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Tale of Bulk Ship

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Abstract. Bulk carriers afford an easy and low-priced way to transport bull cargo over long distances around the sea port of the world. The concept of a bulk ship dates back to the 1850s to transport important food grains, ores and minerals. They have helped us to growth of present vast civilization. From the available statistics, more than half of all bulk carriers have registered in Greek, Japanese, or Chinese owners. Again, more than a quarter of bulk ships are registered in panama. This short reviewed article will briefly describe the evolution of the bulk carrier from history including state of designing, building and ending of life of bulk carriers.

Key Words. Bulk, cross-section, gearless bulker,Hy-Con, capsize,handymax,scraps ship

Introduction

A large ship used for transporting bulk cargo in waterways is bulk carrier. A bulk carrier defines as a ship, which is constructed generally with single deck, topside tanks and hopper side tanks in cargo spaces as per Safety of Life at Sea (SOLAS) in chapter XI, Reg-1.[1]A bulk carrier is manufactured to carry dry cargoes in bulk. About forty percent of bulk cargo carries as a stake by the bulk ships of international shipping sector. The market leaders in terms of ownerships and operations of bulk cargo belongs to the South Asian countries like China, Japan and South Korea as those countries have above forty percent ownership share.[2] However, Greece is another leading owner and operator of bulk carriers. South Korea is the largest manufacturer of bulk carriers. Chinese and Japanese shipyards are also built the bulk ships.[2]Statistically eighty two percent of these ships were built in Asia. At present, bulk carriers make up more than fifteen percent of the world's merchant fleets.[3] They are ranged from single hold mini bulk carriers to massive ore ships able to carry 400000 Dead Weight Ton (DWT). A number of specialized bulk ship designs exist in the world. Among them, some bulk ship can unload their own cargo, some depend on port facilities for unloading and some even package the cargo as it is loaded. Bulk ships are transports cargoes in bulk amount. The cargo transported in such ships is loose cargo, usually without any specific packaging to it and generally contains items like food grains, ores, coals, cement, etc. Since their inception towards the mid-19th century, bulk vessels have been revolutionized and streamlined in order to facilitate greater ease for their owners and operators. This reviewed article will briefly describe the evolution of the bulk carriers from history, categories, design concept including state of starting and ending of life of bulk carriers.

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[1]Marine wiki, 2018; marinewiki.org/index.php/Bulk_Carriers; accessed on Jun, 17, 2018.

[2].Wikipedia, 2018; en.wikipedia.org/wiki/BulkCarriers; accessed on Feb, 26, 2019.

[3].Hossain K. A., Suez Canal: The wonder of maritime world, symbiosisonlinepublishing.com, Toxicology Journal, 2018.

History

Bulk carriers were first used commercially in the 1950s to carry large quantities of non-packed commodities such as grains, coal and iron ore.[1]Today, more than five thousand bulk carriers trade around the world, providing a crucial service to world commodities transportation.[3] Before this modern concept, double bottom structure was utilized for single deck ships in 1890. Bulk ship in triangular shaped topside tank structure has introduced for a cantilever framed ship in 1905.[1,4]Specialized bulk carriers began to appear as steam power ships after steam-powered ships became more popular. The first steam ship used as a bulk carrier was the British coal carrier SS John Bowes. Before 2nd World War (WW II), the international shipping demand for bulk cargoes was low. After WW II, an international bulk trade began to develop among industrialized countries, mainly between the European Countries (EC),the United States and Japan.[2] Ocean bulk carriers became larger and more specialized, due to the economics of this trade.

Types and Categories

Today, Bulk vessels can carry a maximum cargo of about 400000 DWT. Bulk carriers are sub-divided into six major classes based on their cargo carrying capacitance and the important marine channels through which they can easily pass. The various classes of bulk carrier in the descending order of cargo capacitance can be elaborated as very large carriers, capesize, handymax, panamax, handysize and small sized. Some other special types of bulkers are BIBO Bulkers (or Bulk In, Bags Out*)* arethese kinds of bulkers streamline the loaded bulk cargo in the vessel by sacking the same into smaller quantities. Self discharging bulkers are those types of bulkers they are internal equipping of transporter belts. On the other hand, gearless bulkers are unequipped with cranes and conveyor facilities.

Bulk Ship Operation and Loading

The crew on a bulk carrier usually consists of 25 approx and for smaller ships around 8. The crew includes the master, chief engineer, the deck dept, the engine room dept and the domestic dept. The practice of taking passenger aboard cargo ships is very rare today. During the 1990s, bulk carriers were involved in an alarming number of shipwrecks. This led ship-owners to commission a study seeking to explain the effect of various factors on the crew's effectiveness and competence. Crews on better-maintained ships performed better, as did crews on ships where fewer languages were spoken. Fewer deck officers are employed on bulk carriers than on similarly sized ships of other types. A bulk carrier's voyages are determined by market forces; routes and cargoes often vary. A ship may engage in the grain trade during the harvest season and later move on to carry other cargoes or work on a different route.

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[1]Marine wiki, 2018; marinewiki.org/index.php/Bulk_Carriers; accessed on Jun, 17, 2018.

[3.]Hossain K. A., Suez Canal: The wonder of maritime world, symbiosisonlinepublishing.com, Toxicology Journal, 2018.

[4]Lamb,T. , “Ship Design and Construction Vol. I. “ Jersey City: Society of Naval Architects and Marine Engineers. ISBN 0-939773-40-6, 2003.

[2]Wikipedia, 2018; en.wikipedia.org/wiki/BulkCarriers; accessed on Feb, 26, 2019.

Bulk carriers spend more time in port than other ships, because of difficult to discharge bulk cargo. A bulk carrier takes, on average, twice as much time to unload a ship as it does to load on. Loading and unloading a bulk carrier is time-consuming and dangerous. International regulations require that the captain and terminal master agree on a detailed plan before operations begin. Loading errors may even cause a ship to capsize or break in half at the jetty or outer anchorage area. The loading method used depends on both the cargo and the equipment available on the ship and on the dock. In the least advanced ports, cargo can be loaded with shovels or bags poured from the hatch cover. This system is being replaced with faster, less labor-intensive methods. Double-articulation cranes, can load a ship at a rate of 1000 tons per hour. It is a widely used method. The use of shore based gantry cranes, can load a ship 2000 tons per hour. For modern gantry cranes, the usual time of the grab-deposit-return cycle is around a minute.

