

Environmental Impacts of Ship Dismantling- The Case of Aliaga in Turkey

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Abstract— The scope of this project is the environmental impacts which result from ship scrapping. At the beginning, information for ships' life cycle are presented, emphasizing in the issue of ship dismantling. In the main body of this project, is concerned general information on ship dismantling, the areas where this process is conducted, ways that it is performed, and the consequences that are occurred from each action. The outcome is that there is a detrimental fact which affects the environment and the human being. Nevertheless, any kind of pollution that comes from ship recycling industry is analyzed further. Such a study could not have been conducted without examining the institutional framework. It is focused on the case of the Aliaga region in Turkey, where the scrap method is flourishing the last few decades. A risk assessment of working conditions was made at this area and was held an investigation about regulations that came in force. The policy of the most established businesses performing this process in this region is based on the regulations supported by the specific market. Focusing on the current situation in ship dismantling in Turkey, at the end of this study, some substantial

Keywords— Ship dismantling; Ship Recycling; Legislation; Safety; Aliaga Turkey

I. INTRODUCTION (HEADING 1)

Ship dismantling is a notable sector for countries which have a port and reveals environmental and economic perspectives. Ship breaking is the dismantling process of those vessels which have surpassed the blooming period of their life cycle. Simultaneously this field is progressively evolved by seeking new ways towards the attainment of sustainability. Ship recycling gives the chance to reuse many more valuable materials, consequently, this will enhance the economy and thus, ship breaking might be considered as a green process. Undoubtedly, although the efforts that are made, there are many cases that could place human's health, insurance and environment in jeopardy. That is to say that worker's safety in ship breaking areas should be taken into serious account. By discussing the Aliaga case in

Turkey the current legislation will be examined in parallel to a swot analysis which will clarify the benefits and the drawbacks of Turkey's attitude.

II. THE INCEPTION OF SHIP DISMANTLING PROCEDURE

A. Overview

It is important to investigate the scrapping way followed by Aliaga ship breaking area, to dwell on the existing legislation and new legislation that should be implemented. The environmental impact is caused by ship dismantling, which affects the surrounding area and simultaneously puts public health at risk.

It is essential to be known that ship scrapping has advantageously contributed to the labor market, hiring many people at this field annually. Meanwhile, due to the fact that the difficulty level is significantly high, more men than women prefer this kind of job.

To begin with, it is true that a normal ship's life cycle dues between 25 to 30 years and from that moment it is considered that its productive period is over. This is because after this period the vessel stops being profitable, and any potential damage repair will not be cost effective.



Fig. 1. Ship Life- cycle.[1]

Ship dismantling is a demanding procedure that should be taken into serious consideration worldwide. Ship recycling affects shipping industry as it balances supply and demand in ship market and enhances sustainability.[2] After World War II, it started elaborating in industrialized countries and within 25

years it expanded to Asia, while in 1990s it arrived in Turkey and settled in Aliaga region. It would be beneficial if the ship dismantling became a green industry, since entire ship parts could be disrupted, reused, recycled and resold whilst it is necessary to note that this is a market highly profitable for the shipowners.

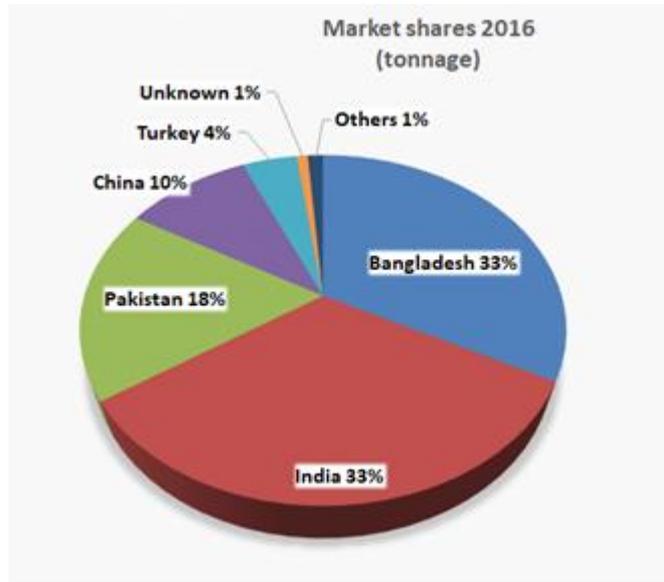


Fig. 2. Ship scrapping by tonnage in 2016.[2]

