

The Risks In Vessel Towing Operation And Its Countermeasures

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Abstract. Vessel's towing operation serves As an important way for sea salvage, maritime transportation, submarine operation, and so on. Lots of risks exist in this process. The risks in towing operation will be analyzed in this paper and the countermeasures for these risks will also be provided.

Introduction

Recent years, the quantity of marine cargo transportation is increasing rapidly , meanwhile the amount of ships is also increasing significantly. Marine accidents break out frequently because of severe weather or some other reasons which are caused by the ship itself. Some ships lose power or meet steering gear problems, which require tugs to take them to the nearest port for repairing or avoiding danger. In another case, in the process of exploitation of marine resources, offshore platforms and some working ships without power also need to be towed by tugs.

For these reasons, the mariners often do the towing operation at sea, during the towing process there will be a variety of risks. The major risks that exist in the towing operation will be analyzed and measures taken to avoid these risks will also be discussed in the following parts of this paper.

Risks Of Towing Operation

Towing at sea for vessels is a very complicated navigational issue. Mariners needs to pay particular attention to the risks in towing operation . The following risks in towing operation are proved to exist by the practice.

Main Towing Hawser Twining the Propeller. Towing operation is that a tug tows another vessel which is usually a cargo vessel without power by a towing hawser. The tug will tow the other vessel to its destination port. See Fig.1 Towing operation mode.

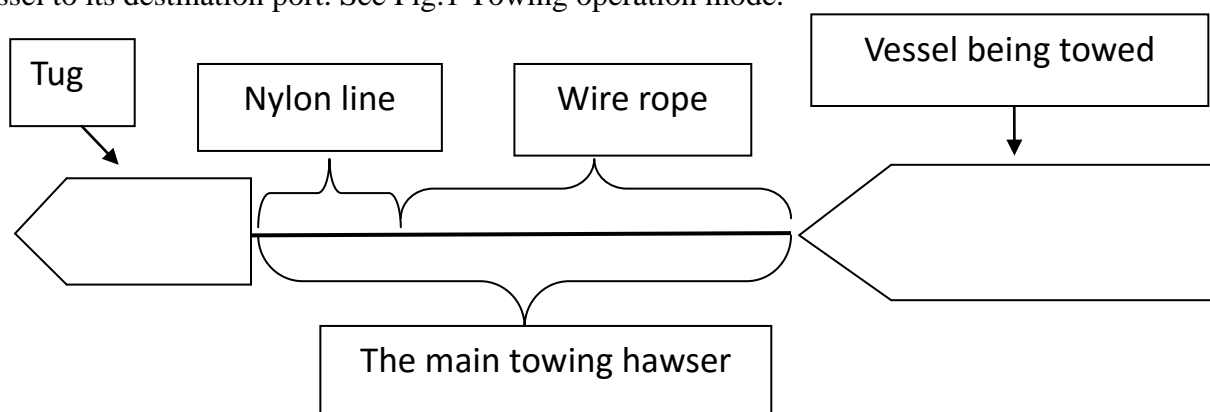


Figure.1. Towing operation mode

The largest risk in towing operation is that the main towing hawser is liable to twine around the propeller [1] of the vessel being towed. Once the main towing hawser twines around the propeller of the vessel being towed, the main towing hawser may break off which will result in a failure of towing operation, more seriously the gearbox or the shaft of the propeller will also be damaged. In that case, the tug and the vessel being towed will lose control simultaneously which may result in

more dangerous condition. Some common conditions which the towing hawser twines the propellers are shown as follow:

(1) During the towing process, the forward part of the towing hawser is a nylon line which consists of 8 strands. The main towing hawser will be left slack for a long time in order to make it easier to connect the towing hawser and the vessel being towed. In this case, this part of slack nylon line which is floating on the sea surface will pile up in the vicinity of the propeller. The rotating propeller will produce a force which suck the towing nylon line into the propeller, and finally twine around the propeller of the vessel being towed.

