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Natural threat to the Turkish straits sea area: the mucilage

Abstract

The Turkish Straits Sea Area comprises the Istanbul, the Canakkale Straits, and the Marmara Sea. The area is the most essential natural waterway connecting the continents of Asia and Europe. However, as of May 2021, it is polluted with Mucilage which is a slippery mass of microorganisms mostly clustered together, covering large areas, mainly in the Sea of Marmara and locally in the Turkish Straits. Unicellular organisms release fatty acids from the body under stressful environmental conditions. The Turkish Straits Sea area, which also connects the Black Sea and the Aegean Sea, constitutes a critical marine habitat among marine species. On the one hand, ballast operations create a sticky surface on the ship's hull and the underwater structure in contact with water. At the same time, there is also the necessity of cooling the ship's machinery with seawater. Ship cooling systems use seawater to cool the ship's engine block, while filtration prevents damage to the system. However, the mucilage effect affects the control of the vessel by causing clogging of the filters that serve to protect the system. The fact that the water taken by filtration is affected by Mucilage, clogging, and involving the outer surface of the ship affects the safety of the vessel at a high level. This research article tries to explain the damage and effects of Mucilage on ships sailing in the Turkish Straits.

Keywords: mucilage, Turkish straits sea area, strategy of maritime transportation, navigation safety, BWMS

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Abbreviations: BWMS, ballast water management system; TSSA, Turkish strait sea area; STCW, standards of training certification and watchkeeping; SOLAS, safety of life at sea; MARPOL, International convention for the prevention of pollution from ships; SoI, the strait of Istanbul; SoC, the strait of Canakkale

Introduction

Turkey geographically connects the Black Sea and the Aegean Sea. Its unique natural straits are one of a kind that can be found in the world. There is a unique historical area and life in the coastal regions, both in Istanbul (Bosphorus) and the Canakkale (Dardanelles) (Figure 1).[1]

The Turkish Straits have been influential in geography, strategy, and geopolitics throughout history. The fact that TSSA-Turkish Strait Sea Area is the only sea route used between the Mediterranean and the Black Sea makes the geography critical and strategic. The validity of the Montreux Convention, which has been accepted by all maritime countries since 1936, is an essential contract for using the Turkish Straits. When the Turkish Straits and Sea area are known to be among the busiest natural waterways in the world. It has been the scene of the largest sea accidents in history, one of the busiest waterway used by local and international shipping elements. Independenta in 1979 and Vitaspirit in 2018 are known casualties (Figure 2) (Figure 3).

Figure 1 TSSA-Turkish strait sea area.[2]

Figure 2 M/T independenta disaster at the Istanbul strait.[3]

Figure 3 M/V Vitaspirit collision between Historic Hekimbasi House (18th century).[4]

The most crucial element in ship transportation, which undertakes the task of transporting world trade in a global sense, is safety. Any expected and unexpected situation that does not comply with this principle is considered a safety weakness. Seafarers are trained and certified according to the standard called STCW. Ships operate according to SOLAS rules, and safety measures are given.

Actions to be taken against marine pollution originating from vessels are regulated according to MARPOL rules and annexes. Ships are exposed to all kinds of dangers during their voyage; capsize from adverse weather conditions, piracy, collision, fire, grounding, explosion, near miss, machinery failure, rudder failure, etc. are examples of an emergency. Many emergencies are generally due to human error and technical defects. While human resources are eliminated with training, technical defects are eliminated with continuous maintenance systems. Experiencing situations that cause accidents and emergencies as a result of natural events that exceed human resources and technical defects, which are the subject of the study, are among the results encountered. It has been observed that the mucilage layer, especially encountered in the Marmara Sea, prevents vessels from navigating in the region and their ability to navigate safely.

