passenger transport or hazardous substance transport.

[2] Former Undersecretariat for Maritime Affairs, İstanbul Regional Directorate

Picture 3: M/V EROL ŞENKAYA

1. 4 Course of Events Leading to Accident

M/V EROL ŞENKAYA discharged her cargo of sodium sulfate at Misurata Port in Libya and started at 11 May 2012 to load 2600 metric tonnes of olive cake cargo to from Zakynthos Island of Greece which was to be discharged at İzmir / Dikili Port. The vessel arrived at Zakynthos Island on 13th May 2012 at 23:00 hours and dropped her anchor. The master submitted the notice of readiness to the concerned people at the same hours.

The vessel berthed at the port on 14th May 2012 around noon hours and loading started a short time after the completion of port formalities. Shore crane was used during loading. Due to incompatibility between the elevations of dock and vessel, the crane operator was not at a point overlooking the vessel's hold and was able to load the cargo at a suitable point of the hold frequently by the leading of vessel's crew. During loading, the vessel often listed towards starboard or port side and the vessel was corrected by getting ballast in the opposite side when heeling increased.

On the 4th day of loading (18th May 2012 Friday) at 18:00 hours, the loader informed the master that there was left very little cargo at the warehouse and the completion of remaining cargo might take 3-4 days, and that if he wished, the loading would end in this way or they had to wait until Tuesday (22nd May 2012). Loading operation was completed at 23:00 hours as a total of 2200 metric tons by loading the last part of the cargo. Listing of the vessel towards starboard side was eliminated by completely filling port side ballast tank number 2 of 35 tons capacity. Following the completion of loading, port departure formalities were completed in a short time, the vessel left the port to go to Dikili where the cargo would be discharged at 23:45 hours without any trim (even keel position). The master and deck cadet who served as radio officer due to the reason that he had G.O.C. certificate were on the bridge.

Chief engineer, second engineer and oiler were in the engine room during maneuvering. Sea speed was maintained half an hour after completing the port departure maneuver, and after that, the chief engineer who was the duty engineer at that watch and second engineer who would take over his watch at 04:00 hours went to their cabins for a rest. Only the oiler was present in the engine room for this watch period.

Some time after vessel had reached sea speed, the master swtiched to automatic pilot and left the bridge after saying to the radio officer that "he would go to his cabin to take a shower and he should immediately be informed in case a change was observed in the clinometers". After about half an hour (1-1,5 hours after the vessel departed the port and when it was 8 sea miles away from Zakynthos Island), the radio officer noticed a listing of 1-2 degrees to port side on the clinometers and informed the master who came quickly to the bridge. He asked the radio officer to go down to the engine room and transmit the instruction of the master in the direction of discharging some ballast from the ballast tank at the port side. After the radio officer went down to the engine room and transmitted the instruction under consideration and was at the stairs on his return to the bridge, he heard the master bringing the engine order telegraph to "stop" position. At that moment, the vessel suddenly started to list towards port side. Radio officer and other crew at the corridors/halls etc. ran out of the accomodation area through the watertight doors to the poop deck. However, the vessel listed to its side in a time shorter than thirty seconds and completely capsized within 1-2 minutes. Some of the crew fell to the sea, second engineer, radio officer and oiler continued to hold on to the guards at the poop deck at the moment of capsizing and then were able to climb the hull of the completely capsized vessel. By the capsizing of the vessel, a life raft was released from the ship and was inflated by the crew in the sea. First three crew members in the sea, then the other three members waiting on the hull took refuge to the life raft and moved away from the floating vessel in capsized position.

Picture 4: Vessel in Semi-Submerged State (1)

Picture 5: Vessel in Semi-Submerged State (2)

After overcoming the first shock, the crew asked for help with the flares present on the life raft and Greek Coast Guard boats reached the accident scene in a short time and the survivors were forwarded to the hospital. As a result of the first search and rescue works realized by divers, first the body of the master was found, then the bodies of chief officer and cook were reached in the works continued in the subsequent days, but the other missing crew members remained unaccounted for.

The vessel completely sank at 34° 41.8 N, 026° 46.9 E coordinates on 16th June 2012 during towage to İzmir / Aliağa.