B. Maintaining the Integrity of the Specifications

III. THE DISMANTLING PROCEDURE AND ITS EFFECTS

A number of steps should be followed in order for a ship to be dismantled within a normal time frame. The most important prerequisite to comply with the deadlines is the preparation that is carried out prior to dismantling operations. This requires peoples' coordination, such as removal of crew's supplies, oil draining off, cleaning the tanks, removal of hazardous wastes etc. [4]

A. Hazardous Materials and Security Measures

Disposal of hazardous materials during ship recycling is very common and it has a destructive effect to the environment. The substances are divided into solid (solid foam), liquid (oil, fuel) and atmospheric pollutants. Asbestos, a known human carcinogen substance can cause chronic lung disease, as well as lung and other types of cancer. So, asbestos is specially treated during shipbreaking, by an expert team fully armed with personal protective equipment and tools such as disposal cloth, groove, masks, special shoes etc. Every country that has a ship breaking area generates this kind of team which is trained completely in order to carry through with this procedure. Because of the extremely hazardous impacts in health, there are dedicated rooms especially for asbestos which are labeled with an obvious warning to prevent any entrance of non-asbestos dismantling workers. Asbestos use is nowadays eliminated in ship building. [5]

TABLE I. HAZARDOUS MATERIALS EXPOSED DURING SHIP SCRAPPING.[6]

Hazardous Materials Exposed During Ship Scrapping	
Asbestos	Polybrominated biphenyl (PBBs)
Polychlorinated Biphenyls (PCBs)	Polybrominated biphenyl ethers (PBDEs)
Anti-fouling systems containing organic compounds as a biocide	Polybrominated naphthalene's
Cadmium and cadmium compounds	Radioactive substances
Hexavalent chromium and hexavalent chromium compounds	Chlorinated paraffins
Mercury and mercury compounds	

In yards, there is a number of employees between 800-1200, which is estimated to create 8000 new positions.

Generally, workers who remove and dispose hazardous materials and work in dismantling areas should be trained in

a strict way, getting all the necessary information and instructions on how acting in an emergency. The worker's daily exposure to cutting metals, combusting substances, elevated surfaces are for sure some of the reasons that governments should take into consideration and approve some measures and techniques that will develop the environmental protection and human health. [6]

As a result, in ship breaking areas in Asia every employer should have an employment contract which will be covered by a scheme for workers' compensation and social protection. The Reduction of Hours of Work Recommendation, 1962 (No. 116), is considered as a guide for working-time arrangements. So, working hours should be arranged so as to provide adequate periods of rest, short breaks for meals, daily or nightly rest, weekly rest and thus, employees will be alerted and well-rested to complete their responsibilities.

In view of the hazardous nature of shipbreaking, night work should be avoided. If, however, night work is required, it should be organized in accordance with the Night Work Convention and Recommendation (No. 178), 1990, whose provisions must be implemented by national laws and regulations, collective agreements or appropriate national conditions and practice.

Safety measures should be taken concerning workers' health, by monitoring and examining them through examinations in order to ensure their physical health and avoid threats such as hearing loss, accidents and so forth. However, dining facilities and accommodation are provided in case of bad weather conditions.[8]

IV. SHIP RECYCLING REGULATION

A few years ago, the ship recycling industry in Asia was used in such ways that did not support an environmental friendly procedure. Ship recycling was not a part of green shipping, till nowadays that this sector has evolved extremely and it has become gradually competitive.