(2) During the towing operation the captain on the bridge and the officer working at the stern of the towing vessel must keep an effective communication through VHF(Very High Frequency), if the captain and the officer can't communicate coordinately, for example, the officer does not report the direction of the towing hawser and the measures should be taken to the captain, the captain will probably not retrieve the slack hawser, in this case, the towing hawser may be sucked into the propeller and twine around it.

(3) During the process of connecting the towing hawser to the vessel being towed, the vessel being towed may operate against the towing vessel due to the communication problems, or due to unskillful or less experienced operation, or due to the outmoded equipment of the vessel. The result of that case is that towing hawser may be sucked into the propeller.

(4) When the towing hawser has been connected to the vessel being towed, the tug begin to tow the other vessel to her destination port. During this process, the tug may be slowed down due to the heavy weather. The towing hawser will become slack and may be sucked in to the propeller of the vessel being towed.

The Yawing of the Vessel Being Towed [2]. Yaw refers to the vessel being towed lies sideways to the tug over time. The vessel will be influenced by wind and current if the vessel is thin and long. The yawing angle sometimes will reach 90 degrees, in that case, the towing hawser will chafe with the bulwark of the tug, the hawser will break off in a short time. Then the towing operation will lose control. If the tug is a small one while the vessel being towed is a large one, the tug may capsize under the force from the towing hawser. vice versa, the tug is not a small one while the vessel being towed is a small one , the later may capsize under the force from the towing hawser. The condition will be worse when there is a bad weather, especially when the wind and current direct is not the same as the course of the tug, the tug or the vessel being towed may be broached by the wind and current and then capsize.

Main Towing Hawser Breaking off [3]. In the actual towing operation, the main towing hawser may break off due to some factors.

(1) Towing operation is often accompanied by bad weather, complex sea conditions, complex channels, these all make the towing operation difficult. Add all these factors together, the more common consequence is the main towing hawser breaks off.

(2) In the towing process, the main towing hawser extending backward from the stern of main deck of the tug, which makes the main towing hawser chafe with the stern roller of the tug over time. The part bearing chafing condition will become thinner and thinner and eventually the towing hawser breaks off.

(3) The length of the main towing hawser [4] is also an important factor affecting whether the main towing hawser will break off. Although the towing hawser is made of wire line which seems to provide no spring force, If the main towing hawser is long, the towing hawser will hang down due to its own gravity and form a catenary. This catenary will provide spring force and buff the shock force in the towing hawser. The longer the towing hawser is, the bigger it provides the spring force.

In the actual towing process, the length of the main towing hawser should be about 1.5-2.0 times the sum of the length of the tug and the vessel being towed. This length should be increased when the speed of the tug increases. which is:

$$S = K (L1 + L2)$$

S: Length of the main towing hawser (m)

L1: Tug Length (m)

L2: length of the vessel being towed (m)

K: empirical coefficients of the towing hawser, generally between 1.5 and 2.0, the higher speed will take a larger value.

Once the main towing hawser breaks off, the tug and the vessel being towed will lose control simultaneously, the tug will increase speed while the vessel being towed will decrease speed. The vessel being towed can't control its course when the towing hawser breaks off. In that case the vessel may collide with reef, shoal or wreck which may result in distress conditions.

Countermeasures to Deal with the Risks of Towing Operation

In view of the major risks in towing operation, it is important to take measures to deal with these risks. The appropriate recommendations to deal with the above mentioned risks in towing operation are given as follow:

The Countermeasures to Deal with Twining Propeller. (1) Firstly, the tug should clearly understand the situation of the vessel being towed, including: position, type, size and other particulars of the vessel being towed, additionally, the hydrological condition, meteorological condition in the vicinity of the vessel being towed should also be understood.

(2) Release the main towing hawser slowly, and ensure the engine is slow ahead so as to keep the towing hawser tight. In this case the towing hawser will lead directly afterward without being sucked into the propeller. In the same manner, when retrieve the towing hawser, the tug must control its speed to ensure the towing hawser is tight and finally avoid twining the tug propeller.