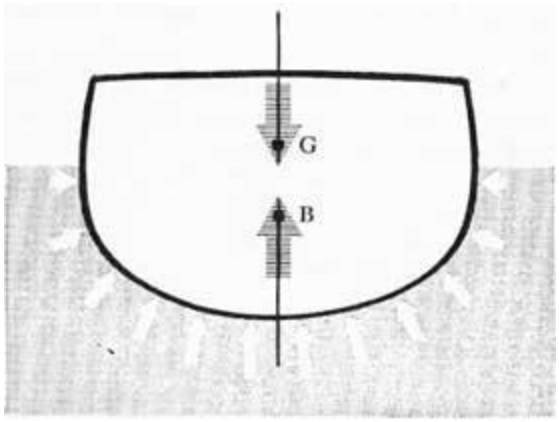
SECTION 2 – ANALYSIS

2.1 Vessel Stability

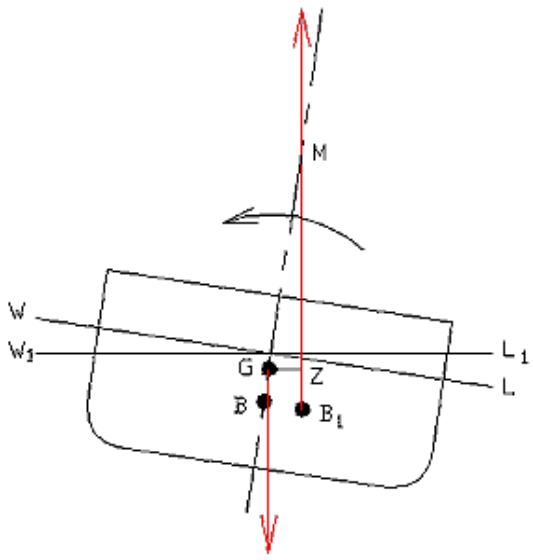
Stability of a vessel is defined by determining two points. These are **Center of Gravity (G)** defined as "*center of vertical forces which form the weight of vessel*" and **Center of Buoyancy (B)** defined as "*center of forces which float the vessel (geometric center of underwater structure of the vessel)*".

Forces acting perpendicular to the vessel from these centers are in opposite directions and equal to each other. In order that a vessel can float upright, these two points must be on the central line of the vessel.

If a vessel floating upright restores to an upright position after heeling due to external factors such as wave, wind, etc., this event shows that the vessel has a stable equilibrium. GM is positive at stable equilibrium (Point G is below point M) and righting moment is in the opposite direction of the heeling of the vessel and it tries to make the vessel have an upright position.



Picture 6: Upright floating vessel



Picture 7: Stable equilibrium

If a heeling vessel maintains this position (not restored to upright position nor heels more), the vessel has neutral equilibrium. Again, if a heeling vessel due to external factors is not restored to its initial position, but continues to heel, the vessel has unstable equilibrium.

Considering that 2200 ton cargo present in the vessel is loaded such that upper sections of the holds are empty, it is assessed that the vessel departed the port probably with a stable equilibrium (with a positive GM); therefore the loss of equilibrium experienced by the vessel should be associated with a factor different than neutral equilibrium or unstable equilibrium. The probability that the cargo slipped from the center of hold to the sides due to the empty spaces at the upper parts of the hold, that is, the center of gravity of the vessel was displaced in the direction of the heeling of the vessel, becomes prominent.[3]

[3] The owner has informed that any hole, crack, sheet steel separation, etc. finding which would cause inflow of sea water to the lockers, ballast tanks or engine room of the vessel was not encountered at the underwater camera records realized by the diver teams whom P&I institution oriented to the vessel.

Motion of the cargo in the hold occurs in two ways: due to topping and due to liquefaction. It is understood from the statements of witnesses that there were not cargo topping in the holds after the completion of loading and, in general, the cargo was loaded homogeneously. However, it is possible that the oil within the cargo may not be distributed equally in the whole cargo. While some part of the cargo contains a high level of moisture / liquid, another part may be dry. Even if the surface of cargo is dry, the layer containing more liquid can be formed within the cargo and easily slip to a side. As it has a gummy fluidity, the cargo may flow to one side of the vessel in a heel, but it may not return completely to the other side with the same heel. Therefore, the vessel reaches to a dangerous angle of heel within the passing time and may quickly capsize.

