

Energy Consumption for Ship Dismantling through Beaching Method

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Abstract : Ship dismantling is an issue currently causing a lot of concern and debates in the maritime world and is a source of valuable recyclable materials, mainly steel scrap. There is energy consumption related to each stage; the ship building process, the operational life of a ship and finally the dismantling and recycling of the ship. Out of several methods, only beaching method of dismantling is discussed. A study of various dismantling sequence of a ship and energy consumption of various activities is presented. Based on the above data an estimation of energy required per tonne is arrived, which can be used for predicting the total energy consumption for dismantling of a ship.

Keywords: Ship dismantling, obsolete vessels, Ship Recycling, Beaching method, Energy Consumption.

I. Introduction

Ship dismantling is done to recover and recycle the materials used in construction of the ships, disposing the hazardous waste as per the rules and regulations. As a ship gets older, its operational costs increases on account of increase in fuel consumption, requirements of spare parts and corrosion protection. Due to wear and tear during its operational life, the structural integrity of a ship is also compromised. After 20 – 25 years of operations a ship becomes uneconomical and unsafe to operate. When a ship reaches this stage (based on type & life cycle) it becomes necessary to discontinue operating the ship and recover and recycle the material's used in its construction. The ship recycling industry performs this function. By recycling the construction materials and components, the demand for natural resources for producing the same materials is drastically reduced with consequent reduction in pollution. There are many reasons to be interested in energy consumption, which gives a measure of use of energy, which guides to analyze whether we are running out of energy, capital costs, to study environmental impacts, keeping energy options open, to meet the challenges of dwindling resources, analysis of fossil resources, CO₂ emissions, develop renewable, to respond to challenges, to Improve performance by industries in a sustainable development perspective accomplished only by implementing the energy conservation [1]. The importance of this industry can be measured from the fact that the ships steel constitutes upto 8.5 percent of annual steel production in India. Therefore, it is clear that the ship is not dismantled but it is recycled, as world life fund defines recycling as "the processing of waste or rubbish back into raw materials so that it can be made into new items. " It is undoubtedly beneficial to the individual, the community and the planet" [7].

II. Ship Breaking Statistics

At present, the global centre of the ship breaking and recycling industry is in South Asia, specifically Bangladesh, India, and Pakistan. These three countries account for 70–80 percentage of the international recycling market for ocean-going vessels, with China and Turkey covering most of the remaining market. Only about 5 percent of global volume is scrapped outside these five countries [1].

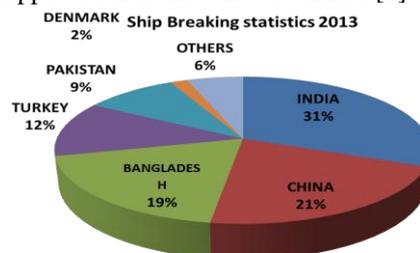


Fig. 1 Shipbreaking Statistics 2013

With 1119 ships broken up in 2013 confirms the good health of the ship-breaking industry. The rhythm appeared to have noticeably slowed down compared to an outstanding year 2012, with a decrease of 16% in number of ships demolished and 20% in tonnage of metal recycled, but 2013 is still by far the 2nd best year for the industry since 2006, start-up of the Ship-breaking (293 ships).The total tonnage of metal recycled in 2013 exceeds 9 million tonne [1].

III. Methods of ship dismantling

The various methods of ship dismantling methods are categorized below [3]:

a.) Beaching Method: Beaching is the most common method and is widely used in most places in India, Bangladesh and Pakistan. In the beaching method, the ships are grounded in the inter- tidal zone, either under their own power or under tow, during spring tides (i.e. beached). This method requires minimum infrastructure and level of skill of the workers involved. The only infrastructure required is shore based winches, crawler cranes and other material handling equipment. The size of the ship to be cut is restrained only by the tidal range of the beach, its slope (a flat beach is suitable) and material of the beach (a beach made up of rocks or coarse sand poses problems).

b.) Berthing Method: Ships are also broken while berthed along .The ships are tied up alongside a quay and cut up while still afloat. After removal of detachable items / material, the ship is cut using oxygen-LPG or oxygen-acetylene torches. Pieces weighing not more than 5 tonne are cut and lowered on to the quay by shore based or ship-board cranes. The cutting should be carefully planned so that the floating ship does not become unbalanced and capsizes or sags or hogs. The bottom of the hull is winched on to dry land (beached) for final demolition.

c.) Dry-docking Method: Ships are also broken up inside dry-docks (either graving docks or floating docks). The ship is moved inside a graving dock or a submerged floating dock and properly positioned. In case of a graving dock, the dock gates are closed and the water is pumped out. In case of a floating dock, the dock is raised, lifting the ship out of the water. Subsequently the ship is cut up as usual. In this method also round the clock working is possible.

d.) Air Bag Method: In the Air-Bag Method, the ship is winched onto dry land over a slipway made up of inflatable rubber bags. Once on dry land the ship is settled over a line of keel-blocks and the air bags are removed. The ship is subsequently cut up in the usual way.

e.) Slip-way Method: In the slip-way method also, the ship is winched on to dry land over a concrete / masonry slipway and cut up on dry land. This method is similar to that of the Air Bag method, except that instead of a slip made of air bags, the ship is winched onto dry land over a concrete slip way [3].

IV. Stages Of Ship Dismantling

Most of the ship dismantling yard use manual labour to dismantle ships in whatever facilities is available, often beaching method. Although, it is possible to increase productivity by using mechanized ship breaking methods, these are capital intensive and require special investment. A typical ship procurement process for dismantling is shown in Fig.2

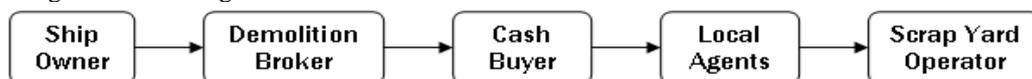


FIG. 2 Ship Procurement Process for Dismantling

During initial stage of ship dismantling, the owners of vessel undertake various operations including stopping up all intake apertures, pumping out all bilge water. Blocking off intakes and valves, and removing all non-metallic objects together with potentially explosive gas.

