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THE LIFE CYCLES' PARTICULARITIES IN ROMANIAN SHIPBUILDING INDUSTRY

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Abstract*: In the new economic order, in particular case of shipbuilding activity, the issues of energy consumption and environmental protection becomes the major priority. The paperwork is based in its intercession, on the study of the particular activity in Romanian shipyards sector. The research was focused on several main directions as follows: direct and indirect energy cost analysis, life cycle analysis of ships, promoting technology and practical methods to reduce energy consumption and its environmental impact. The research conclusions underlines the need for modern approaches environmentally friendly, throughout the entire economic life cycle: from the conception and planning phase of a ship, further to its construction and operation and finally to the phase of the dismantling and recycling. In this respect, the paper studied those particular issues related to the streamlining process of materials used in shipbuilding and further to the results of the dismantling process, from the perspective of their main threats and risks. Owning a practical approaching, the paperwork has proposed some research and action directions for the medium and long term in case of the Romanian shipbuilding sector.*

Key words*: shipbuilding, energy, environment, life cycle*

1. INTRODUCTION

The energy consumption and environmental impact issues are some of the major direction of research demarche in area of sustainable development of any economic sector. From this point of view shipbuilding is one of the most relevant industries. A multiple scientific papers reveal the existing echoes in worldwide shipping industry, in terms of reducing consumption of raw materials, optimizing energy consumption and not at least in terms of reducing environmental impact (Ivankovic & Ljubenkov, 2009; Pablo Coto-Millan, 2010). The paper research methods are based on shipbuilding industry analysis applicable for Romanian shipyards sector, within period of 2004-2010. This study has revealed that the traditional and recent "actors" as well, in Romanian shipbuilding industry, have already developed programs including the medium and long perspective, taking under consideration contemporary relevant topics as: risk management and health security issues, environmental aspects and phenomena of natural resources degradation, affecting factors and variables interfered in climate change management, energy consumption problems associated with technological issues in ship repair and construction sites (Schmidt, 2008).

2. THE ASSESSMENT OF SHIPS' LIFE CYCLE

Ship as a final product of a shipyard is the result of a chain of activities that include: conception and design, supply of raw materials, prefabrication process/ manufacturing and post-manufacturing, launching water, outfitting insurance, operation, dismantling and recycling by state scrap. As is has been described, the life cycles have stated a series of stages with destructive effects on resources, that mainly consist in raw materials and energy consumption and environmental pollution (ECDGE, 2007). Quantitative and qualitative study of technology flows from Constanta Shipyard, STX Offshore Tulcea, Braila Offshore, STX Damen Galati Shipyard led the authors to identify two defining issues relating to: the energy wasting in the construction of a ship and the assessment of ships' life cycle. In this manner, the assessments made during throughout the research led to some particular issues for Romanian shipping, as it has been described in the very next subchapters.

2.1 The shipbuilding and the energy waste

The study of the technological chains locations shows higher energy consumption for each stage of construction and operation of a ship. In this respect, the indirect energy consumption is associated with both construction and naval systems (main propulsion, diesel electric plant, etc.) but with the auxiliary components consumptions as well (raw materials like tin naval, paint, welding materials). Direct energy consumption associated processes determined by the authors are: handling and storage of raw and auxiliary materials, marking, cutting and conditioning of steel plates and profiles, welding, fabrication of 2D and 3D blocks, assembly of grand blocks, erection, outfitting, commissioning and trials. Further, as it has been figured in the Figure 1, the authors have identified and have evaluated for each technological flux: quantities of energy used sources (electricity, fuel, gas energy), the volume of pollutants and the quantity of the heat released uncontrolled and excessive into the environment.

2.2 The Assessment of Ships' Life Cycle

Life Cycle Assessment (LCA) adopts a holistic approach by analyzing the entire life cycle of a product starting with raw materials extraction and acquisition, materials processing and manufacture, material handling and transportation, product fabrication, product transportation, distribution, operation, consumption, product maintenance and repair and finally product disposal/scrapping. The solid waste management hierarchy involved in the product disposal/scrapping includes waste prevention, waste minimization at source, reuse, repair, recover, recycle, incineration (with or without energy recovery) and possibly landfill. Thus, based on the holistic approach in case of the product life cycle analysis, this study is regarding Romanian shipyards activity and has been built on three main research pillars, as follows:

- *inventory analysis* for the quantitative assessment of energy consumption and environmental resources affected (air, water, soil);
- *impact analysis* for determining technical characteristics and variables that would affect human health, environmental safety and/or damage to resources;
- *improvement policies* aiming to purpose implementation of clean technologies and to promote an environmentally friendly shipping industry desiderate.

