Marine Structures 58 (2018) 361–366

Contents lists available at ScienceDirect

Marine Structures

journal homepage: www.elsevier.com/locate/marstruc

Evaluation of mechanical behavior of multifilament discarded fishnet/glass fiber and polyester composites for marine applications

A. Amala Mithin Minther Singh[a,*], F. Michael Raj[a], P. Arul Franco[a], J.S. Binoj[b]

[a] AP, University College of Engineering, Nagercoil, Tamil Nadu, 629004, India
[b] AP, Sree Vidyanikethan Engineering College (Autonomous), Tirupati, 517102, India

ARTICLE INFO

Keywords:
Fishnet
Glass fiber
Hybrid composites
Mechanical properties
Mechanized boat hull structure

ABSTRACT

Composite material has long life, higher strength, lower weight and less maintenance cost. Most of the marine crafts are fabricated by glass fiber and polyester matrix in worldwide, but it is toxic to the aquatic life as well as the manufacturer who are in close contact with the boat. Glass fiber is a non-biodegradable and involves high risk during processing. In general, a mechanized boats hull structure has 13–25 layers of glass fiber and woven roving for 35 ft–90 ft length of the vessel. Fishnet gets damaged and large amount of them are wasted every year. The fishnet generally made from nylon fiber and woven in a grid-like structure, which is tough possess high tensile strength, elasticity, luster, resistant to abrasion, impact and chemicals. So the idea of the present work is to reduce the toxic nature of the building material (Glass fiber) by replacing some of the constituent layers with a suitable ecofriendly and less poisonous nature-based material nylon fiber which is available abundantly in the discarded fishnets. The discarded fishnet is used as an alternate source of glass fiber for manufacturing mechanized boat hull structures. The evaluation of mechanical behavior such as tensile, impact, and flexural properties of these specimens was studied according to ASTM standards. A novel hybrid composite is suitable for eco-friendly and less poisonous nature-based also helps to sustain green environment.

1. Introduction

A composite material which is used in the construction of boat has created the need to evaluate the basic design tools that are used to create safe marine structures. The composite construction of vessels has length about 100 m. In general marine composite structures are constructed by glass fiber and polyester. IMO, USA developed FRP marine composites of motor yachts having length up to 49 m, larger fast ferries about 200 feet, and mine hunters 57 m [1]. The composite structures are utilized in the marine crafts are approximately 10% lighter than aluminum craft and 35% lighter than steel craft of the same size [2]. (see Fig. 9)

Indian marine coastline has 8118 KM long and 14.5 million fishermen from fishing production and accompanied by 0.05 million mechanized boat [3–5]. In India (ChinnaMuttom Boat Yard, Tamil Nadu), 75 feet long mechanized boat has thickness of the bottom hull is about 13–21 layers of glass fiber including 5–9 layers of woven roving, the weight of the boat is nearly 40–60 tons. However, multifilament discarded nylon fiber has alternate materials for manufacturing the composite deckhouse from mechanized boat [6]. The nylon fiber has less weight when compared to the glass fiber. The light weight composite materials are laminated into boat

* Corresponding author.
E-mail addresses: mithinlites2011@gmail.com (A. Amala Mithin Minther Singh), amalsmce2014@gmail.com (F. Michael Raj), arulfran@gmail.com (P. Arul Franco), binojlaxman@gmail.com (J.S. Binoj).

https://doi.org/10.1016/j.marstruc.2017.11.013
Received 17 April 2017; Received in revised form 7 September 2017; Accepted 29 November 2017

Table 1
Specifications of used FISH net.

[1] Dimensions of fishnet			
[2] Mesh size [mm]	[3] Twine diameter [mm]	[4] Knotting	[5] Netting color
[6] 16	[7] 0.27	[8] Single	[9] White
[10] 32	[11] 0.27	[12] Single	[13] White
[14] 60	[15] 0.27	[16] Single	[17] Saffron

surfaces to assist and support dynamic loads to prevent hull failure [7]. Nylon can be used as the matrix material in composites with reinforcing fibers like glass, carbon etc. such composites has higher density than pure nylon.

In India about 7000–8000 metric tonnes of solid waste of nylon 6 products are generated every year [8]. In 2009 about 230 million tons of plastics were produced globally per annum. In North Sea marine was more than 70% of floating debris is made up of plastic items [9]. Marine Debris has been estimated that around 80% of land-based sources are Tourism related litter. The remaining 20% is from ocean based sources are fishing related debris includes fish nets, fishing pots, lost accidentally by commercial fishing boats and wastes from ships and boats [10]. Plastic and synthetic materials are the most common types of marine debris and cause the most problems for marine animals and birds.

Marine debris of plastic bags can cause economic losses to recreational boats when they block water intakes and result in burned out water pumps. Boats and ships can also incur costly repairs when derelict fishing gear such as nets and ropes get entangled around propellers and rudders [11]. This can also be a safety concern should a propeller become clogged in a storm [12]. Recently it was reported that an entire Russian submarine became entangled in discarded fishing net in 600 feet of water off the Kamchatka coast [13].

An integrated waste management system has to be planned in order to effectively use, recycle and dispose the polymer materials. Reuse of discarded fishnet to minimize the manufacturing cost of the mechanized boat hull structure with higher strength from the conventional material and minimize the marine pollution. The present work is focused on the discarded fishnet as an alternate material of glass fiber partially incorporated with polyester matrix with a view to safeguard our environment.

2. Materials and methods

The materials used for the experimental work is three different multifilament waste fish net (Gill net) that are used extensively (Table 1) and dumped in Kanyakumari district, Tamil Nadu, India are collected. Glass fibers were obtained from Binani India products, Chennai. Polyester resin and hardener was obtained from Ciba Gugye Limited. This has a viscosity of 10 Poise at 250 °C. In this three different mesh sizes of discarded fishnets were used as the partially incorporated composites.

The required amount of discarded fishnet is cleaned by soaked in the water for 30 min and washed three times at room temperature. After washing it should be dried in the direct sunlight for an hour. The composites are developed by using hand layup technique.

The specimens prepared are shown in Figs. 1 and 2.

Composite-1 is prepared by using polyester matrix and sixteen layers of glass fiber (300 g/m2) as an alternative layers as shown in Fig. 2. The specimen size is 30 × 30 cm (see Fig. 3).

Composite-2a, 2b, 2c are prepared by using fifteen layers of glass fiber and polyester matrix followed by one layer of discarded fishnet with 16 mm, 32 mm and 60 mm mesh and glass fiber respectively with polyester matrix. The mesh orientation is T90°. The specimen size is 30 × 30 cm.

Composite-3a, 3b, 3c are prepared with fifteen layers of glass fiber and polyester matrix followed by 2 layers of discarded fishnet with 16 mm, 32 mm and 60 mm mesh and polyester matrix. The mesh orientation is T90°. The specimen size is 30 × 30 cm.

Composite-4a, 4b, 4c are prepared with fourteen layers of glass fiber and polyester matrix followed by 2 layers of discarded fishnet with 16 mm, 32 mm and 60 mm mesh. The mesh orientation is T90°. The specimen size is 30 × 30 cm. In total ten composites were prepared.

The Total number of mesh in T90 orientation is 110 and for stretched orientation is 256. The total weight of the fishnet included in the T90 orientation is 0.160 gm and for stretched orientation is 0.385 gm.

Fig. 1. Different mesh sizes of discarded fishnet for fabrication of composites.