Conveyor belts are a very efficient method of loading, with standard loading rates varying between 100 and 700 tons per hour. The most advanced ports can offer rates of 16000 tons per hour. Self-discharging ships use conveyor belts with load rates of around 1000 tons per hour. Once the cargo is discharged, the crew begins to clean the holds. This is particularly important if the next cargo is of a different type. When the holds are clean, the process of loading begins immediately. It is crucial to keep the cargo level during loading in order to maintain stability.[5] As the hold is filled, machines such as excavators and bulldozers are often used to keep the cargo in check. Leveling is very important when the hold is partly full, since cargo is more likely to shift. An extra precaution has usually taken for smooth loading. Such as adding longitudinal divisions and securing wood atop the cargo.

Design Concept

A bulk carrier design is principally defined by the cargo that will carry, size and the demand of owner. The cargo's density as known as its stowage factor is the key factor to design a bulk ship.[2] Again densities for common bulk cargoes vary from 0.6 tons per cubic meter for light bulk like food grains to 3 tons per cubic meter for heavy bulk like iron ore. The overall cargo weight is another limiting factor in the design of an ore carrier.[2] On the other hand, coal carriers are limited by overall volume, since most bulk carriers can be completely filled with coal before reaching their maximum draft. Another limiting factor which governs the ship's dimensions is the size of the ports and waterways like allowable beam, draft, length of the canal or river or port.[4,2]Bulk Carriers are generally developed for a wide range of main particulars and capacity. Bulk Carriers may less than 100 m long or more than 350 m long with a capacity of 400000 DWT. Today’s bulk carriers are generally characterized by a single screw type of vessel with a high block coefficient hull.[6]

[5]Hossain K. A., Analysis of important steering factors which give Success to Global Shipbuilding Leaders, Journal of recent advancement of petrochemical science, Volume 4, Issue 5, Jan 2018.

[2]Wikipedia, 2018; en.wikipedia.org/wiki/BulkCarriers; accessed on Feb, 26, 2019.

[4]Lamb,T. , “Ship Design and Construction Vol. I. “ Jersey City: Society of Naval Architects and Marine Engineers. ISBN 0-939773-40-6, 2003.

[6]Hossain, K. A., “Ship recycling practice and annual reusable material output from Bangladesh ship recycling industry,” Journal of fundamentals of renewable energy and application, Vol 7, Issue 5, Sep 2017.

For bulk ship, special attention needs to be paid to the design of the fore body (bulbous bow), resulting in good wave pattern, a low overall resistance and related good propulsion

performance. Again, an excellent after body design, with a good flow towards the propeller and rudder, without flow separation is an important concern.

Handysize and Handymax size bulkers comprise of around 70 percent of the total dry bulker fleet. This size of bulk carriers are seeing the maximum growth rate in today's market, as shipping companies prefer smaller sizes due to many restrictions put on ships of larger size. Ships of these size are also able to access most of the ports and canals, which increases their scope of trade-making abilities. The use of double hull in bulk carrier designs has increased rapidly over the last ten years. The wing tanks at the sides are an added advantage, and provide more marginal ballast, and better control on the stability of the ship. Again, Ore-Bulk-Oil Carriers have holds such arranged that they can carry ore, solid dry bulk, and oil in the same voyage, without interference between each cargo type. We will discuss the design of these bulk carriers in a later stage of this article. On the other hand, Ore and Oil carriers can carry a combination of ore and oil in the same voyage. These vessels need to comply with special codes that are to be followed for containment and transportation of oil at sea.[7]A typical Bulker side view, 3D view, body plan and stem area view has been shown in figure 1 below.The characteristic feature of a bulk carrier's hull geometry is its high coefficient of buoyancy. In other words, it has a full-form, which means when compared to finer form ships like container ships or naval warships, the volume of the hull at the forward and aft sections is higher in case of a bulk carrier. The ballast capacity of bulk carriers is usually high so as to achieve propeller immersion.[8]All bulk carriers today have a transom stern and a bulb shaped aft below the waterline which allows undisturbed streamlined flow onto the propeller disc and maximizes the propeller efficiency. The design speed of most bulkers is range from 12 to 18 knots.[9] Section plan and hull shape of different types of Bulk/Cargo Carrier has been shown in figure 2 below.

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[7]BrennonBorbon, "List of All Ships Scrapped Worldwide in 2016" September 9, 2017, http://rstudio-pubsstatic.s3.amazonaws.com/306134_ebb046c5dff146cdb01fccc14b45c635.html, accessed on Jul, 28, 2018.

[8]worldmaritimenews.com/archives/213139/clarksons-2016-busy-year-for-scrapping, accessed on Jul, 28, 2018.

[9]Hossain K. A.,"Development of an Assessment Model for Ship Recycling Industry in Bangladesh" Proceedings of the 2nd International Conference on Industrial and Mechanical Engineering and Operations Management (IMEOM), Dhaka, Bangladesh, December 12-13, 2019.

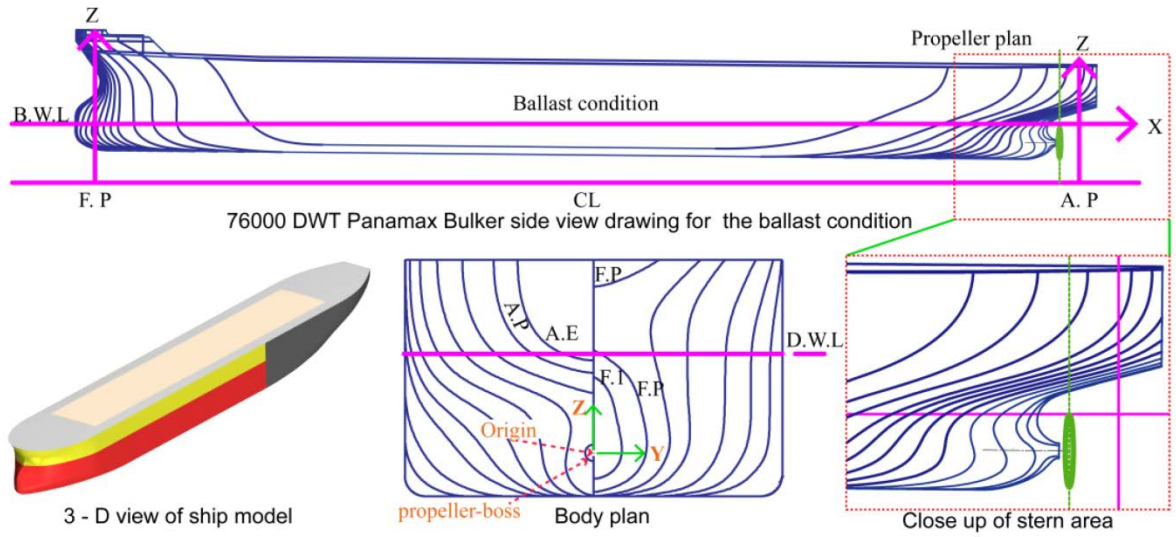

Figure 1: Typical Bulker side view, 3D view, body plan and stem area view.[10,11]