LCA of ships should include not only environmental impacts but should also include rational use of construction and outfitting materials, rational use of energy in all stages and phases of ship design, construction, outfitting, operation, maintenance, repair and finally ship scrapping. The main materials commonly used in ship production, which require rationalization, are: steel plates, sections and pipes, welding coils and rods, castings, forged parts, timber, paints, etc. The rational use of these materials should not only minimize energy consumption and the negative environmental impacts but should also have positive economic gains.

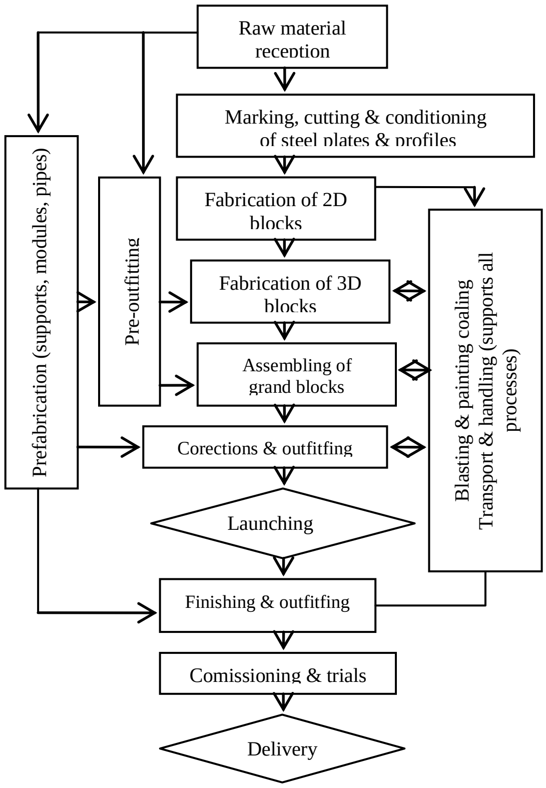

Fig. 1. Flow technology in shipbuilding

Life cycle assessment issues in case of a final product, as a ship could be considered, must underline all those aspects which can be quantified and further modeled. Therefore, the authors have proposed, addressing to the Romanian shipyards, a number of technical and managerial solutions aiming to reduce energy consumption and its negative impact on the environment, as follows: the rationalization of transport between the phases and stages of the fabrication processes, the implementation of hot pressing technology, the large sheet metal using, the welding operations improvement, the developing of higher processing margins, the minimizing of the welds length, the maximizing weld down hand, the minimizing of the steel plates length by cutting of, the wide use of automatic cutting lines and the minimizing of scrap metal processing operations.

3. RESEARCH AND ACTIONS DIRECTIONS

The experience and the international practice in shipping industry correlated with the scientific concerns exiting worldwide for sustainable development of this sector, requires an interdisciplinary approach to complex problems, based on "*design-construction-recycling*" operations cycle. Further a future research is requiring a closer partnership with the Romanian economic environment, in terms of achieving sustainable economic and technical solutions, applicable for shipping field.

4. CONCLUSIONS

Energy preservation and negative environmental impact assessment of shipbuilding industry (in terms of new construction and ship repairing models) require rigorous and valid scientific approaches based on a series of performance indicators, related to energy and environment variables. In this context, life cycle assessment of vessels should be used to assist shipyards in order to indentify and justify those rational and efficient solutions, properly designed as to minimize and to control energy consumption and environmental impact assessment, to reduce in perspective the direct and indirect costs, through more efficient using of scarce resources. "Environment-energy dimension" need to be addressed starting with the design procedure of ships. An integrated and multidisciplinary approach, that will take under consideration all those issues relating to the energy and environmental protection, will be able to conduct toward a healthy and sustainable development of shipbuilding and shipping sector.
The stage of production planning must consider that a rational use of raw materials should reduce environmental impacts, the energy consumption and thus, which in a corresponsive manner, will reduce production costs and industry output. Finally, waste management as a tool in dismantling work will provide not only and exclusively economic benefits, but also will have a positive impact on the environment on a long term.

The main conclusions drawn up from this paper are:

- energy used and negative environmental impacts in the Romanian shipbuilding and ship repair industries require serious evaluation and quantification;
- LCA could be used to assist shipyards companies to identify and quantify opportunities to minimize/control energy consumption and its impact to the environment and to realize cost savings by making more effective use of available resources;
- the rational use of shipbuilding materials should not only reduce the negative environmental impacts and energy consumption but should also have positive economic gains;
- waste management in ship scrapping should not only have significant economic opportunities but should also have positive impact on environmental protection.

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