A. Basel Convention – EU Ship Recycling Regulation

In order for the ship scrapping areas to maintain safety and healthy employees, it is common to conform to some regulations. Aliaga's area generally comply with Basel Convention and European Union's regulations, specifically with EU Ship Recycling Regulation (SRR). It was elected by committee of the 20th of December 2013, and its target was to control the cross-border movement of hazardous materials, hence their process and scrapping methods. This commission published a regulation and especially an IHM (Inventory of Hazardous Materials) that will be required for all ships entering EU ports, as well as for EU-flagged ships. All ships headed to recycling will need an IHM. [9]

B. Hong Kong Convention

In May 2009, under the auspices of UNO - institutions, namely, International Maritime Organization (IMO) and, International Hong Kong Convention was drafted. The main aim of this convention is to ensure that ships recycled will not occur any unnecessary risks to human health and surrounding environment. This convention addresses environmentally hazardous substances issues to ensure safety and ship recycling [10] The requirements for an IHM are expected to be detailed by Hong Kong Convention's IHM, specifically concerning accuracy and comprehensiveness. In order for this convention to be entered into force, it must be ratified by at least 15 States and this is the reason why the convention's approval council has obliged many countries to comply with it.

comprise the 23% of global shipping capacity, consequently many more countries should accept this convention in order the global shipping sector to be benefited.[12]

TABLE II. COMPARISON SRR – HONG KONG CONVENTION [13]

<p style="text-align: center;">IHM (Hong Kong Convention 2009)</p> <ul style="list-style-type: none"> • Adopted at Diplomatic Conference in HK May 2009 • Aimed to regulating ship recycling • Main items to be listed (asbestos, PCBs, ODS, TBT, heavy metals & radioactive substances) • Ratified by the following nations: Norway, Congo, France, Panama, Turkey, Belgium, Denmark, Japan, Serbia, Netherlands, Estonia • IHM demand for all vessels within 5 years of ratification and immediate for all vessels going for recycling • States that vessel recycling should: “not pose any unnecessary risk to human health and safety or to the environment”
<p style="text-align: center;">EU Regulation 1257/2013</p> <ul style="list-style-type: none"> • Signed and approved by EU parliament and in force from December 2013 • Aimed to facilitate early ratification of the Hong Kong Convention 2009 (within EU and outside EU countries) • Additional 2 new hazardous materials to be sampled (PFOS and HBCDD) Perfluorooctane sulfonic sulfonic acid / Brominated Flame Retardant • In line with HKC requirements with specifics for the EU region and EU-flagged vessels. Will be implemented without waiting for HKC ratification • EU-flagged vessels of 500GT and over will be required to carry an IHM • When calling EU ports, vessels from non-EU countries will also be required to carry IHM onboard

V. SHIP BREAKING AREA IN ALIAGA

The ship dismantling industry in Turkey has began in 1990s, when the ships were transported for recycling to the bight of Golden Horn, and thus, the local steel industry was extremely boosted. Similar services, were provided by another state-owned shipyard, located 100km southeast of Istanbul, in Seimen region.

In 1976, the scrap yard was moved to the Aliaga area, a place 60km north of Izmir, at the Aegean coast side. This ship recycling unit was the first to be created by a government decree, which was proclaimed in 1976 and employed workers coming from Toka and Sivas, areas of east Turkey. It is the only shipyard in the Mediterranean region which is capable of dismantling small vessels up to 10,000 LTD. Till 2002, 2.8% of total ships' number, 1.1% of the global fleet capacity and 11% of the total demand of ferrous scrap was being dismantled in the area. [14]

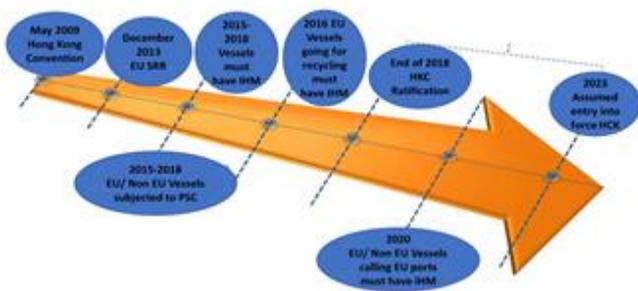


Fig. 3. Timeline of ship recycling regulations regarding environmental protection and human's health safety.[5]

Up to date, 11 countries that have accepted Hong Kong Convention are Denmark, Norway, France, Japan, Panama, Democratic Republic of the Congo, Serbia, Estonia, Netherlands and in 2019 Turkey has just ratified the convention. All these countries