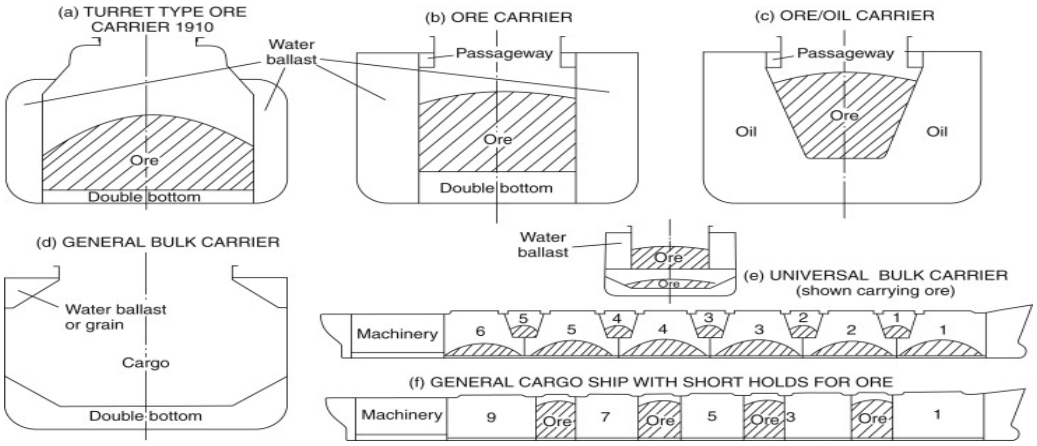

Figure 2: Section plan and Hull shape of different types of Bulk/Cargo Carrier[12]

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[10]Hossain, K. A., "Material Flow Analysis (MFA) is A Better Tool to Calculating Reusable Material For Ship Recycling" 11th International Conference of Marine Technology, Proceeding MARTEC 2018, UTM, Malaysia, Aug 13-14, 2018

[11]Hossain, K. A., "Calculation of Yearly output of reusable material of Ship Recycling Industry of Bangladesh," Journal of Recent Advancement of Petrochemical Science, Vol 5, Issue 3, Jun 2018.

[12]Hossain K. A., Suez Canal: The wonder of maritime world, symbiosisonlinepublishing.com, Toxicology Journal, 2018.

Bulk Ship Design and Construction

Bulk carriers are usually to design for easy to build and to store cargo efficiently with ensuring stability. To facilitate construction, bulk carriers are built with a single hull curvature. A bulbous bow allows a bulk ship to move more efficiently through the water. Naval architects like full hulls, with large block coefficients, are almost universal. As a result, bulk carriers are inherently slow. However this is offset by their efficiency. Comparing a ship's carrying capacity in terms of DWT to its weight when empty is one way to measure its efficiency. It is interesting to know that, a small Handymax ship can carry five times its weight. Whereas a Capesize ship can carry eight times its weight. Bulk carriers have a cross-section typical of most merchant ships. The upper and lower corners of the hold are used as ballast tanks, as is the double bottom area. The corner tanks are reinforced and serve another purpose besides controlling the ship's trim.

Naval architects choose the angle of the corner tanks to be less than that of the angle of repose of the anticipated cargoes. This idea greatly reduces side-to-side movement, or shifting of cargo which can endanger the ship during loading or voyages. The double bottoms are also subject to design constraints. The primary concern is that it should be high enough to allow the passage of pipes and cables. These areas must also be roomy enough to allow people safe access to perform surveys and maintenance. On the other hand, concerns of excess weight and wasted volume keep the double bottoms very tight spaces. Bulk carrier hulls are made of steel, usually steel. However, some manufacturers have preferred high-tensile steel recently in order to reduce the tare weight. Again, the use of high-tensile steel for longitudinal and transverse reinforcements can reduce the hull's rigidity and resistance to corrosion. Ship’s transverse partitions are made of corrugated iron, reinforced at the bottom and at connections.

Double hulls have become popular in the past ten years. Designing a ship with double sides adds primarily to its breadth, since bulk carriers are already required to have double bottoms. One of the advantages of the double hull is to make room to place all the structural elements in the sides, removing them from the holds. This increases the volume of the holds, and simplifies their structure which helps ships in loading, unloading, and cleaning. Double sides also improve a ship's capacity for ballasting. The ship may have to increase its draft for stability or sea keeping reasons, which is done by adding ballast water. A recent design, called Hybrid Configuration (Hy-Con), where ship has design doubles the forward-most and rear-most holds and leaves the others single-hulled. This approach of naval architect has increased the ship's solidity at key points, while reducing the overall tare weight. Actually, double hull has been more of an economic than a purely architectural decision, some argue that double-sided ships receive less comprehensive surveys and suffer more from hidden corrosion. However in spite of opposition, double hulls became a requirement for Panamax and Capesize vessels since 2005.

Naval architects use the correlation between longitudinal strength and a set of hull thicknesses called scantlings to manage problems of longitudinal strength and stresses. A ship's hull is composed of individual parts called members. The set of dimensions of these members is called the ship's scantlings.[13]

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[13]J.H. Park, J. H., Choi, J. E., and H.H. Chun H. H., “Hull-form optimization of KSUEZMAX to enhance resistance performance**”** Int. J. Nav. Archit. Ocean Eng., 7 (1) (2015), pp. 100-114, 2015.