When the mucilage structure is examined, it has a unique and different system in marine environments and habitats. Mucilage, encountered as a gel structure, is also known as foam or sea snow or mass, cloud, or mucilage.[5–9] The mucilage structure was researched and explained in the Sea of Marmara when observed in mid 2000s. But in those years, it was not seen as harmful.[10] When scrutinized, it is understood that the abundance of zooplankton and the community

structure in the Marmara Sea have been displaced due to mucilage. Mucilage harms fisheries and marine tourism.[11] In the maritime transportion sector, although it is thought that precautions are taken with contracts, there has been deterioration in aquatic ecosystems due to anthropogenic effects and has directly affected many living species that make up marine biology. Thus, the structures and demographic changes of the seas have occurred. As of 2021, other differences have been observed. Especially in the Marmara Sea, its damage to marine biology and marine tourism has been observed.[12] The effect of mucilage on maritime transport has a great influence. The mucilage layer affects the direct use of seawater by the ships during the cruise and creates situations that will weaken the safety of the pumps, filters, and heat exchangers.[13,14]

This study aimed to investigate whether the main engine of the ship, on which the cooling process was carried out utilizing seawater, could fail due to the mucilage effect. In this way, it was aimed to raise awareness about the Turkish Straits Sea Area and its components being affected by the mucilage layer and the navigational safety of ships.

Material and methods

For the machines used on ships, which operate continuously and at high power while underway, their temperatures reaching high levels need to be cooled to handle efficiently. Meeting this need, particularly for vessels, consists of easy and careful methods. The indispensable source of this need is sea-sourced cooling water. The part where seawater is used in cooling water systems is defined as sea chests. In the cooling water used in ships and related systems, the part where seawater is used is defined as sea chests. These sea chests used on Vessels are designed as high and low levels and designed for ships. For the vessel to sail safely, keeping one chest open and the other clean and ready for use in the engine room according to the water level is the main reason for the operation. In this way, when the filters in the sea chests are contaminated by marine pollution or living organisms, the cooling process is continued using spare parts (Figure 4).

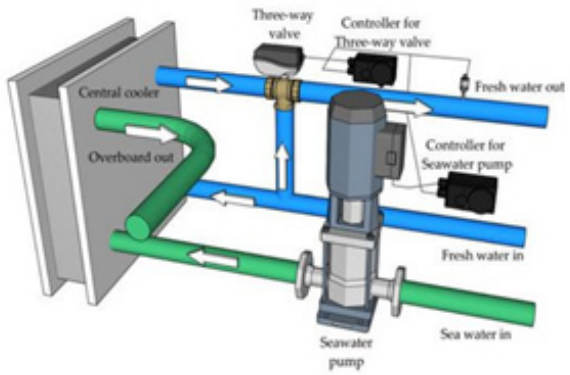

Figure 4 The Ship central cooling system's example.[15]

Machine circuits and parts were observed in May and December 2021. The same type of vessel was observed between May and December 2022. Sea water and its effects are indispensable elements of the cooling principle in ships. Therefore, the effect of the mucilage layer can be extensive the equipment that first encounters the mucilage layer is known as firstly Seawater Inlet Chest Filters/Valves, than Seawater LT Coolers, Air Cooler, Oil Cooler, Ballast Water Filters, Evaporators, and Emergency Fire Pumps.[16]

As shown in Figure 5, mucilage deposits/residues accumulate in the filter and quickly clog the pores. Thus, the amount of water drawn from the sea to the circuit is reduced. Since it is known that the system works with water circulation, the pressure required for water circulation is not formed. Since the cooling system can not function to its full capacity the temperature may rise causing the primary circuit to overheat. In this way, cooling system cannot complete the cooling processes.

Figure 5 Mucilage effects on Seawater Inlet filters.[17]

As seen in Figure 6, Sea Chest is a remarkable structure that meets the cold water needs of various ship cooling water systems. It is a kind of cooling water compartment used for cooling the freshwater we want to cool when we do not want the machines on the vessel to meet directly with the sea's chemical status.