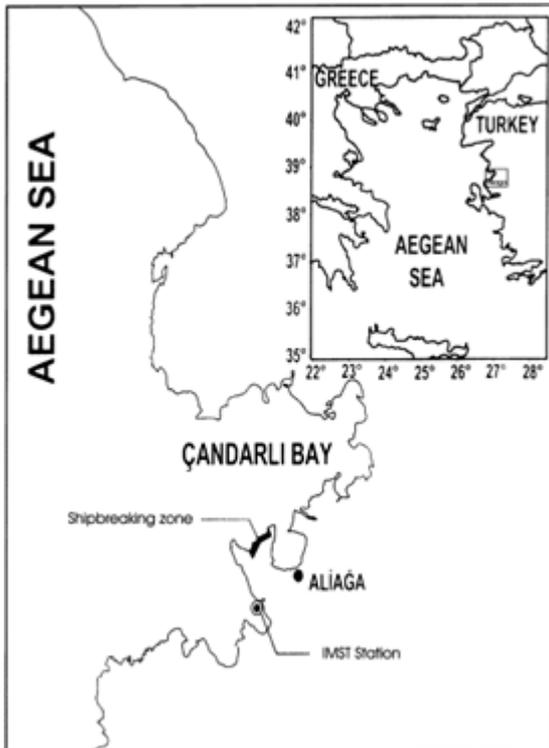


Fig. 4. Aliaga ship breaking area [15]

The last few decades ship breaking area in Turkey, has altered conspicuously, while there happens a great deal of effort in order for this sector to be improved further. During ship recycling, Turkey use the landing method as there is a considerable depth near the coast and even large vessels are run or towed ashore. The vessel is cut from the bow and then is removed. With the assistance of powerful wrenches, the vessel is pulled onto the cutting area on land. Cranes remove vessel's sections and equipment and they are transferred to special areas to be cut. Because of the absence of extreme tides and its proximity to the local industry, the site of Aliaga is advantageous for shipbreaking. However, the road to the shipbreaking yards is of low quality, creating a hazard for work safety.[16]



Fig. 5. Landing Method in Aliaga coast.[16]Units

The main purpose of Aliaga area is to provide security to employees combined with environmental safety, by bearing ISO certificates and statements of compliance with IMO, in order to become established to their field and to have the trust of their customers.

Few years ago, the conditions in the shipbreaking area were worse than those of other eastern countries, since 2009, when Turkey made the decision of altering its attitude, by reacting to the international criticism that was subjected and introducing new methods and ways of managing hazardous materials. Not only the shipyards are led by experienced consultants and researchers but also cooperation among European governments induced great progress in Turkey. [18]

Definitely, there should be a perpetual improvement referring to deficiencies of ship breaking areas, for instance the planning of a new road which will allow a safe access to Aliaga's area. Generally, the approval should be taken the soonest and starts the operations by combining research of innovative technologies.[19]

As Turkey is the 12th country of steel production worldwide, its industry is processing PCBs and other organic compounds, due to the refinery and the ship scrapping. Since large amounts of iron are cut and melted in high temperatures, it is observed an extreme percentage in PCBs concentration. The solid waste that a vessel can produce, could reach 15% of its capacity.

Each recyclable material that a vessel has, during shipbreaking it is subjected to an appropriate process for the purpose of reuse. Turkish State Authority team intervenes when it is about chemical substances, like paints, petroleum mixed with oil, by gathering them and transport to special places to meet safety standards. As for the liquid waste, it is transferred either in Aliaga or in specialized facilities of sewage. In addition to this, both the soil and sea water in this area can also be contaminated by antifouling paint leaching such as copper oxide.

The ship breaking process, is highly harmful for the ozone layer as the air pollutants such as the air condition and cooling devices release chlorofluorocarbons. However, such gases can be extinguished by fire extinguishing systems while the air pollution affects the procedure of electrical cables' stripping, as it is conducted by burning the insulating material, resulting a huge percentage in toxic gases' concentration.

For this reason, Aliaga has recently stopped this form of cable stripping. Cables are sold to specialized companies that remove insulation by a method of incineration in a specialized and controlled environment, or by grinding the insulation material in a special place.

It is important to note that it is possible to occur an explosion if the residues of fuels or oil tanks in specific proportion are blended with the air. So, it is crucial to investigate further the procedures of gas release in order to have the appropriate monitoring and avoid any accident. By adhering new rules there has been a sharp improvement and reduction in accidents since 2004, and even deaths have been eliminated.

