

FIBREGLASS REINFORCED PLASTIC SHEATHING FOR WOODEN FISHING BOATS

R. Balasubramanyan
*Central Institute of Fisheries Technology
(Craft & Gear Division), Cochin - 5*



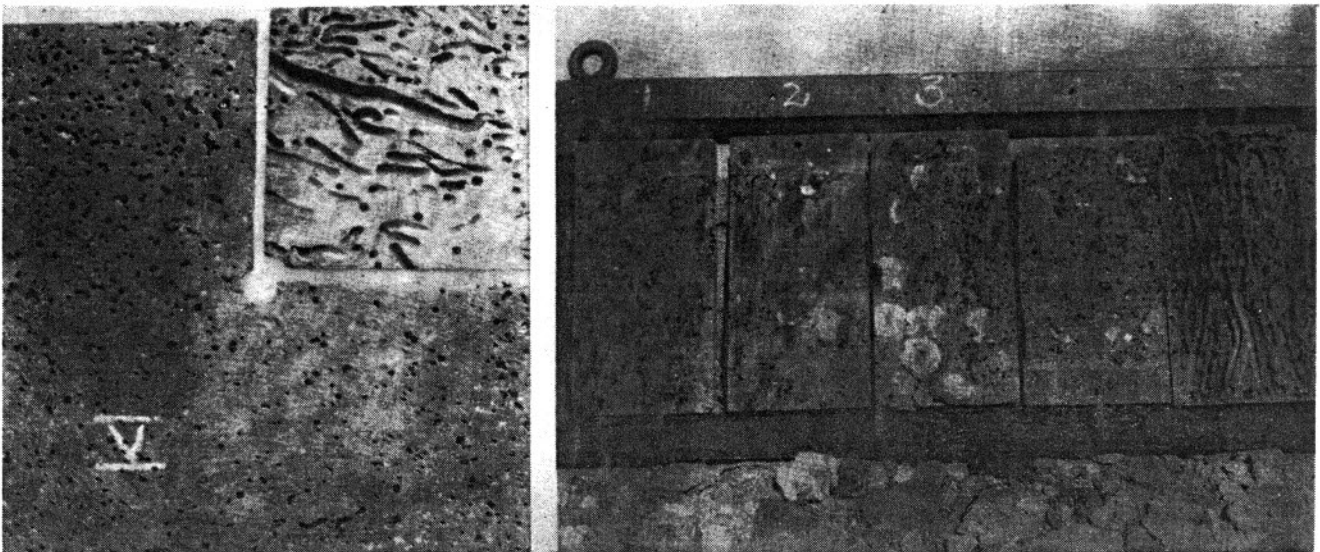
Introduction

Wood, being an organic material, is very much susceptible for rapid deterioration due to several biological agencies like, Fungii, Termites, and Marine wood boring organisms. While it has been possible to check and control fungus infection and white-ant attack on timber structures to a level of satisfaction by utilising naturally resistant species of timbers or by using suitable

toxic wood preservatives yet a sure and successful method of preventing marine wood borer attack on timber structures in sea-water has not been fully evolved. The well known species of boat-building timbers under constant immersion in sea-water have been found to possess very little resistance against the attack of the marine wood boring organisms and as such they are severely infested and destroyed sooner or

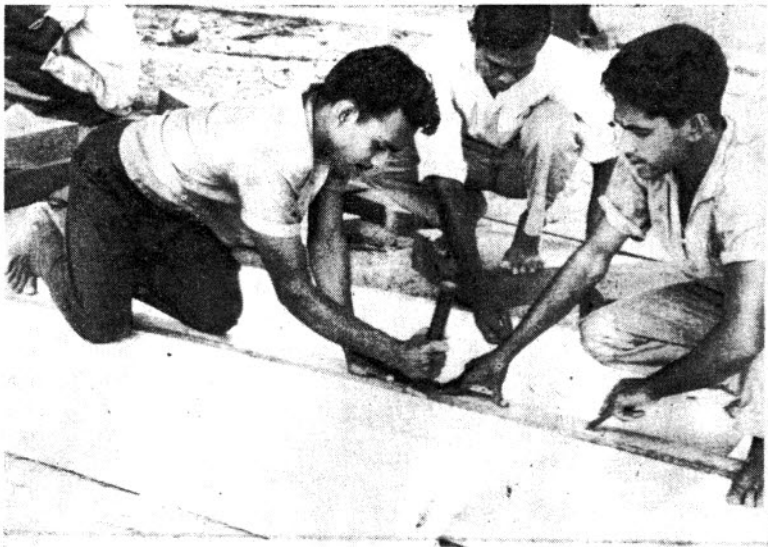
later, depending on the type of wood used and the condition and location of exposure in the different harbours in India (Text Fig. 1&2). The untreated bare wooden hulls of fishing boats thus have to be carefully protected, particularly the hull below water line that is in constant contact with sea-water. Even very new boats built of the best wood and finest of materials are sheathed nowadays as a routine measure lest they would be riddled by these borers.