Figure 6 Sea Chest filter after mucilage effect.[18]

Results

Although the mucilage effect seen in TSSA has decreased as of May 2021, it is still seen, albeit slightly. Cleaning works initiated by the rapid response of the authorized institutions of the Republic of Turkey as of May 2021 are essential. The most critical element of the vessels navigating the seas, which is a dynamic surface, is their safety of navigation. In the marine science studies conducted on the Marmara Sea, the most crucial component of TSSA with a surface area of 11.111 square kilometers, it has been understood that the low-salt surface waters from the Black Sea can be renewed every 5 to 6 months, and the salty bottom waters from the Mediterranean can be renewed every 6 to 7 years.[19] It has been determined that the mucilage structure observed this year in 2021 harms the marine life in the Sea of Marmara and disrupts the life cycle on the sea surface. According to the latest findings, dense mucilage layers are in the 5-30 m depth range. This depth range is in the draught range of ships using the

straits, affecting and harming the safety of navigation. Operations of the ship's main engine systems, such as preventing mechanical wear during the process, reducing the stresses caused by heat, and keeping the combustion efficiency at the optimum level, are carried out using seawater. The seawater used for the cooling process during the operation of the ship's engine is pre-filtered with the filters in the seawater inlet boxes. It is pumped to the heat exchangers using seawater pumps. The cooling process should be completed with a closed-circuit mechanism and the principle of operating the cooling fluids at the required level. After this process, seawater circuits press it into the sea again without contacting any polluting factor.

Discussion

The protection area status of the Strait of Istanbul-SoI (Bosphorus), the Sea of Marmara, and the Strait of Canakkale-SoC (Dardanelles), which form the Turkish Straits Sea Area, needs to be improved with the effect of mucilage. The importance of the studies on taking samples from the coastal organization, which has been done and should continue, is increasing with the number of repetitions. In the case of TSSA, it is significant for national and international maritime traffic that the transitional waters between the Black Sea entrance of the SoI and the Marmara Sea, SoC are provided in cooperation with the state authority and academic institutions. Shipping is an essential part of global trade. Especially with the effect of 2020 COVID-19, the importance of logistics, predominantly maritime transportation, has increased considerably during the Pandemic. With the increase in maritime transport, there has been an increase in the trade capacity and potential in the world's seas. IMO, maritime states have protected the seas with international and national regulations. However, although the regulations worked for control, they could not prevent mucilage formation, as in the Marmara Sea in May 2021. Also, mucilage effects are still happening in the Turkish Sea Area.

The need for water from the sea is used in many areas in vessel operations and as cooling water, especially in machinery operations. Since the entrance points of the systems and circuits draw water with the mucilage effect, there will be filter blockages.

Significantly and primarily affects the safety of navigation. In regions with natural valley characteristics, such as the Marmara Sea and especially the Turkish Straits, machinery malfunctions can cause environmental pollution and loss of life and property. For this reason, it is vital to find and use rules, methods, and technologies that will increase the prevention of mucilage and reduce the impact on vessel operations. The main task is to assess marine pollutants and return the marine ecosystem to its natural state. As a result, the factors contributing to the mucilage phenomenon encountered in the Sea of Marmara are not only caused by sea vessels.

Conclusion

The mucilage structure plays a vital role in the daily working operations of ships, especially in maritime transport, which was rarely seen in the past but has become common as of May 2021.

Seawater, an essential source for the cooling of machinery systems, is a crucial need, is used in many areas of ship operations, explaining its importance for ship maneuvers.

It has been determined that the entry points of the systems and circuits that draw water with the mucilage effect will affect the safety of navigation, especially with effects such as filter clogging.

In regions with natural valley features, such as the Turkish Straits Sea Area, machinery malfunctions can cause environmental pollution and loss of life and property. In the past, it has experienced how much the marine environment has been affected by accidents such as Independenta, Nassia, and Vitaspirit vessels.

For this reason, it is vital to use the rules and methods related to Maritime. The proper steps taken by the Turkish authorities and the use of technological opportunities for navigation are among the primary measures. But first of all, the main task is to rehabilitate marine pollutants from ships or land and return the marine ecosystem to its natural state due to the evaluation.

As a result, the factors contributing to mucilage formation are not only caused by the vessels navigating in the Sea of Marmara. The main reasons are coastal industrial facilities, maritime convenience facilities, and ships. To eliminate these effects, it is necessary to develop mucilage and similar pollution control systems and ultimately contribute to the natural cleaning systems of the marine ecosystem.

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Conflicts of interest

The author declared that there is no conflict of interest.

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