Application of Green Manufacturing Technology in Ship Structure

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Abstract: Shipbuilding industry has a great influence on water sources. In order to meet the requirements of social environmental protection, ship engineering needs to change the disadvantages of polluting water sources, wasting raw materials, damaging the atmosphere and so on, which puts forward higher environmental protection requirements for ship structure design and ship manufacturing. Firstly, the article summarizes the basic meaning of green ship manufacturing. Secondly, it analyzes the design of green manufacturing technology in ship structure from frame design, energy-saving design, material design, standardized design and other aspects. Combined with the main characteristics of green ship, it puts forward the application of green manufacturing in ship structure.

1. Introduction

Nowadays, the information society characterized by computers and networks has changed our way of life and the way of work of ship designers. The form and connotation of design are changing [1]. As for the shipping industry and shipping industry, its pollution to the environment has also become the focus of the international community. As we all know, in the process of ship manufacturing, it will consume a large amount of energy and bring serious pollution to the surrounding environment. In order to create a good ecological environment for people, it is necessary to apply the concept of green manufacturing to ship manufacturing to improve manufacturing efficiency and level on the basis of reducing energy consumption [2]. Green manufacturing technology for ships is a modern manufacturing mode that comprehensively considers environmental factors and resource utilization efficiency. It requires to minimize the negative impact on the environment and to maximize the utilization efficiency of raw materials and energy. In order to realize the goal of becoming a powerful shipbuilding country in the world, we must practice our internal skills well [3]. We must firmly grasp the good opportunity of the world shipping market, improve industrial quality and enhance comprehensive competitiveness through optimizing design, improving technology and strengthening management, so as to realize the synchronous growth of economic benefits and total economic volume and promote the sound and rapid development of China's shipping industry.

2. Overview of Green Ships and Technologies

At present, great importance is attached to the development of green ships in the field of ship manufacturing. Green ships refer to the integration of the concepts of saving resources and environmental protection into the design and production of ship structures in the process of making ships so as to minimize the pollution and waste caused by the use of ships. The philosophy of green ship building exists in the whole process of ship building. It is the integration of various subsystems such as supply and manufacturing. It requires the main body of each subsystem to follow the principle of “compatibility with the environment”. It is a production technology that strives to minimize the impact on the environment and maximize the utilization rate of resources in the ship manufacturing process [4]. In the process of ship design and manufacture, waste and harmful emissions are minimized to reduce pollution to air, water and land; At the same time to reduce energy consumption, reduce the impact on the surrounding ecological environment, but also to service providers, manufacturers and users to provide good products. Including the hull green

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design, the use of green environmental protection materials, green manufacturing technology, pollution prevention and other aspects of the content, so the green ship belongs to a systematic concept. In the process of ship green design, there should be a clear green target to guide ship functional design and ship structure design. Only in this way can the ship design conform to the environmental characteristics and specific requirements, thus realizing the ship green design.

3. Implementation Approaches of Green Ship Structure Design

3.1 Optimizing and Integrating Ship Design

For the structural design of green ships, it is necessary to actively optimize the hull structure, fully consider the saving of resources and energy, make necessary optimization for the ship's model and scale, improve the speed of the ship as much as possible, enhance the stability of the ship, improve the load capacity of the ship, and ensure the safety of the ship. Function is taken as the premise and starting point of division in ship design, and the key parameters such as economic cost, appearance structure, product performance and generalization degree of ship modules are determined, thus providing premise for division of ship functional modules [5]. Its core standard lies in the whole life cycle of green ship design, manufacturing, service and decommissioning. It comprehensively considers its economic and social benefits and other factors to minimize the impact on the surrounding environment, reduce energy consumption and improve the application efficiency of effective resources. Reasonable arrangement of parts, supports and loads in the product shall be designed to determine appropriate overall dimensions and improve material utilization rate. The design structure conforms to the manufacturability and processability, so as to reduce the material loss and energy consumption in the processing process; Such as the efficiency of the main engine, the kinetic energy of the slurry and the power generation equipment, etc., must be equipped with energy-saving and environment-friendly devices in order to optimize the ship propulsion system and achieve the goal of green ships [6].