Pictures showing the extent of damage caused by the marine wood borers on the unprotected timber test blocks under continuous immersion (six months) in the port of Cochin



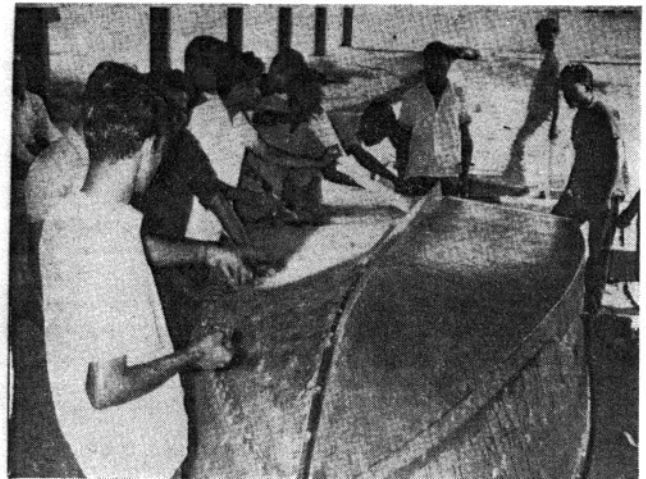


Measuring the area of the wooden hull to be sheathed with FRP. (Left). Filling up bolt holes, seams, crevices and corners with special seaming compound, and surface preparation



Cutting of Fibre glass chopped strand mat to desired shape and size (Left). Careful mixing of accelerator and catalyst to the polyester resin for its activation before use.

Activated polyester resin is applied by brush all over the wooden surface to be sheathed with Fibreglass mat. (Right) FRP sheathing in progress.



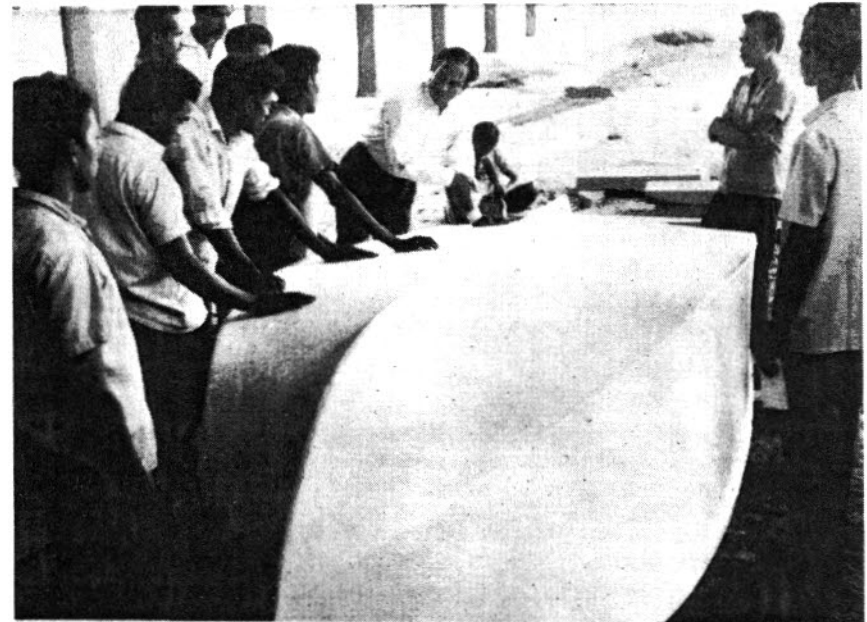
With very few exceptions, today both big sailing crafts and modern mechanised fishing vessels have their outer hulls properly protected with copper sheets. Due to restrictions on imports and scarcity all over the world, copper has become a rare and costly commodity (retail price at Rs. 25/- per Kg.). Under this crisis special marine quality indigenous Aluminium-magnesium alloy sheets were recommended as a suitable substitute, the use of which as a hull sheathing material has given encouraging results besides proving to be the cheapest method of hull protection known so far (Retail price at Rs. 10 per Kg.). However, protection through metallic sheathing can never be the final answer to this problem since the use of conventional metals in sea-water also possess a serious handicap due to metallic corrosion.