The next stage is to beach the ship and remove large metal structures such as masts, pipes, superstructures, deck equipment, and main engine, auxiliary equipment of machinery room, decks, platforms, transverse bulkheads, propeller shaft bearings, upper hull sections, and bow and stern sections. The remaining portion of ship is then hauled or lifted on to dry land by means of slipways, ramps or drydocks and cut into large sections, or the vessel is simply winched on to the beach. Finally, the panels and sections obtained from the ship are cut into smaller pieces as required, using oxy-fuel cutters. The scrap is then assembled for transport to its ultimate destination [3].

V. Requirement Of Various Energies For Ship Dismantling Using Beaching Method

The raw materials required are LPG, Oxygen, Electricity, and Diesel. The LPG and oxygen are supplied in cylinders which will be transported to and from the project site by road trucks. The LPG will be received in cylinders and stored in individual plots prior to use. Every plot normally stores maximum three days LPG requirements. IOCL supplies commercial LPG cylinders of two sizes 47 kg cylinders and 19 kg cylinders. At the site preferably 19 kg cylinders are used as they are more convenient to handle (e.x, lifting them on to ships decks and then into the superstructures). Diesel is consumed by diesel powered cranes, winches, pumps, etc., Electricity Power is used for illumination purposes and for other fluid removing operations only [2]. The methodology followed to arrive at energy consumed to dismantle per tonne from a vessel is shown in fig. 3:

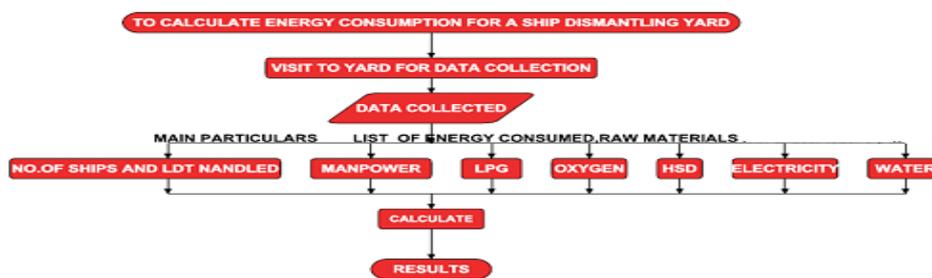


FIG. 3 Methodology to calculate energy consumption

Using the methodology shown in fig. 3, energy consumption for dismantling one tonne is arrived and shown in Table1:

Sl. No	Raw Materials	Energy (MJ/Tonne)
1.	LPG	753.62
2.	Oxygen	340.26
3.	Diesel	130.78
4.	Electricity	0.90
	TOTAL	1225.56

Table 1: Energy consumption for dismantling one tonne

The average consumption of raw materials to dismantle one tonne was collected from dismantling yard at Alang, Gujarat. This is converted to energy terms as per guidelines [6] to convert into terms of energy [9] from NPC and is presented in Table 2. From the above data, the energy consumption for a vessel of any tonnage can be predicted, which can be effectively used for predicting the cost and resources required for dismantling. Therefore energy consumption to extract per tonne of recycling material from a vessel is 1226 MJ.

Type	Consumed quantity	In energy	Source and hints
LPG	15 kg/ton	= 15*12000 =180000 kCal = 753.624 MJ	Source: NPC council Conversion factor to kCal= 12000.
OXYGEN	70 qm/ton	= 70*1.35 =94.5 kWh/qm =94.5*860 =81270 kcal = 340.26MJ	Energy required to produce 1qm of oxygen is 1.35 kWh/qm, From NPC council: Conversion factor to kCal= 860.
DIESEL	Per ton, 3.5 litres of diesel is required, of which 2 litres for plot services, 1 litre to transport materials and .5 litres to transport raw materials.	=3.5*.85 =2.975 kg =2.975*10500 =31237.5 kCal = 130.78 MJ	From NPC council: Conversion factor to kCal= 10500, for diesel in supply unit of kg
Electricity	0.25 unit of electricity is consumed per ton. i.e,0.25 kWh	=0.25*860 = 215 Kcal =0.90 MJ	From NPC council: Conversion factor to kCal= 860

Table 2 . Energy consumption to dismantle per tonne

VI. Conclusion

The vessels after decommissioned are taken to ship dismantling yards. The Indian subcontinent accounts more than 70 percent of the global demolition. Energy consumption for making one tonne of steel by recycling one tonne of steel scrap extracted through dismantling a ship is 8226 MJ, whereas energy consumption for making one tonne of steel from iron ore is 23000 MJ. The Ship Recycling Industry (SRI) converts end-of-life ships into steel and other recyclable items. For that reason, it can be considered as a sustainable and green industry, as when a ship arrives at the end of its life, almost everything can be recycled or reused. Therefore, ship dismantling, when looked at from a life-cycle assessment point of view, is the most environmentally friendly and sustainable way to handle ships that are no longer operational [7].

Among the various methods of dismantling a ship, beaching method is the most widely used. The various raw materials for dismantling are studied as sources of energy. Energy consumption for dismantling per tonne of material is arrived based on the average consumption data at a plot in Alang, and which works out to be 1226 MJ/Tonne and energy saved by recycling the scrap material and manufacturing steel is 14774 MJ/Tonne. This data can be effectively used for estimating the energy consumption for ships of any size.

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