3.2 Choose to Use Green Raw Materials

In the process of green ship design, the application of original coating materials should be reduced as much as possible, and modern coating technology should be applied to select coating with environmental protection characteristics, so as to reduce the influence of coating materials on ecological environment and water source to the standard range, thus achieving the effect of green ship structure design. The painting construction process is shown in Figure 1.

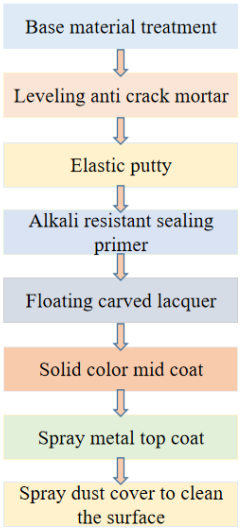

Fig.1 Painting Process

The coating materials selected for traditional ship engineering in our country are harmful to water source, environment and human body. They usually carry out preliminary treatment for the steel to be coated, and then carry out secondary coating on the treated steel. These characteristics

will be reflected in the whole life cycle of green ships. Therefore, environmental protection characteristics should be scientifically set according to the actual situation in each link of the life cycle. The green concept is integrated into the ship design process, improving the efficiency of ship design, integrating multi-disciplinary knowledge and multi-domain content, and truly constituting the content, process and core of ship green design. Using reasonable methods to improve the propulsion method of the ship structure, using energy saving and environmental protection methods to improve the propulsion speed of the ship; Therefore, traditional coating materials should be avoided as much as possible in the design of green ships, and advanced coating technology should be used as much as possible, and green and environment-friendly coatings should be actively selected to minimize the harm of coating materials to the environment, water source and human body, thus realizing the purpose of green ship structure design.

3.3 Ship Standard and Modular Design

The standardized design of green ships can effectively optimize the hull structure. The selection of parts to be used in marine engineering shall be carried out strictly in accordance with the standards, which can effectively avoid the loss and waste caused by wrong selection [7]. The interface design of modules should also be highlighted in the modular design of ships. Only by advocating the modular design of ships with high matching interfaces and multi-functional interfaces can there be more design space and integration capability, thus providing the possibility of energy saving and consumption reduction for ship design.

The material flow, information flow and capital flow in the traditional supply chain are unidirectional, while the material flow, information flow and knowledge flow in the shipbuilding supply chain under the green manufacturing mode are bidirectional, i.e. there is a feedback process (fig. 2).

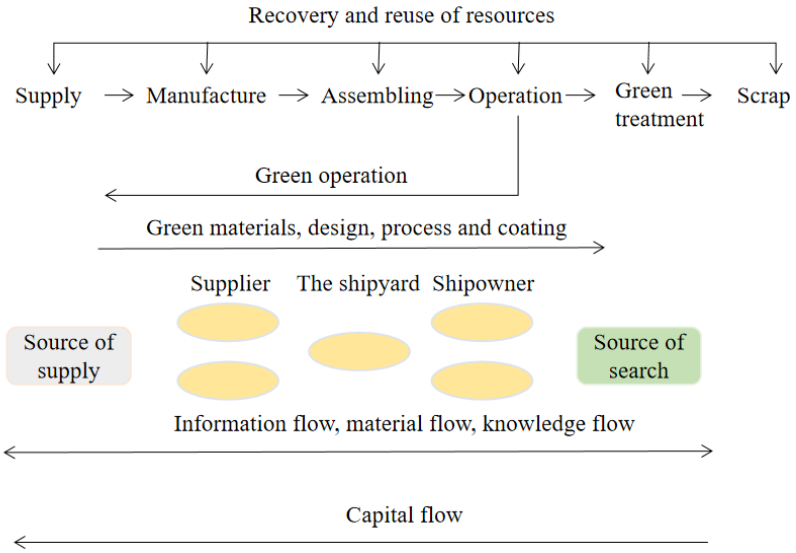

Fig.2 Network Structure Model of Shipbuilding Supply Chain Based on Green Manufacturing

