Analysis of Causes of Maritime Accidents
Qun-sheng CHEN*, Xin QI and Qian-qian SUN
Marine College of Shandong Jiao Tong University, Weihai, 264200, China
*Corresponding author

Keywords: Sea accident, Marine transportation, demerit, ship safety.

Abstract. In recent years, some serious shipwrecks have occurred to many countries and regions, such as the South Korean SEWOL sinking, whose causes are due to bad weather or human negligence. The statistics show that more than 80% of the causes of shipwreck accidents are caused by human factors, which result from the faults brought about by the faults of the inadequacy of ship management and crew qualifications and management. The paper aims to analyze the current condition and reasons of important maritime accidents in the world after the implementation of the ISM Code, posing the corresponding measures to prevent the occurrence of shipwreck accidents so as to enhance the safety ship management for shipping companies and maritime administrations and to operations in Providing operational measures in strengthening ship safety and to ensure ship safety with proposing feasible measures to protect the marine environment as well as some other respects.

Preface
The sinking of the SEWOL in South Korea is not only a disaster for the country itself but also the misery for the world. Recently, some major shipwrecks have happened in many countries and regions which are mainly caused by bad weather or human negligence. With the acceleration of world trade liberalization, economic integration and globalization of information, world shipping industry has been greatly developed. The total tonnage of the world's merchant has increased[1]. There is a high risk feature of the marine transportation. Once an accident happens, the harm will be so enormous that it causes not just the death of people but also the social and economic loss. Some even lead to serious environmental pollution.

For the past few years, the general trend of world disaster accident has slowed down, but it is still not optimistic that the number of maritime accidents remains at a high level. Therefore, how to avoid the sea accidents to achieve the goal of IMO "safer shipping, cleaner ocean", becomes a hot topic of the attention and research. Researches showed that there were many factors that could lead to shipwreck accidents, most of which can be divided into two types: human factors and natural factors. In fact, many disasters caused by natural factors are related to human activities. In order to improve navigation safety, concrete countermeasures to prevent sea accidents will be introduced through analyzing the factors affecting safety of navigation in the paper.

Recent Shipwreck Condition
A shipwreck is a marine traffic accident that is caused by a collision, stranding, hitting the rocks, touching damage, wave damage, wind, fire, explosion, self-immolation accident and some other reasons that lead to the death of people and direct economic losses.

In recent years the number of accidents has indicated reduction due to improved hull structure, navigational equipment and technology, as well as the improvement of the relevant international treaties. Compared with the previous century, the shipwrecks nowadays have changed with respect to the quality and quantity. Its ratio is also reduced relative to the ship's in possession. In 2004 the total loss vessels all over the world amount to 402, and in 2013, 213[2].

More than 80% of the causes of the shipwrecks are human errors. No matter how well made, the navigation of the ship is manipulated by the ship officer. The disaster, firstly, is caused by shipping
technology; and secondly, it is engaged in the marine safety management by the ship company. Therefore, it is practicable to evaluate the level of navigation technology of the country according to the situation of ship disaster and the state of ship's registry. The total loss rate of Japan is known as one of the greatest disaster countries in the world in 1930s. 80 years later, the Japanese ship's in possession has dramatically increased. Then Japan scrapped old ship, actively improved ship quality, modernized the ship and improved shipping technology. Now, in terms of the safety of the ship sailing, Japan has become a reliable shipping country in the world.

From the point view of the ship’s age of world total loss of the ship from 2008 to 2016, the total loss of the older age ship increases, namely: 0-4 years, 4.6%; 5-9 years, 5.6%; 10--14 years amounts to 16.5%; 15-19 years, 26.7%. The actual situation in 2013: total loss of the ship from 20 to 24 years for 213 vessels, accounting for 27.2 percent, while its number of vessels takes up only 15.2% of whole ship kind, thus the total loss of the vessel constitute rate / retain Boats constitute total loss rate is approximately 1.79.