2.2 Cargo Compatibility

Document of compliance of the vessel for the carriage of solid bulk cargoes contains the information that "*the vessel doesn't have a structure or rigging suitable to carry cargoes which have the probability of liquefaction, but is suitable only to carry the cargoes containing moisture which doesn't exceed the limits defined in IMSBC Code*". However, the cargo is defined in the issued bill of lading as "**olive cake having a content of olive oil more than 3% in unit weight**."

Before carrying cargoes having the probability of liquefaction, real moisture content and transportable moisture limit within the cargo should be known. Because, cargo movement arising from the liquefaction of the cargo are realized when the moisture content of the cargo is more than the transportable moisture limit.[4]

In accordance with SOLAS Chapter 6 / Regulation 2, the master must be informed by the shipper a sufficient time beforehand on the matters concerning the cargo and such information must be delivered to the master in writing together with the other required transport documents before the cargo is loaded to the vessel.

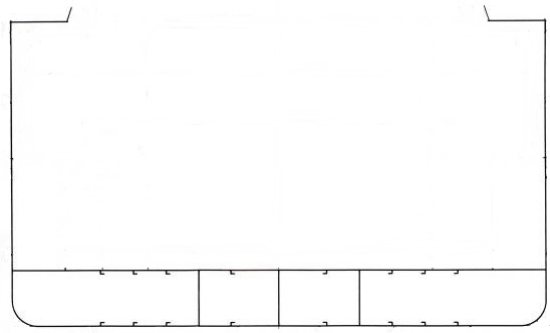
As understood from the statements by the vessel's crew, the cargo in question contains pretty much liquid (olive oil) in its body and it is in the form of mud. The expression included in the bill of lading that "*more than 3%*" does not clearly indicate the rate of olive oil within the cargo. In the interview made with the relevant personnel of the owner, it is understood that any information directed to the character, properties and stacking of the cargo was not handed over to the vessel by the shipper.

Topside / upper wing tanks at both sides of the hold in bulk carriers has a function to prevent / reduce the movement of cargo. However, the holds of the vessel in question has a straight form as been in a large portion of general cargo vessels of such tonnage and this form causes easy progress of the moving cargoes to the sides during heeling.

[4] As indicated in IMSCB Code, Rule 7.3.2, the cargoes having a moisture content over the transportable moisture limit may be carried in cargo vessels specially designed and equipped with portable partitions to be able to keep any movement in the cargo at an acceptable level.

Picture 8: Olive cake (1)

Picture 9: Olive cake (2)



Picture 10: Hold Design of Bulk Carrier 11: Hold Design of General Cargo Vessel

2.3 Shortage in Loading

In the voyage order, which was notified by the Charterer to first the Company and then to the ship, it was stated that 2600 metric tonnes of cargo would be loaded. Loading preparations (cargo plan, stability calculations, etc.) were made according to this cargo amount. However, a short while before the completion of loading, the ship was notified that there wasn't any more cargo at the factory, no more than 2200 tonnes of cargo could be delievered to the ship and that the ship would have to wait until Tuesday for the remaining amount of 400 tonnes. Ship's Master opted to depart with a short loading of 400 tonnes, thus leaving both cargo holds in slack condition (cargo holds not being loaded fully). However, the cargo has a quite viscous and fluid nature and has a very high tendency to move even at a few degrees of listing. The loading of this cargo as such that the holds will remain partially empty is a great risk and requires sensitive stability calculations to be made.

2.4 Lack of Coordination Experienced Between Vessel, Owner and Shipper

No information is delivered to the vessel about the properties of the cargo or the matters on which special care must be shown during loading. (Company authorities have expressed that the charterer did not deliver them any detailed information about the cargo.)

Authorities of the owner have indicated that the master of the vessel did not give notice to them that stability calculations did not meet the requirements following the loading of 2200 mt or that the holds were not safe for navigation in their present status and the missing 400 tonnes of cargo must be loaded to the vessel; in addition, they have stated that the vessel was already in demurrage, therefore waiting for Tuesday would not be a loss for the company and any pressure or inducement to the master was not in question.