On the basis of thinking about the application of energy and resources, scientific setting should be made in combination with the ship framework and scale, so as to improve the ship operation efficiency as much as possible and ensure the stability of the ship operation. In ship design, computer-aided technology should be used to simulate the process and key points of ship design, and the level and quality of ship design should be evaluated efficiently through expert aided decision system. Advanced manufacturing technology and technology can improve various performances of ships. Relevant data show that the quality of foreign ship engineering is obviously higher than that of domestic ship engineering, because foreign technology and technology are more advanced than that of domestic ship engineering. Modular design can effectively prevent outfitting from being shipped piece by piece, thus reducing pollution and noise hazards in the cabin, improving work efficiency and quality, and greatly reducing labor and capital consumption. To

promote the timely updating of equipment, thus contributing to the optimization and integration of resources and achieving the goal of energy conservation and environmental protection of green ship engineering.

4. Effective Application of Green Manufacturing Technology in Ship Structure

4.1 Lightweight Green Design Process

The realization of green ship should be based on green ship manufacturing technology, which is closely related to green ship manufacturing. Green ships should carry out green design of ship structure through green ship manufacturing process, and then use green and environmentally friendly materials to make ships. This will to a large extent determine the performance of the shipbuilding supply chain and the realization of green manufacturing. Therefore, the selection of ship supporting enterprises with compatible corporate culture with the shipyard and the establishment of strategic partnership are the guarantee to realize the best efficiency of the shipbuilding supply chain and green manufacturing. All factors affecting the utilization of resources and environmental pollution in the whole life cycle of ships from preliminary design to scrapping and dismantling are comprehensively considered, each design link is optimized, the reciprocating process of product production is reduced, the resource utilization rate of the whole manufacturing system is improved, the rejection rate is reduced, and resources are saved. Because CSR (Common Structure Code of International Association of Classification Societies) and HCSR (Coordinated Common Structure Code for Bulk Carriers and Oil Tankers) have higher structural requirements, they will increase the economic cost of manufacturing ships and waste of raw materials. Therefore, green ship design technology, i.e. lightweight design technology, needs to be used [8]. According to the requirements of green ship building, the standards for members of the shipbuilding supply chain are proposed, determined and evaluated, and the basic framework for forming the shipbuilding supply chain is proposed. Therefore, in green ship manufacturing, the net forming technology needs to be actively applied to realize the energy saving and environmental protection effects of green ship manufacturing.

4.2 Process Simulation and Precision Shipbuilding Technology

4.2.1 Process Simulation Manufacturing

In the process of manufacturing green ships, process simulation manufacturing is generally used in heating processes such as water and fire bending plates. However, in the traditional ship manufacturing process, the method of experiment before simulation is adopted, while in the green ship manufacturing process, the parameters of each mechanism can be obtained before manufacturing, thus determining the production parameters of the ship. The design scheme of shipbuilding supply chain is put forward in detail, which is based on the requirements of green ship construction. The main contents of the design include the composition of shipbuilding supply chain, the source of raw materials, production design, logistics management system design, etc. The simulation process and results of ship design and manufacture realized on the platform of virtual software can realize professional analysis of the whole life, cycle and process of the ship. Through systematic models and data, the results and problems of ship design can be displayed, thus providing support for improving the efficiency and quality of ship design and embodying the green design of the ship. Through the three-dimensional simulation diagram, the process design parameters can be found more clearly, and detailed simulation and design can be carried out, which not only enhances the design accuracy, but also reduces the environmental pollution and influence caused by multiple design and manufacture [9]. Process simulation technology is used to combine numerical simulation, physical simulation and expert system to determine the best process parameters and optimize the process plan, predict the possible defects in the processing process and take preventive measures, thus effectively controlling and ensuring the quality of the processed workpiece.