The use of Fibreglass Reinforced Plastics (FRP) in boat building industry has increased considerably over the last few years in many other countries particularly for the construction of "All Plastic" fishing boats. In India at present only small row-boats and pleasure crafts built out of FRP have come into use and are slowly becoming popular, while there is plenty of scope for popularising FRP fishing trawlers specially for mass production of the standard designs. *

Basic Materials Required

Fibreglass: Fibreglass and resin are the two basic and inter-dependant components that go to make up a sheathing laminate. The most widely used and highly developed material for reinforcing

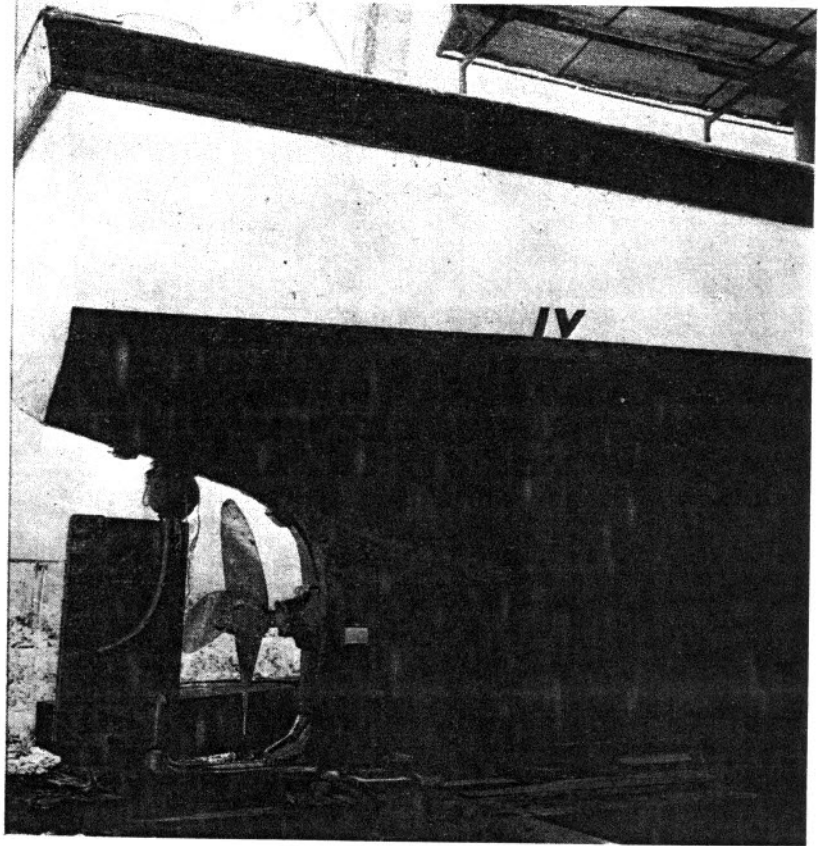
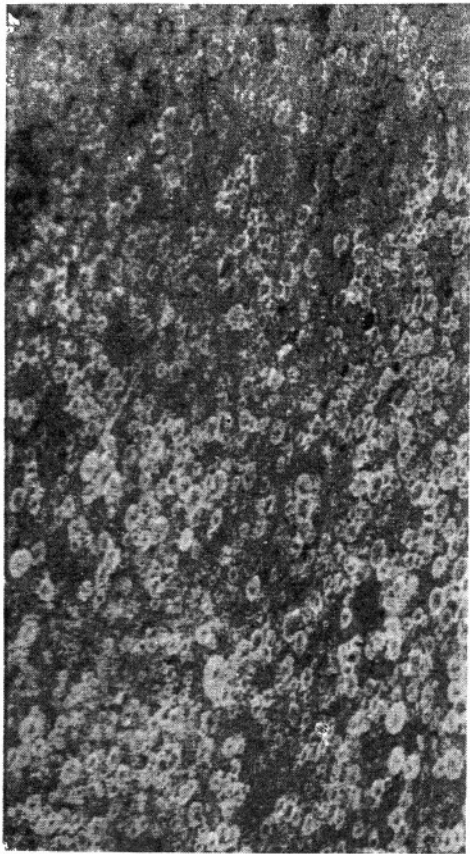
* The present paper describes in detail FRP as a sheathing material for wooden fishing boats.