From the interviews made with the survivors, it is understood that the master and chief officer were surprised in view of the viscosity of the cargo at the moment when the first part of the cargo was brought by trucks and emptied to the dock, then to the vessel's hold by the coast crane; that the vessel often heeled to port side or starboard side to a great extent during loading and such heeling was eliminated by taking ballast to the opposite side; that this extraordinary event experienced at the port seriously worried the crew.[5] The company authorities have expressed that there was no information transfer to them in this regard by the vessel's crew. It is clearly seen that the master had no contact with the company following the problems experienced at the port, that there existed coordination and communication failures related to mutual information-opinion sharing.

However, communication, planning and briefing between the vessel and shore is of vital importance particularly during handling of bulk cargo which has fluidity properties. The vessel officers and loader firms must act jointly during loading such cargo. Interrupted and inadequate communication between the vessel and shore, unconscious loading plan and unsuitable cargo distribution within the holds create serious risks in the process of handling and carrying the bulk cargoes. Elements such as frequent over heeling of the vessel to port side / starboard side at the dock during loading, shortage in the loading of the previously determined quantity of cargo, permitting the departure of the vessel from the port with 400 tonnes less cargo where the vessel's holds in slack position (and without checking the stability calculations) are assessed as an indicator that a weakness was experienced by the loader firm, port facility and port authority on the matter of performing their liabilities.

Indeed, the master of the vessel should not start the voyage before ensuring the conditions of seaworthiness / travel worthiness and under the conditions which would risk his crew, vessel and cargo The master of the vessel shall be sure that the vessel will have a safe equilibrium until it arrivesat the port of discharge and permit loading only after he has such opinion.

SECTION 3 - CONCLUSIONS

The matters of safety concerning the occurrence of the accident are listed below:

1- Although the loaded cargo is a pretty viscous and slippery cargo, loading was performed to make the upper partitions of both holds empty and the possibility that the cargo could move in the hold was neglected.

2- The cargo carried does not comply with the cargo requirements indicated in the document of compliance of the vessel for the carriage of solid bulk cargoes and thus its transport is not allowed in that document.

[5] A survivor has stated that he continuously kept his life jacket near him following the vessel started navigation.

3- Despite the hesitations and worries experienced concerning the characteristics of the cargo and loading conditions, the master was not in consultation with the company authorities and did not notify them.

4- The charterer or loader did not provide the ship any information which explained the characteristics and content of the cargo in detail.

5- There existed managerial delays and coordination deficiency between the vessel and the operating company .

6- Stability calculations concerning the loading was not asked for by the port authority from the vessel and compliance of such calculations was not checked.

SECTION 4 - RECOMMENDATIONS

The following recommendations are made to the related parties:

4.1 To Owner / Operator Firm (Yakamoz Denizcilik) of EROL ŞENKAYA:

1- To take corrective actions for the purpose of increasing coordination between the company and vessel,

2- To provide the briefing of the master of the vessel on the matters of character, specifications of the cargo to be carried and its compliance to the structural properties / certificates of the vessel; To make detailed investigation for the cargoes to be loaded and not undertake to carry the cargoes which are not compliant with the vessel,

3- To check whether the stability calculations are made by the vessel's master / chief officer for each loading / discharging operation,

4.2 To IMEAK and Mersin Chamber of Shipping:

1- To publish a circular to remind the member owners and operators – emphasizing the subject sea accident – on the matters of paying attention to the compliance of the cargo in question and bulk cargoes of similar quality having the liquefaction / displacement potential to the structural properties / certificates of the vessel and necessity of sensitive stability calculations,

4.3 To Zakynthos Port Authority and Loading Terminal:

1- Considering the displacement tendency of the cargo in question, not to permit the loading of the vessels where their holds become slack and not to permit their departure in this manner,

2- To request the stability calculations for the loaded vessels and check their compliance,

3- To brief the vessel masters about the requirements related to the character, properties and transportation of the cargo to be carried,

4- To stay in continuous coordination and communication with the vessel's master and chief officer before and during loading.