Naval architects calculate the stresses a ship can be expected to be subjected to, add in safety factors, and then can calculate the required scantlings. These analyses are conducted when traveling empty, loading and unloading, when partially and fully loaded, and under conditions of temporary overloading. Places subject to the largest stresses are studied carefully, such as hold-bottoms, hatch-covers, bulkheads between holds, and the bottoms of ballast tanks. Since April 2006, the International Association of Classification Societies has adopted the Common Structural Rules. The rules apply to bulk carriers more than 90 meters in length and require that scantlings' calculations take into account items such as the effect of corrosion, the harsh conditions often found in the North Atlantic and dynamic stresses during loading. The figures 3, 2 and 3 shown below are the general arrangement (Profile view, Plan view, and Midship Plan) of a bulk carrier. A common dry bulk carrier has a clear main deck with the machinery room and superstructure. Hatches with unrestricted access to holds are designed on the main deck with steel hatch covers to facilitate easy loading and discharge of cargo. A Lines plan of a 1990 Capesize ore carrier has been shown below in fig 3. A Typical midship section of a bulk carrier with a single hull and double bottom has been shown below in fig 4.A typical cargo crane, hatch and hold arrangement of a bulk carrier has been shown below in fig 5.

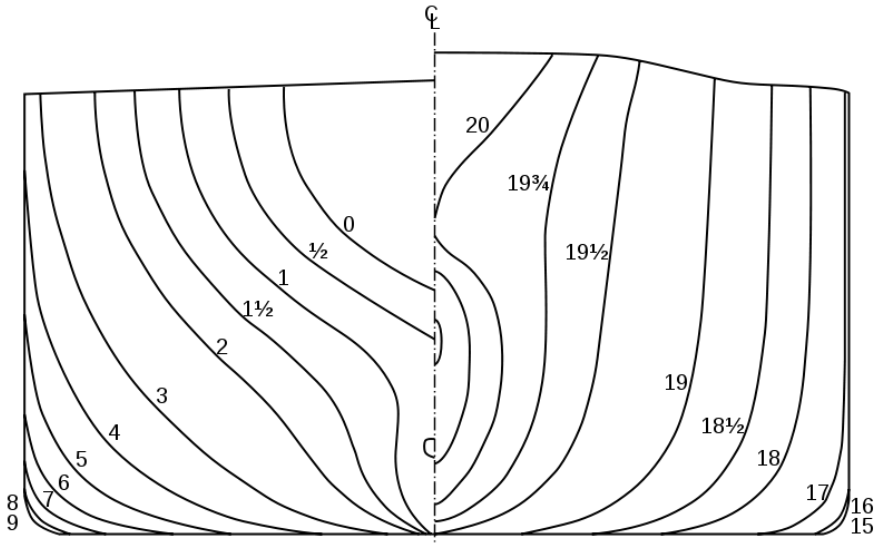

Fig 3: A Lines plan of a 1990 Capesize Bulk or ore carrier[14]

[14]Hossain, K. A., “Ship recycling status of Bangladesh and annual reusable material output,” Journal of Toxicology, Vol 2, Issue 2, Oct 2017.

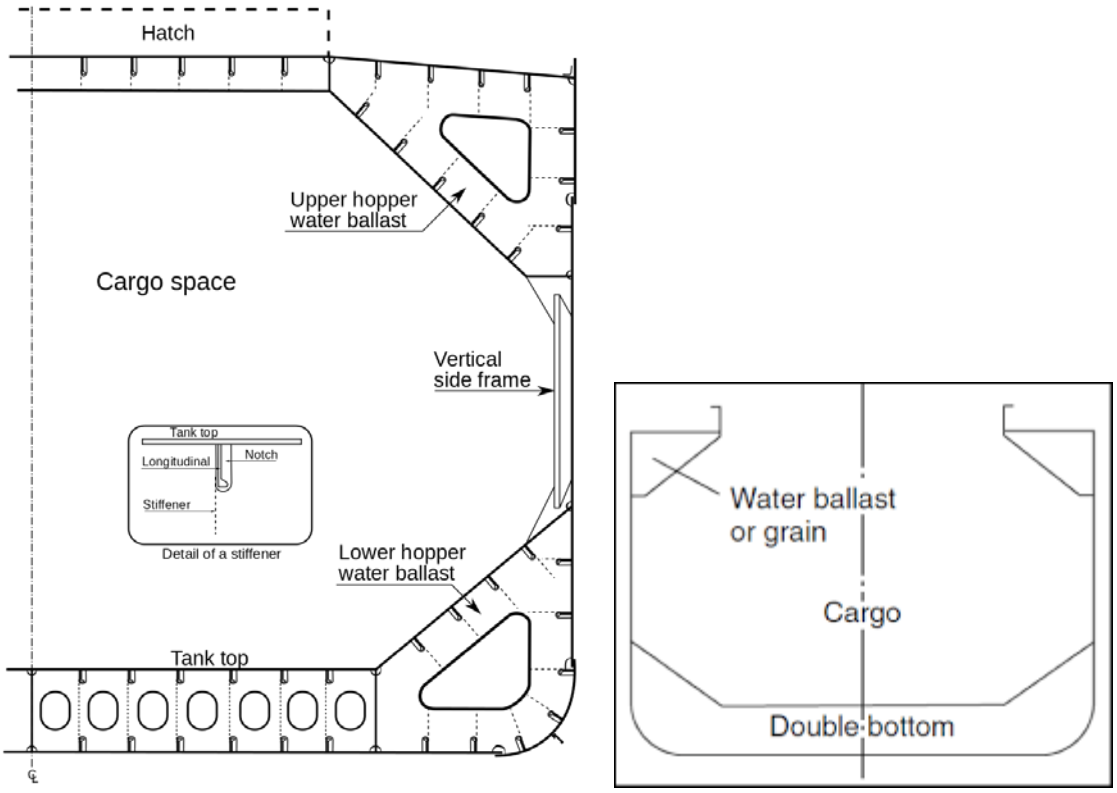

Fig 4: A Typical midship section of a bulk carrier with a single hull and double bottom[15]