Table 1. The Situation of the Total Loss Ships Worldwide

<table>
<thead>
<tr>
<th>nationality of ship’s registry (country)</th>
<th>ship in possession (annual average)</th>
<th>number of total loss ship (annual average)</th>
<th>ratio of total loss ship (annual average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taiwan</td>
<td>628</td>
<td>7.4</td>
<td>1.18</td>
</tr>
<tr>
<td>Korea</td>
<td>1995</td>
<td>12.8</td>
<td>0.64</td>
</tr>
<tr>
<td>Panama</td>
<td>5089</td>
<td>30.9</td>
<td>0.61</td>
</tr>
<tr>
<td>Greece</td>
<td>1953</td>
<td>8.1</td>
<td>0.41</td>
</tr>
<tr>
<td>Liberia</td>
<td>1586</td>
<td>4.6</td>
<td>0.29</td>
</tr>
<tr>
<td>Japan</td>
<td>9935</td>
<td>24.3</td>
<td>0.24</td>
</tr>
<tr>
<td>Germany</td>
<td>1383</td>
<td>2.3</td>
<td>0.17</td>
</tr>
<tr>
<td>Norway</td>
<td>2185</td>
<td>5.0</td>
<td>0.23</td>
</tr>
<tr>
<td>America</td>
<td>6311</td>
<td>12.9</td>
<td>0.20</td>
</tr>
<tr>
<td>Spain</td>
<td>2329</td>
<td>7.3</td>
<td>0.31</td>
</tr>
</tbody>
</table>

In the past 8 years, the number of total loss ships has been 1836, of which 788 occurred in the Pacific Ocean, accounting for about 43%, 488 occurred in the Atlantic Ocean, about 26%. The number of total loss vessels in these two regions accounted for about half of the world total loss ship[3]. There were a lot of total loss ships in the Indian Ocean and the Mediterranean Sea and other waters. The number of the total loss vessels in the Caribbean (including Bermuda sea is called the devil waters) accounted for 6%. According to Lloyd's register statistics, the world total loss vessel accidents are divided into the following seven categories: flooding, sinking, missing, fire and explosion, collision, striking on rocks, and other factors. During 8 years from 2008 to 2016, there were many total loss vessels particularly because of flooding and sinking, accounting for 42% of the total loss ships, damage, wreckage about 21%, fire, explosion, about 15%, 78% of the other three. From 2008 to 2016 casualties caused by the ship shipwreck totaled 10013, about 100 people annually. Most deadly sea accidents is resulted from collision, accounting for 42% of the total number of casualties; Injuries caused by flooding, sinking accounted for 40%, the total of the two added up to 82%, which became the main reason of casualties.

**Reason Formation of Shipwrecks**

In the records of shipwreck, the most common causes of the accidents are collisions, including collisions between the ships and the fixture between ship fittings, adding up to 313, accounting for 46.23%. Followed by fires and explosions, there are 203, accounting for 29.99%[4].

340
This shows that collision and fire and explosion are the main reasons of shipwreck, it is important to pay special attention to avoiding such accidents. The shipwreck factors can be divided into two types: human factors and natural factors. In practice, many natural disasters are related to human activities, such as inappropriate use of equipment, instrument and device, inaccurate guide of the program, failing to follow the correct procedure, improper stowage reducing the ship's stability, and so on. Some of the actors leading to the shipwreck are unexpected or beyond human control, however the human factors are very important. For example, many accidents are due to driver's negligence and faults[5]. Statistics shows that 80% of average sacrifice of ships, machine damage and pollution accidents are caused by human factors such as the shortfalls in ship management and crew qualification and errors of management, manifested in: (1) paying less attention to the safety of navigation; (2) the crew members’ subnormal state of mentality and the inadequate quality of the crew.

**Human Factors**

Man-made factors, especially the human errors are the main causes of the sea accidents, which has become the consensus of Marine industry. In fact, more than 80% of the maritime accidents are caused by human errors; in addition, in recent years the accident data of studies have shown that fatigue is an important cause of human errors. Artificial errors caused by fatigue are the main cause of large amounts of sea accidents.

1. Shipwreck caused by old facilities and human errors
2. Shipwrecks caused by malfunction and Sailing in violation of international rules
3. Shipwrecks caused by stranding and improper operation

**Too Old Ship**

The designed service life of bulk carrier is generally 15 years. The vessel of more than 20 year’s age will not be registered in some countries. But the average life of bulk carriers is about 25 years, because the benefit of 10 years ago must be at least 50% over 15 years. Shipping companies try to extend the service life of the ship. Then the proportion of the aged and superannuated ships is increased. Unseaworthiness of vessel

C. Force majeure such as natural disasters and other external factors

According to the analysis of the shipwreck accidents occurred from January 2002 to March 2009, most shipwreck accidents result from the disaster of bad weather. Loss of 29 bulk carriers was due to the weather disaster, taking up 42% of total quantity. The average age of total loss bulk carriers was 20.3 years.