Concurrently, in the same period, Turkey's regulation in 2004, emphasized the already applicable regulations that related to the ship waste, the environment's protection and the social insurance. Given the above, any company that did not comply with these arrangements will not be entitled to manage ship dismantling procedures in Aliaga. To realize this safety in a short period, some inspections should be accomplished and sometimes companies subcontract to external affiliate collaborators, who come to decisions regarding the ship breaking processes.

People in charge at shipyards, should be responsible for controlling workers' health and safety. If subcontractors will not be punctual, then yard's team must press them to abide by the rules without deviations. Apart from this, there is a need for staff that is trained in firefighting, in insulation removal material and in consistently crane handling. Generally, OSHA (Occupation Safety and Health Administration) imposes workers' training on the use of the appropriate equipment and on their rightly co-ordination.[20]

Ship dismantling market placed in Turkey operates 22 companies which enforce the European rules and adapt their policy framework to current existing laws. Below, there are cited some of the most active companies in Aliaga's ship breaking industry.

A. LEYAL Gemi Söküm

LEYAL Gemi Söküm one of the oldest ship recycling plants in Turkey, was established in the early 1980s and up to date the most remarkable part of scrapping facilities is operated in the country and is capable of handling more than 100.000 tons of ships annually.

This was the first ship recycling company that applied the European Regulation on ship waste during the recycling process.

It was also a founding member of the International Ship Recycling Association (2007) and today has good reputation, as it has recycled high profile ships and as a company has successfully been inspected by American oil producers. In 2006, the company received certification from a major UK entity, and ten years later, in 2016, it was the first to be certified by the IMO for the Hong Kong Convention. In December of 2018, the company became the first non-European recycling plant to be approved by the European Environment Committee and integrated into the approved plant catalog in accordance with European standards.

Policy: This company has a wide range of facilities specializing in both outdoor and indoor storage. It performs the ship recycling process using the area landing method, and uses cutting tools such as welding, mechanical cutting with movable shear. Prior to any action, the company informs local authorities, as well as the Environmental Management Center (EMC), and in combination with its expertise and the information it gets from the shipowner, can execute a

sustainable ship recycling plan. Following the issuance of the necessary documents by the local authorities, a team of experts is designing how to remove the hazardous substances carried by the ship and after an extensive cleaning they proceed to the dismantling work.

The company adheres to strict international regulations and also participates in a four-year EU-funded research program referring to technical development and alternative scrapping processes, which seems to struggle in order to implement greener shipping methods.



Fig. 6. LEYAL's Gemi Söküm vessels' cutting premises.[22]

B. Dörtel Gemi Söküm

Dörtel Gemi Söküm was founded in 1989 in the Aliaga area with the aim of providing ship dismantling services with responsibility, providing the necessary safety to the employees and by using recyclable methods it contributes to environmental protection.

The services that the company offers concern vessels of up to 30.000 mt- LTD. Since Dörtel started to have an active profile in shipping industry, it seems that it recycled 82 vessels which represent over 280.000 mt.

Policy: The company's priority is focused on the safety of its workforce, while employees are trained appropriately in company's premises regarding safety and pollution control. They are provided the mandatory protective equipment which is frequently renewed. Company's aim is to measure up to stakeholders' needs using innovative techniques, but also to comply with national laws, EU regulations, the Basel Convention and Hong Kong Convention. Except for environmental consciousness, it strives to avoid working accidents and to maintain quality consistence in the management system.



Fig. 7. Dörtel's Gemi Söküm company's statement of compliance with IMO.[20]

C. Sugurya Recycling Inc.

Sugurya Recycling Inc. is centered in Istanbul, and having 1 million in capital is the owner of a large plot in the ship recycling zone of Aliaga. Company's target is to be competitive through this industry both in Turkey and worldwide. In a short period Surguya achieved to acquire reliability in recycling market and is continually planning determining investments for the future.

Policy: The way the company handles ship recycling, plays a part to enhance sustainability and greener techniques. By engaging buying and selling transactions of some scrap materials with small enterprises, it boosts Turkey's economy. Its certificates are in accordance with international standards and as a facility has an increased environmental awareness.