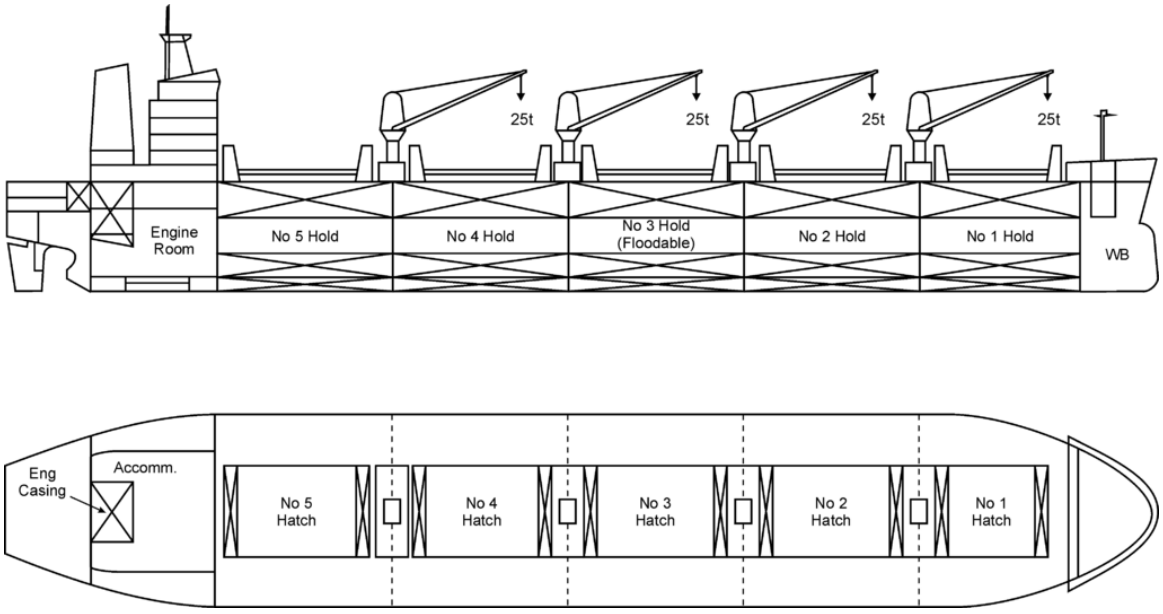

Fig 5: Cargo Crane, Hatch and Hold arrangement[16]

[15]Marine wiki, 2018; marinewiki.org/index.php/Bulk_Carriers; accessed on Jun, 17, 2018.
[16]Wikipedia, 2018; en.wikipedia.org/wiki/BulkCarriers; accessed on Feb, 26, 2019.

Safety and Stability

Many bulk carriers sank during 1980s and 1990s, where 99 were lost between 1990 and 1997 alone. Most of these were sinking suddenly and it was impossible for the crew to escape and few hundred (approx 650) sailors were lost during that time. A series of international safety resolutions regarding bulk carriers were adopted during the 1990s.Cargo shifting causes a great danger for bulk carriers. The problem is even more serious with grain cargoes, since grain settles during a voyage and creates extra space between the top of the hold. Cargo is then free to move from one side of the ship to the other as the ship rolls. This can cause the ship to list and that causes more cargo to shift. This kind of chain reaction can capsize a bulk carrier very easily. The 1960 SOLAS Convention need to adopt new regulations; like the upper ballast tanks designed in a manner to prevent shifting. They also required cargoes to be leveled by using excavators in the holds.The practice of leveling reduces the amount of the cargo's surface area in contact with air for cargoes like coal, iron, etc. Another sort of risk that can affect dry cargoes is absorption of ambient moisture, as it creates free surface effect. The only way to control these risks is by good ventilation practices and careful monitoring of water and moisture. In 1990 highest 20 bulk carriers sank and the American Bureau of Shipping (ABS) identified that the losses were directly traceable to failure of the cargo hold structure. Again Lloyd's Register of Shipping added that the hull sides could not withstand due to local corrosion, fatigue cracking and operational damage.

The new rules adopted in the 1997 annexes to the SOLAS Convention focused on problems such as reinforcing bulkheads and longitudinal frame, more stringent inspections and routine port inspections. For crew safety since December 2004, Panamax and Capesize bulk carriers have been required to carry free-fall lifeboats, placed on the stern. As a result, it allows the crew to abandon ship quickly in case of a catastrophic emergency. Again since December 2002, Chapter XII of the SOLAS convention was amended to installation of high-level water alarms and monitoring systems on all bulk carriers. As a result, the bridge and the engine room watch keepers can take necessary in case of flooding in the holds of the ship.A Japanese dry bulk carrier transporting wood chips grounded during a storm and later broke apart off the port of Hachinohe on the northeast coast of Japan’s main island of Honshu on 11 August 2021. The Japan Coast Guard successfully evacuated the crew without incident and initially reported that the vessel was not in danger.[17]

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[17]The world merchant fleet in 2012 Archived 22 Jan 2015 at the Way-back Machine. Statistics from Equasis, Retrieved 2015-07-15.

The MV Wakashio ran aground and caused oil leakage near Blue bay Marine Park in southeast Mauritius on August 11, 2020. The MV Wakashio, a Japanese-owned but Panamanian-flagged vessel, ran aground in July 2020, spilling more than 1,000 tonnesof toxic fuel into the pristine waters of Mauritius, coating mangroves, corals and other fragile ecosystems.[18]B0th the bulker accident has been shown in figure 6 below.

Fig 6: A Japanese and a dry bulk carrier grounded during a storm and later broke apart[19]

Global Shipbuilding Market

Usually shipbuilding market of merchant-ship has divided into few categories like, oil tankers, bulk carriers, container ships, general cargo ships, and passenger ships. Global shipbuilding market share by main ships types in 2020 has been shown in figure 7 below. In 2020, the Bulk carrier sector dominated the shipbuilding market with the largest market share. Bulk carriers are the merchant ships mainly developed to transport bulk amounts of unpacked cargo, like coal, ore, cement, steel coils, food grains, etc. These ships are usually rough and dense. These kinds of ships are designed to increase capacity, durability and efficiency. Again on the basis of end-use, the shipbuilding market is classified into transport and military. In 2020, the transport segment has dominated the shipbuilding market by acquiring the maximum revenue share (IHS Markit 2022). [20]

Forecast of Global Shipbuilding Market by 'KBV Research'

The forecast of future global shipbuilding market (both commercial and military together) by size or value in billion USD has been shown in fig 8 below. It has expected that shipbuilding market will reach USD 176.1 billion within 2027.