4.2.2 Digital Precision Shipbuilding

The purpose of using digital precision shipbuilding in ship manufacturing is to improve the accuracy of the ship itself. Advanced digital technology and green ship manufacturing technology are used to design and process various parts of the ship structure to avoid rework and remedial work, thus greatly improving the work efficiency and meeting the requirements of saving and environmental protection. At present, virtual design and manufacturing are mainly based on the application of CAM and CAE software. Virtual production and manufacturing integrate conceptual design, assembly practice and specific use conditions together, and coordinate human engineering, ergonomics and material science to form a more comprehensive and accurate evaluation of ship design, which further provides a platform and possibility for the integration of green concept into the details and foundation of ship design. The combination of virtual manufacturing technology and network technology can temporarily form different companies involved in products into a virtual company linked by computer network according to market demand. Shipbuilding enterprises and design institutes can establish manufacturing resource information networks through the Internet to implement agile manufacturing.

4.3 Automatic Welding Process

In the manufacturing process of ship mechanism, automatic welding technology can also improve the green and environmental protection of ships. Using automatic welding technology can reduce the economic cost of manufacturing ships and improve the quality of ships. It is one of the most efficient and green technologies in green ship manufacturing technology. Application of high performance welding equipment. Welding equipment, as the core element in green ship manufacturing, is very important for the reasonable selection and application of equipment. Because the high-performance welding equipment itself has great energy-saving and environmental protection, the welding effect is ideal, and thus has been widely used in green ship manufacturing, which can better meet the energy-saving requirements of green ship manufacturing. According to the principles of hull separation, regional outfitting and regional coating, the coating production design should be deepened, with emphasis on the quality of steel pretreatment, shortening the manufacturing cycle of segments, improving the rate of pre-outfitting and integrity of segments, and strengthening the dynamic management of coating production. As high-performance welding equipment has the advantages of energy conservation and environmental protection, strong welding pertinence and good welding effect, it is necessary to actively apply such equipment in green ship manufacturing to meet the requirements of energy conservation and environmental protection in green ship manufacturing.

4.4 Green Processing Technology

At present, net forming technology has been continuously improved and applied, which can be well used in the production of green ships. Forming manufacturing technology includes casting, plastic processing and other technologies. Forming manufacturing technology is developing from approaching the shape of parts to directly forming the shape of workpieces, that is, precision forming or net forming. In order to ensure the overall effect of ship manufacturing, the welding process used in green ship manufacturing needs to be rationally selected. Net forming technology is to directly produce raw materials into the shape of the required products, and also with its functions, eliminating intermediate links. Some formed parts can be directly or slightly processed to form products, which can greatly reduce the consumption of raw materials and energy.

The dry processing technology is reasonably and effectively applied to the production of green ships. These technologies and processes are based on the development of current science and technology, which can effectively avoid unnecessary waste of resources. Moreover, the dry processing technology is simple to operate and overcomes many inconveniences brought by the use of coolant. Moreover, the process flow is effectively simplified and the processing cost is comprehensively reduced, thus the dry processing technology is favored by many industries. Dry processing technology can effectively streamline the technological process of ship manufacturing,

save the resources of ship manufacturing and reduce the pollution and damage to the environment. At present, dry machining has been applied locally in foreign countries, such as the United States, Japan, Germany and other countries have achieved certain results by using dry turning, dry grinding, dry boring, etc. Our country has just started research, and its main application field is mechanical processing industry. As a new processing technology, it is expected to play its due role in ship manufacturing.

5. Conclusion

The design and manufacture of green ships can reduce the energy consumption of ships and the emission of pollutants, and greatly reduce the pollution of the marine environment caused by the ship industry. Using green manufacturing technology to build high quality, low pollution and energy-saving ship structures, with the continuous maturity of technology, it is necessary to continuously improve the green ship technology. While ensuring environmental protection and green, it is also necessary to take safety, power and practicability as the basis of green technology. Under normal circumstances, the ship's green standard is displayed on the ship's application life cycle. Adhering to the standards of environmental protection and energy conservation, modern technology is applied to realize the environmental protection and energy conservation of the design and manufacture of green ships under the condition that the ship's own functions are fully stimulated. Based on the principles of safety, environmental protection, energy conservation and other requirements, it will increasingly become the green standard of the shipping industry. It is of great significance to implement the design and manufacture of green ships under the condition of applying advanced technologies to ensure the functionality, service performance and safety of ships.

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