(3) During the whole process of connecting the towing hawser to the vessel being towed, ensure the VHF(Very High Frequency) communication is properly carried out, and also make sure the bridge act coordinately with the after part of the tug. The officer at the after part of the tug should report the condition(including condition of towing hawser, direction of the towing hawser, action should be taken by the bridge) of the tug to the bridge to help the bridge take correct action which can avoid twining the propeller.

(4) During the whole process of connecting the towing hawser to the vessel being towed, the two vessel should act coordinately. The crew of the tug should be skillful and experienced to connect the two vessels together. Meanwhile, dispatch the well-equipped tug to do the towing operation. Do anything to decrease the risk of twining tug's propeller.

(5) Release more towing hawser to provide more spring force [5] to buff the shock force, especially in bad weather. The tug should send crew to check the towing condition periodically, adjust the towing speed, towing hawser's length, towing hawser's direction, prevent the towing hawser from twined around the tug propeller.

Countermeasures to Deal with Yawing. (1) In order to reduce the yawing condition of the vessel being towed, we can adjust the trim of the vessel being towed. By adjusting the trim of the vessel being towed, the part of the vessel where face to the wind can be adjusted. We can decrease the area of the vessel facing the wind so as to reduce the yawing condition of the vessel being towed.

(2) Adjust the course of the tug, steer a zig-zag maneuver. By doing this, the tug can avoid the courses which are seriously influenced by the wind. In that case, the wind will apply at the pivoting point of the vessel and the yawing condition will be reduced.

(3) Analyze the cause of yawing, if the yawing is mainly caused by the wind, we can increase the speed of the tug so that the resultant force of the wind and the towing force will reduce the yawing condition. On the other hand, if the yawing is mainly caused by the current, then we can adjust the towing course to reduce the yawing condition.

(4) The vessel apply follow up rudder according to the tug. The vessel being towed can apply a rudder angle the same as the tug applies to coordinate the two vessels' action. This method will reduce the yawing condition and will contribute a better effect as the speed increases.

(5) We can make the vessel being towed dredge her anchor to reduce the yawing condition. The vessel being towed lets go a stern anchor, thus the stern of the vessel being towed will also be towed

by her own anchor, the tug's towing force and the anchor's towing force will apply on the vessel being towed simultaneously, the two forces will make the vessel being towed in a line with the tug. This method will reduce the yawing condition significantly, but the towing speed will also be reduced at the same time.

Countermeasure to Deal with Main Towing Hawser Breaking off. (1) After connecting the tug and the vessel being towed, the tug should increase her speed gradually and pay attention to the condition of the towing hawser. The tug should stop engine or slow down if necessary. The tug can't set a fixed speed until a long towing hawser has been released.

(2) The tug should ensure sufficient length of towing hawser be released and there is a proper catenary forming at the middle part of the towing hawser. When there is a length of 500 to 800 meters of towing hawser being released, the towing hawser will provide an effective spring force to buff the shock force on the towing hawser. In that case, the towing hawser will not be liable to break off.

(3) The tug can use nylon rope to replace the wire line at the beginning part of the towing hawser (about 50 to 100 meters) because it can provide a much bigger spring force compared to wire rope. This method is very useful especially in bad weather.

(4) The towing hawser and the roller of the tug will chafe each other frequently, we can use chafing gear to prevent the towing hawser from being chafed. The common chafing gear used on board is canvas and hemp rope. We can use canvas to wrap up the towing hawser and then use hemp rope to secure the canvas. By doing this, the canvas and the roller chafe each other first, the towing hawser is protected. The officers on watch needs to pay attention to the canvas and the hemp rope condition, replace them if necessary.

(5) Steering control. The tug should alter her course gradually to avoid towing the vessel sideways. If the tug wants to alter course significantly, she should alter her course several times and change her course in a small angle (not exceed 20 degrees, in heavy weather this angle should not exceed 5 degrees).

Conclusion

In a summary, vessel towing operation are influenced by weather , mechanical failure of the ship itself, poor towing skills of the mariners, lack of experience and many other factors. However, the mariners can deal with these problems as long as they are familiar with the cause of these risks and their countermeasures. A safety and effective towing operation at sea can be completed by the mariners.

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