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[18]Global merchant fleet; number of ships by type 2019, Statista.Archived from the originalon 22 December 2019, Retrieved 23 May 2021.

[19]Maritime Safety Committee's 70th Session, 1999.American Bureau of Shipping, Archived from the original on 4 September 2007, Retrieved 19 May 2021.

[20]IHSMarkit, Maritime and trade research and analysis, Feb 2022, available at: https://ihsmarkit.com/research-analysis/shipbuilding, (Accessed on 20 Jun 2022).

The average growth of shipbuilding markets is 3.4% (as CAGR) during the forecast period (2017-2027). However, 'main factors responsible for the growth of the shipbuilding market are seaborne trade, rising demand for cargo transportation, increasing agreements related to trade, advanced technologies adopted by the ships, and automation in ships' (KBV Research 2022).[21]

Today's modern specialized ships design and building is high-tech and complicated affair. As example, nuclear aircraft carrier can travel around globe with a mini airport and hundred aircraft for few decades without refueling; nuclear submarines are capable of attacking enemy territory from deep sea by in disguise and can stay underwater around six months. Modern cruise vessel, oil tanker or buikers are so colossal that those looks like a small city.

Salient factors driving growth of the global shipbuilding market are 'GDP, economic growth, global seaborne trade, incremental demand for cargo transportation through sea, trade-related agreements, technological advancements, market trend of EOL ships, marine rules and regulation, trend of automation in marine transport sector' (Hossain K 2021).[22] However, variations in transportation and inventory costs, ecological concerns, and global financial or other unfortunate crisis like COVID-19 pandemic or Russian war on Ukraine; which affect globally are few significant trends that could hinder growth of such market.

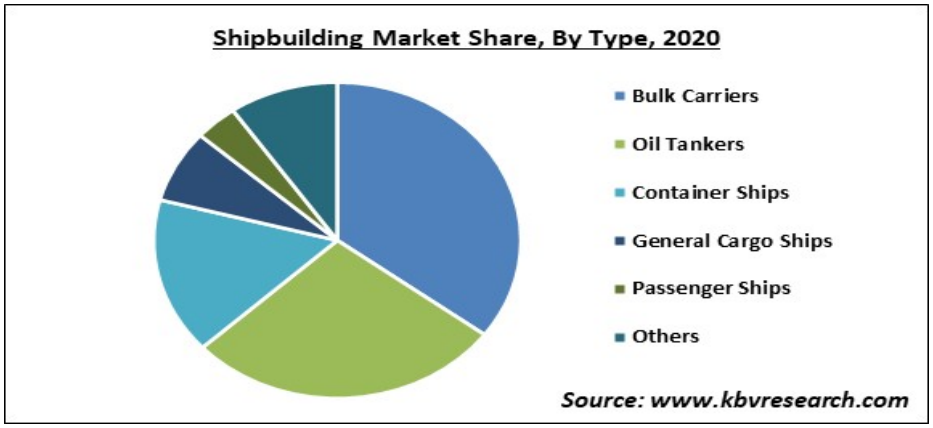

Fig 7: Global merchant shipbuilding market share by main ships types in 2020[23]

[21]KBV Research (2022) Shipbuilding market size and share, available at: https://www.kbvresearch.com/shipbuilding-market, accessed on 29 May 2023

[22]Hossain Commodore K Akhter (2021a) Ship recycling process and material distribution channel model for Bangladesh, Journal of BIMRAD, Published on 05 Aug 2021.

[23]New IMO bulk carrier regulations enter into force on 1 July 1999, International Maritime Organization, Archived from the original on 26 September 2007, Retrieved 20 Mar 2021.

Fig 8: Forecast global shipbuilding market (commercial and military) in billion USD[24]

Trend Analysis of Global Shipbuilding New-Orders

Let's see the trend of global shipbuilding industry. The two-thirds of global ship building were of dry bulk carriers and tankers. In 2020, ship deliveries declined by 12%, mainly due to lockdown induced labour shortages and that disrupted marine industrial activity. In 2020, the new-ships delivered were mostly bulk carriers, followed by oil tankers and container ships and that has been shown in table 1 below (UNCTAD 2021).[25]Since 2015, an increasing proportion of shipbuilding has been taken place in four countries. Those are: China, South Korea, Japan, and Philippines.

[24]Review of Lifeboat and Launching System Accidents, Marine Accident Investigation Branch, Retrieved 21 Nov 2020.

[25]UNCTAD (2021a) Ship recycling by countries annual, Jun 2021, available at: http://stats.unctad.org/shiprecycling, accessed on 03 May 2023

Ships type	China	South Korea	Japan	Philipp ines	Rest of the world (ROW)	Total	Percen tage (%)
Bulk Carries	15,051	1,442	9,383	551	311	26,738	46
Oil Tankers	2,702	7,071	1,901	1	478	12,152	21
Container ship	2,665	5,357	394	56	200	8,671	15
Gas Carriers	869	4,046	353		7	5,275	9
Ferries and passenger Ships	251	64	76		1,208	1,600	3
Chemical Tankers	488	88	465		55	1,095	2
General cargo	390	1	142		360	893	2
Offshore	340	101	7		118	566	1
Other	501	4	107		162	775	1
Total	**23,257**	**18,174**	**12,827**	**608**	**2,898**	**57,765**	**100**
Percentage	**40%**	**31%**	**22%**	**1%**	**5%**	**100**	**%**

Table 1: Deliveries of new-building merchant ships (thousand gt) by the countries in 2020[26]

[26]Double-Hull Tanker Legislation: An Assessment of the Oil Pollution Act of 1990, Marine Board Commission on Engineering and Technical Systems, 1998, Retrieved 23 Jun 2020.

Global Ship Recycling State

Ships are generally removed from the fleet after end of life (EOL) through a process known as recycling. Ship owners and buyers negotiate scrap prices based on few factors; ship's empty weight or LDT and prices in the scrap metal or recycle market. In 1998 almost 700 ships went through the recycling process at ship breakers in places like Chottogram, Bangladesh, Alang, India and Karachi, Pakistan.[27, 28]The world wide ship recycling industry dismantles around 1000 large ocean-going vessels annually, where more than 50% are tanker.[29, 30]In 2020, 'almost half of the recycling was of bulk carriers, reflecting declining charter rates and following the trend of recycling ageing tonnage in LDT' (Jiang 2021, Clarksons Research 2021c).[31] Around two-thirds of reported tonnage (LDT) sold for recycling in 2020 was in Bangladesh and India. 'With Pakistan and Turkey, the share of the top four countries reached 93% and that has been shown in the table 2 below. The highest increases in shares have observed for Pakistan, by 14.7%, and for India by 3.2%' (UNCTAD 2021d).[32] However, there were visible reductions in Bangladesh, by 15% and in China by 2%. Market share of China has reduced due to ban on recycling international ships (in 2018). And, Bangladesh market share has declined due to local restriction by government regulation.