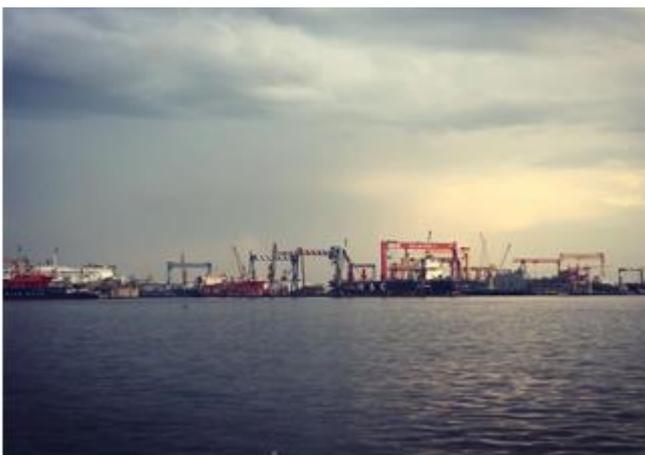


Fig. 8. Sugurya's Recycling Inc. vessels' cutting premises.[22]

VI. SWOT ANALYSIS

STRENGTHS
<ul style="list-style-type: none"> • Good reputation • Reliability • Experience in ship recycling • Specialized and reliable human resources • Flexibility in strategy • Proper financial management • Competitive advantage • Sustainable evolution • Work sector enhancement • Compliance with IMO, ILO, Hong Kong Convention and European Regulation (SRR) guidelines
WEAKNESSES
<ul style="list-style-type: none"> • Noncompliance with defined ship breaking plans • Lack of appropriate health regulations • Noncompliance with the safety measures during ship dismantling occurring accidents • Noncompliance with the determined processes of vessels preparation for ship breaking • Coastal contamination comes from material disposal from refined ships • Environmental pollution by evaporating substances during combustion • Inadequate marketing to attract more customers
OPPORTUNITIES
<ul style="list-style-type: none"> • Upgrade Infrastructure • Less time-consuming methods • Ship breaking evolution with advanced systems • Companies' compliance with regulations of Hong Kong Convention • Turkish companies attempt to receive European certificates • Compliance with ship dismantling procedures is necessary to maintain a green environment • Compliance with work convention and recommendations in order to maintain employees' safety
THREATS
<ul style="list-style-type: none"> • Risk of environment's over-contamination due to wrong operations • Employees' health risk in case of noncompliance with safety regulations • Due to the fact that Aliaga ship breaking area lacks some significant facilities, this is a reason why some customers will choose another area to dismantle their vessels • Due to the fact that Aliaga does not meet some requirements (noncompliance with all international agreements, deficiency of certificates etc.), will not be considered to be reliable as a ship breaking area

VII. CONCLUSION

Consequently, it is obvious that Aliaga coast suffers from pollution, with extremely high contamination rates, attributed to past actions, when the rules were irrepensible. Besides, it should be highlighted that some environmental impacts are rather unavoidable even if all shipyards comply with the imposed rules without deviation. For a smooth operation of ship breaking both for Turkey and international countries, a common strategy and an overall conformity in European regulations should be applied, by ship breaking companies.

It is crucial the companies obey the Ship Recycling Regulation and the Hong Kong Convention and abide by the prohibition of exporting hazardous waste to countries that have not accepted to host these devastating methods. There is an intense need of ratifying Hong Kong convention in many more countries so as this way will assure a great level of safeness, in which every hazardous material that a vessel contains, will be broadly documented. Aliagas area must require the use of alternative fuels such as processed refined waste which can be used as fuel with proper gasification or incineration, in order to save its coastal zone. This policy will save energy, which largely will solve the problem of pollution.

If all the above mentioned be put into effect, ship breaking market will be developed rapidly and European catalogues will include more Turkish companies, as they will obey the necessary rules. The vision for a blooming green shipping is intended as it will contribute to the total coast purity. The followed methods by the companies will arouse the competition among them, converting the scrapping market into an ideal model, by boosting Turkey's bonds with other industrialized countries.

ACKNOWLEDGMENT (*Heading 5*)

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