Completed sheathing, the two layers of FRP undergoing post curing. Further surface preparation and pointing procedures are being chalked out (top). A 25' open type beach-boat made of marine plywood and Fibre glass sheathing (FISH TECH No. 3, CIFT, Cochin)

synthetic resins is glass fibre. Fibreglass chopped strand mats are produced from continuous glass filament fibre as also the other unidirectional rovings, woven rovings and woven-cloth. The most widely used fibreglass chopped strand mat consist of strands approximately 50 mm (2") long held together in random mat form by adhesive resinous binders.

It is now indigenously manufactured in India from standard 'A' glass composition having an alkali content of about 10 to 15 percent and weighing 450 to 750 gm. per square Meter (approximately 1½ to 2½ ounces per square feet) and are available in the form of standard rolls of 75 cm and 150 cm width, weighing 50 kg. per roll. The other costlier variety, known



Heavy Fouling (Barnacles) on an unpainted FRP sheathing. FRP sheathing has to be coated with an anti-fouling paint to keep the surface free from the settling organisms in Sea-water (left). A wooden trawler with FRP sheathing and a final coat of anti-fouling paint ready for launching. Now the hull below water-line will be safe and sound as long as the FRP sheathing is in tact.

as the "E" glass which is not readily available in Indian markets, is the lime-alumina borosilicate glass with low alkali content. Unlike the "A" glass, it has high chemical stability and moisture resistance. In the case of chopped strand mat the filaments provide fairly consistent multi-directional strength and are easier to fit into deep curves and difficult corners as on the hull and inside the fish-hold of a wooden trawler. Woven glass cloth possess higher strength but it is more expensive than the chopped strand mat.

Glass fibres have low weight but possess extremely high tensile strengths. The tensile strength of

bulk glass is in the order of 10,000 pounds per square inch while in fibre form it is near about 400,000 psi. They have the desired thermal co-efficients of expansion as that of the resin and low water absorption rates. The glass fibre serves purely for reinforcement while the thermosetting resins help in the proper binding of the material.

Resin: Although a number of thermosetting resins such as phenolics, melamines, silicones and epoxies are used, along with certain thermoplastics such as polystyrene and polyvinyl chloride, the thermosetting polyester resins have found the widest use in reinforced plastics today. The

term polyester resins encompasses a variety of materials. However, technically speaking, by virtue of usage, the compositions which are generally recognised by this designation are the common unsaturated polyester resins. While exhibiting good compressive strength properties, polyester resins have low rigidity, tensile and impact strength and as such, before use, they are to be reinforced with Fibreglass. The polyester resins are used in a variety of applications such as moulding, casting and coating. The properties of unsaturated polyester resins which characterize them and the chief factors in their success are (1) ease of handling in

liquid form (2) rapid cure (3) excellent dimensional stability and electrical properties (4) good general physical properties and (5) ease of colouring and modifying for special characteristics. The composite structure of fibreglass and the thermosetting polyester resin displays the highest ultimate strength, durability and improved physical properties and for that these two major inorganic and organic phases have to be chemically linked. The term "reinforced plastics" refers to any plastic material (Polyester resin) whose physical properties have been up-graded by the addition of some auxiliary material (fibreglass). In fact reinforced plastics are analogous in several respects to reinforced concrete where the low tensile strength of concrete is up-graded with steel rods. Besides the resulting compatibility, strength to weight ratio of such a reinforced material (FRP) exceeds most of the other conventional materials. Polyester resins possessing a wide range of viscosities are available in several types and grades. The medium viscosity Isophthalic grade of polyester resin is superior to other conventional polyesters for its good mechanical strength, toughness and rigidity resistance to chemical attack, good water resistance and its adhesion to glass fibre and other surfaces.

Accelerator and Catalyst: The process of converting polyester resins from the liquid to the solid state involves the chemical reaction with the addition of an accelerator (*Cobalt naphthenate* or *Cobalt actoate*) and a catalyst (*Methyl ethyl Ketone Peroxide*) to cause polymerization at room temperature and the resin mix gets activated and is ready for immediate use. The ratio of Catalyst to accelerator and the ambient temperature, control the speed at

which polymerization or 'cure' takes place. Polymerization generates its own heat so that the lamination work with Fibreglass reinforcement is cured at room temperature. If the addition of predispensed colour pigments or fillers to the resin mix is contemplated it must be done by mixing thoroughly with the accelerator and before the catalyst is added. (Caution: under no circumstances should the catalyst and accelerator be allowed to come in contact *directly* with each other as this would lead to explosion and constitute a fire hazard).