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[27]Double-skin bulk carriers: Paradise or problem, The Naval Architect, May 2003.
[28]Understanding Design of Bulk Carriers, Marine Insight, https://www.marineinsight.com › naval-architecture, Retrieved 23 Jun 2020.
[29]https://www.hydracaptainsclub.gr/double-skinned-bulk-carriers, Retrieved 22 Jan 2021.
[30]https://www.motorship.com/news101/industry-news/doubling-up-proves-of-benefit-beyond-safety, Retrieved 21Nov 2020.
[31]Jiang J (2021). IMO 2020 and demolition volumes splash 24/7, June 2021.
[32]UNCTAD (2021b) Trade and Development Report 2021, Mar 2021, available at: https://unctad.org/webflyer/trade-and-development-report-2021,accessed on 21 May 2023
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Ship Types	Bangladesh	India	Pakistan	Turkey	China	Rest of the world	World Total	Percentage
Bulk Carries	5,254	1,317	1,718	34	125	61	8,509	**48.9**
Container ship	160	1,428	282	206		68	2,143	**12.3**
Oil Tankers	616	410	617	159	10	226	2,038	**11.7**
Offshore supply	125	257	4	308	3	273	969	**5.6**
Ferries/ passenger Ships	26	279		545	3	26	879	**5.1**
General cargo	176	219	175	203	47	29	848	**4.9**
LPG/ LNG	169	241		8		176	594	**3.4**
Chemical Tankers	12	125	94	1		10	241	**1.4**
Others	157	786		135	9	93	1,180	**6.8**
Total	6,694	5,061	2,890	1,598	195	962	17,401	**100**
Percentage	**38.5**	**29.1**	**16.6**	**9.2**	**1.1**	**5.5**	**100**	**(%)**

Table 2: Global ship recycles in LDT in thousand gross tonnes sold in 2020.[33]

[33]ToshijuliShigemi and Tingyao Zhu, Extensive study on the design loads used for strength assessment of tanker and bulk carrier structures, Journal of marine science and technology (Online), NKK, Jan 2004.

Bangladesh Ship Recycling State

In Bangladesh, average 200 different types of obsolete ships are recycled annually in different yards located in Chottogram. [27,28,30]Again, from on ground statistics of ship recycling yards of Bangladesh, we can see that, average 2000000 LDT different types of scrap ships are recycled annually in different yards in Bangladesh. [29,30]In figure 9 below, total LDT of different types and size of ships recycled and reusable material output in Bangladeshi recycling yards between the years 2009 to 2015 has been shown. The most basic level of the waste and reusable material flow diagrams for recycling of a sample bulk carrier (out of 26) EOL ships, developed by software STAN [34,35,36,30,37,38,39 and 40], is shown in figure10 and 11 respectfully in local yards in Bangladesh. Estimation and output of reusable and waste material of different types and sizes of 5 sample EOL bulk carriers by using MFA technique has been shown in fig 12 and 13 respectively.[30],[41],[42],[38],[40]Two large bulk ships have been shown in figure 14 below. The detail and exclusive data, analysis, result, graph and output has been described in my Ph D research work. [37,38,43]

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[27]Double-skin bulk carriers: Paradise or problem, The Naval Architect, May 2003.

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[43]Hossain K. A., Ship Recycling Process and Material Distribution Channel Model for Bangladesh Ship Recycling Industry, Vol 2, Issue 1, Journal of BIMRAD, May, 2021.

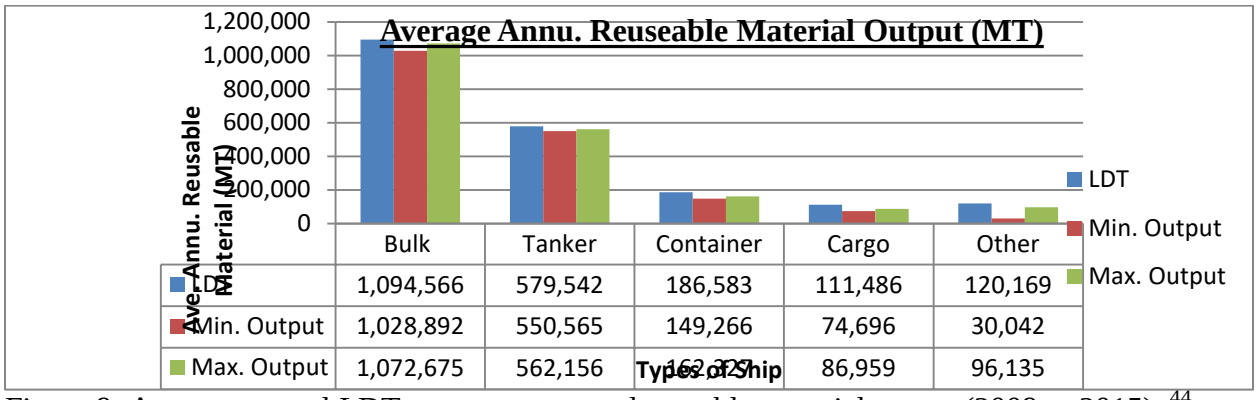

Figure 9: Average annual LDT vs average annual reusable material output (2009 to 2015). [44]