**Some Methods to Reduce Shipwrecks**

By analyzing the situations and causes of the shipwrecks in the world, the preventing measures are concluded as follows, inspection work before departure, the response during the voyage, in addition, the ship maneuvering, strengthening ship operations management and improving the quality of maritime personnel are also very important.
Inspection before Departure

The implementation of PSC and ISM requires ships to maintain a good technical condition.

1) Evaluate the safety of the ship equipment to deal with emergency situations. Following projects should be evaluated and inspected: marine mechanical and electrical equipment (main engine and donkey engine e.g.), navigation handling equipment (steering and anchor, etc.), positioning equipment (collision-avoidance system and autopilot, etc.), communication equipment, lifesaving and fire-fighting equipment and admiralty charts and publications and so on. Moreover, it is important to determine if the vessel is seaworthy.

2) Inspection and evaluation of hull structure. First check the stress corrosion of the hull structure; the hull strength depends on the corrosion of structural components. Some parts rust severely.

3) Stowage. The stress of the hull according to the stowage plan should be less than that calculated on the instruction. The following factors should be taken into considerations: whether to carry out freighting according to hold capacity or not; whether the cargo stowed in hold evenly; whether there are inappropriate broken stowage and ballast or not; loading in turn reasonably. In any stage of loading, make sure that every cargo compartment is within the limit of the maximum hydrostatic pressure and the bending moment and trimmed reasonably. Besides, ensure the water-tightness of the cargo hold, and the hatchway covers, every hold and passageway are in good conditions.

Inspections underway

It's too late to find the danger and lose the favorable opportunity to take measures in earlier time, which is the main reason to encounter severe perils of the sea, and then suffer a great loss. However, there have also been in a timely manner, taking emergency measures correctly and having saved the cargo and the lives of the crew. Therefore, check on the voyage and good manipulation is an important means to avoid the accident of the perils of the sea.

1) Deck patrol. Check each ballast tank and bilge tank before and after the big waves.

2) Routine inspection. Four corners of hatch-end coaming, whose center is easy to crack, especially several big holds close to the midship should be inspected.

3) Complete inspection of the side cabinet. The focus of the check is the longitudinal ribs under the main deck.

Ship Handling

It is suggested to make full use of good seamanship to avoid damage resulted from the severe sea condition. Strive for and take full advantage of all favorable factors to avoid danger when proceeding in rough sea. Once appears, take effective measures to head off the danger in time. While sailing in the rough sea, the propulsion, buoyancy and stability should be kept.

To Strengthen the Operation Management of the Ship

Relevant management personnel should take the check of ships’ seaworthiness seriously. Shipping companies should be more serious, because potential safety hazard can cause irreparable damage. Port State Control (PSC) is considered to be the last line of the defense of maritime security. PSC plays an increasingly vital role in ensuring marine safety, protecting maritime environment and implementing the safety standards of IMO. Experiences have proven that PSC, especially by the regional and even the global cooperation, is the most effective way to promote maritime safety and environmental protection.

To Improve Navigation Personnel Quality

The cause of the sea accidents is most closely related to the operating personnel management. Thus it is necessary to strengthen the safety consciousness of operators and improve their operating skills in order to reduce accidents. The shipping company should conduct regular Maritime safety consciousness education and safety skills training. Carry out regular inspections and maintenances.
of the ship to ensure that the facilities are in good condition. Popularize safety knowledge to improve the quality of the crew. Education programs on safe production shall be carried out in shipping companies. Furthermore, the crewmembers had better learn more knowledge about safe production and master the security technology[7].

Conclusion

The paper mainly analyzes the current condition and causes of shipwrecks, introducing the check before setting off, response during the sailing travel, ship maneuvering, enhancing ship management, raising the quality of the crew and other aspects to explain how to prevent marine accidents. Some measures are put forward to provide necessary reference for ship management sections, ships and marine colleges. It can be believed that the ability of people to overcome shipwrecks will be developed with the attention of international marine organizations and the government as well as the hardworking of the international industry.

References