Depending on the condition of storage, the unmixed polyester resin will have a normal shelf life of atleast 3 months when kept in closed tins at 30°C. but once activated with accelerator and catalyst it must be used up within 15 to 60 minutes based on the mixing ratio. If kept unused beyond this period, the mix will gradually tend to gel and become a solid mass. Larger quantities of resin mix to be used over a period of one or two days should only be accelerated in bulk and small batches of about 2 kg. catalysed immediately before use. The polyester resin when it has been activated goes through five stages before it can be regarded as fully cured. These are (1) liquid stage (2) gelled stage (3) set stage (4) cured stage and (5) final cured stage. The whole process is mostly influenced by the activators, their proportion of mix and the working temperature. Under tropical Indian conditions this period may extend from ten to fifteen days. During this period of curing no work should be undertaken on the sheathing. Fibreglass reinforcement materials and polyester resin should always be measured by weight, while catalyst and accelerator can be measured by

volume in separate measuring cylinders, replacing 1 gram by 1 c.c. Paint brushes, plastic buckets, plastic mugs, thick glass rods, a pair of big scissors, disc-rollers and improvised 'squeegee' are the minor equipments required for the hand lay up process of FRP sheathing either on boat hulls or for fish hold lining commercial quality acetone can be used as a solvent for all cleaning purposes. For reasons of efficiency and economy the following schedule of work was adopted in all prototype studies conducted at the Central Institute of Fisheries Technology and the procedure followed have given excellent results.

Method of Sheathing Boat Hulls

(1) The entire wooden hull must be completely dry (very low moisture content) and free from oil, grease and oily preservatives. From the hull planks of old boats, oil, grease and tar if any have to be completely removed using suitable solvents or a metal scraper. Sander well if necessary. Oily surfaces will not hold the FRP.

(2) The plank seams and bolt holes should not have the conventional caulking Cotton and white putty but instead a special seaming compound has to be made and used by mixing activated resin and any of the fillers like *Calcium Carbonate*, *Silica*, Saw dust or *titanium dioxide*. The seaming compound should be allowed to dry fully before sheathing is attempted. (Plate 1 Figs 2 & 3).

(3) The Wooden surface of the hull to be sheathed has to be sandered with coarse abrasive paper since only such a rough surface will have a better holding power for the resin and the following layer of glass fibre.

(4) Apply by brush one generous coat of activated polyester resin over the wooden surface to be sheathed. Porous woods will absorb some resin and hence supplement the resin by a further coating. For every Kg. of fibreglass, take 2 Kg. of polyester resin and for every Kg. of resin take 1 to 1.5% of accelerator and catalyst depending on weather conditions. A lesser quantity of accelerator and catalyst are recommended under very hot climatic and open air conditions. (Plate I. Figs 4 & 5).

(5) When the resin is still tacky on the hull, lay upon it the fibreglass chopped strand mat that has already been cut to suitable size and shape. (Pl. see illustration.) Apply the activated resin over the mat and work with the brush for the proper impregnation of the resin into the chopped strands. If necessary use hand rollers up and down, pressing the resin soaked glass mat on the wooden surface. Level off the excess resin using a rubber "squeegee". Thus complete the first layer of FRP throughout the hull allowing full 1 to 2 inch overlapping wherever necessary at all joints of the mat. No area of glass mat should remain without the resin. Avoid air bubbles and bloating. If seen, rupture them and re-do the sheathing on that spot. Allow the surface to dry. When slightly tacky, lay up the second layer of fibreglass mat and work up with the activated resin as before. If necessary, special predispersed colour pigments or fillers can be used with the final coat of activated resin (Mix pigments or fillers before the Catalyst is added). The final coat of resin gives the surface a smooth finish. Once the desired number of layers of fibreglass mat has been built up, allow the surface to dry and cure completely. In about 10 to 15 days of post

curing the surface will become very tough, dry and hard. 2 layers of fibreglass chopped strand mat of 450 gm/m² has given adequate protective sheathing as good if not far better than copper or aluminium sheathing. More layers may be necessary only under special circumstances.