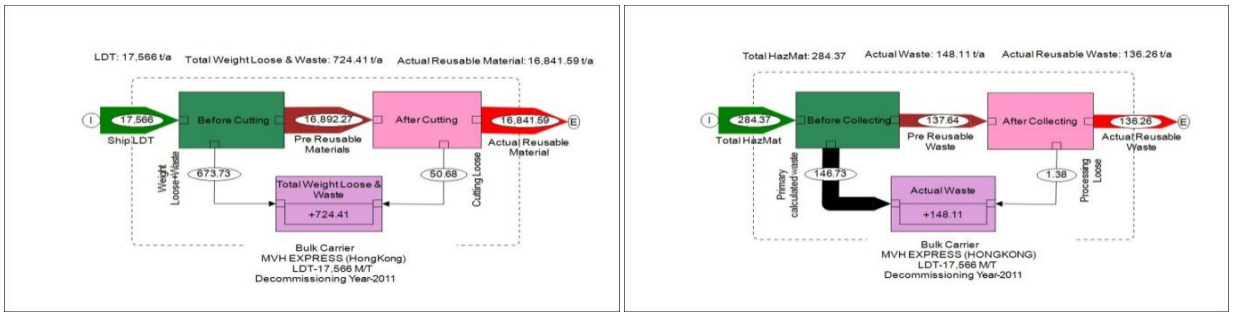

Fig 10 and 11: Reusable and Waste material flow diagrams for recycling of a sample bulk carrier EOL ship dismantle in Bangladeshi recycling yards. [45]

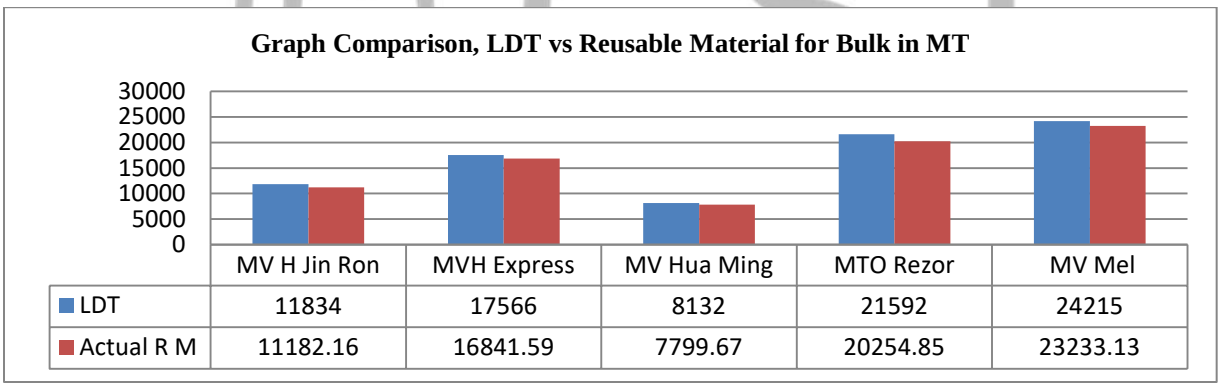

Fig 12: Estimation and output of reusable material of different types and sizes of 5 EOL bulk carriers. [46]

[44] KhandakarAkhterHossain, Story of Containerization, CPA Journal and News, Vol 4, Issue 3, Oct, 2019.
[45] IHSMarkit, Maritime and trade research and analysis, Feb 2022, available at: https://ihsmarkit.com/research-analysis/shipbuilding, (Accessed on 20 Jun 2022).
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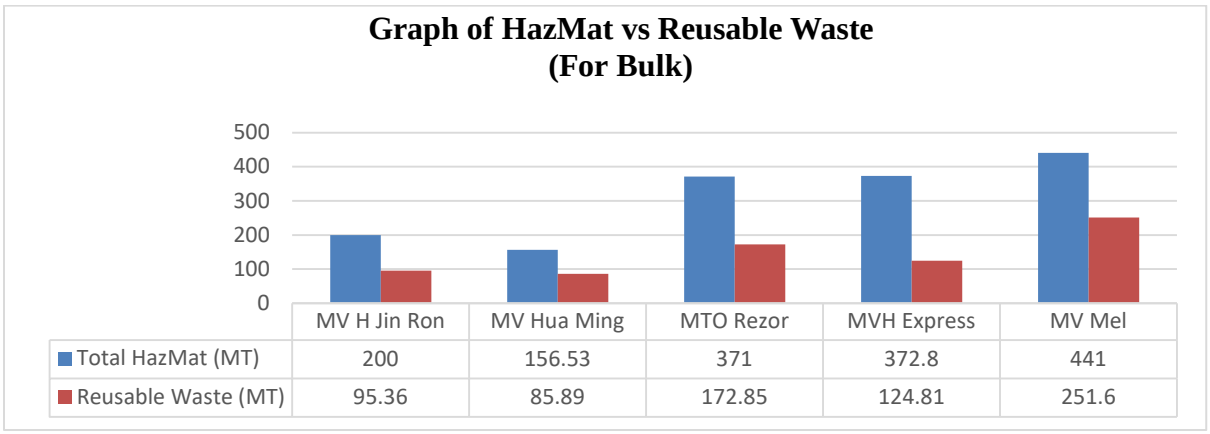

Fig 13: Estimation and output of waste material of different types of 5 EOL bulk carriers. [47]

Fig 14: Images of two Bulk ships[48,49]

Conclusion

The bulk ships have a stake of about forty percent in the international shipping sector. South Korea is the largest single builder of bulk carriers. Statistically more than eighty percent of these ships were built in Asia. At present, bulk carriers make up more than fifteen percent of the world's merchant fleets. The International Association of Classification Societies has adopted the Common Structural Rules since April 2006 and now bulk shi are more safe and stable. Again for crew safety since December 2004, Panamax and Capesize bulk carriers are carrying free-fall lifeboats, placed on the stern as per SOLAS new adopted rules in 1997.

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[47] Clarksons Research (2021b) Seaborne Trade Monitor, Volume-8, No-6, June 2021.
[48] Clarksons Research (2021c) Shipping Intelligence Weekly, No-1478, 25 June 2021.
[49] Clarksons Research (2021d) World Shipyard Monitor, Volume-28, No-1, Jan 2021.

At present, South Asia is the global centre for ship recycling activities including EOL bulk carriers.A total of 933 ships of a combined 44.4 million DWT were scrapped in the year 2016. Global major recycling yards are located in India, Bangladesh, Pakistan, China and Turkey. [41, 50, 40] In ship recycling yards of Bangladesh, average 2000000 LDT different types of obsolete ships are recycled annually[41], where 30% are bulk carriers. Bangladeshi recycling yards are dismantling around 30% of global EOL ships including 30% of global scrapped bulk carrier in term of DWT.

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