(6) On the dry surface of the FRP Sheathing use a chemical etchant or coarse sand paper so that the sheathing will tenaciously hold any further coat of painting. Being a non-toxic surface, FRP sheathing will gather all the marine fouling organisms on them under continuous immersion in sea-water. (Plate II. Fig. 1)

(7) Use one or two coats of good quality marine antifouling paint 8 to 12 hours before launching. Once launched, the vessel need be hauled up again after a year of service to renew the antifouling paint. On the slipway, scrape the fouling settlements on the hull if any and allow the surface to dry completely. Check for any delamination or damages to the sheathing. Cut out the sheathing in that area and re-do the patch work in the same way the original sheathing was done. FRP surfaces can be easily drilled for fixing fastenings and any fittings. By any chance the wood below the sheathing is damaged by mechanical means, replace the damaged part and resheath that area alone with FRP following the standard procedure. As a result of these prototype studies, it has been estimated that the 2 layers of FRP lamination as per Central Institute of Fisheries Technology standard schedule would cost round about Rs. 100 per square meter. However, the cost may vary according to the type of glass fibre, (Woven roving, surface mat

etc.) resin used (Isophthalate, Orthophthalate etc.) number of layers adopted and also fillers and pigments incorporated,

Many years of research investigations and comprehensive trials carried out at the Central Institute of Fisheries Technology, both in the laboratory and in the field, have brought to light the versatility of FRP as a sheathing material for the successful protection of wooden structures in a marine environment where the other conventional methods did not show the anticipated success. It is now apparent that being tough, rigid, impervious to the effect of salt water under continuous immersion, FRP sheathing has shown adequate signs of great promise in protecting the wooden hulls of modern mechanised fishing boats exposed to sea water. FRP is impervious to rot, do not leak or open up at seams, do not corrode and do not absorb water and become heavier. If done with proper materials and by following standard methods, sheathing will be stable and free from deterioration for a very long time. The wood is safe as long as the sheathing is in tact. The marine wood borers could not get access to the wood that has been sheathed with FRP. FRP also affords adequate protection to various timber structures exposed to marine atmospheric conditions as in the case of deck planks, hatch covers, cabin and wheel house of a fishing trawler. FRP is also ideally suited for the lining of fish holds in all fishing vessels. Several layers of FRP built up on wooden structures not only protect them but also provide them with a bit of additional strength by becoming one solid structure with wood. The FRP sheathing on a wooden hull is a continuous smooth skin without any seams

and joints. The hull will always be dry and clean. Unlike the metallic sheathing, FRP layers do not add undue weight to the hull. However, heavy and constant abrasion is likely to cause gradual thinning of the FRP sheathing and as such care is necessary in this regard.

Before "All Plastic or Fibreglass" fishing boats could dominate the scene, FRP, as a hull sheathing material for the thousands of mechanised wooden trawlers that are already in service and for the 8,000 new wooden boats that would be joining the existing fleet in the course of

another five years has a great role to play in lieu of the conventional copper or aluminium sheathing. It is gathered that a number of wooden boats have already been sheathed with FRP so far. Substitution of copper means an enormous saving of foreign exchange for us in India.



**STATEMENT ABOUT OWNERSHIP AND OTHER PARTICULARS
ABOUT THE NEWSPAPER 'INDIAN SEAFOODS'**

(to be published in the first issue every year after the last day of February)

FORM IV
(See Rule 8)

- | | |
|--|---|
| 1. Place of Publication | ... Ernakulam, Cochin-16 |
| 2. Periodicity of its Publication | ... Quarterly |
| 3. Printer's name | ... M. P. Haran |
| Nationality | ... Indian |
| Address | ... Secretary, The Marine Products Export Promotion Council, Ernakulam, Cochin-16 |
| 4. Publisher's name | ... M. P. Haran |
| Nationality | ... Indian |
| Address | ... The Secretary, Marine Products Export Promotion Council, Ernakulam, Cochin-16 |
| 5. Editor's name | ... M. P. Haran |
| Nationality | ... Indian |
| Address | ... Secretary, The Marine Products Export Promotion Council, Ernakulam, Cochin-16 |
| 6. Names and addresses of individuals who own the newspaper and partners or share holders holding more than one per cent of the total capital. | The Marine Products Export Promotion Council, Ernakulam, Cochin-16 |

I, M. P. Haran, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Cochin-16
Date: 31-3-'71

(Sd.) M. P. HARAN
Publisher.