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Biofouling resistant polyethylene cage aquaculture nettings using polyaniline and nano copper oxide

Muhamed Ashraf P., Manju Lekshmi N., Sasikala K.G. and ¹Raghu Prakash R.

ICAR-Central Institute of Fisheries Technology, Cochin

¹Visakhapatnam Research Centre of ICAR Central Institute of Fisheries Technology

In Indian fisheries scenario, cage aquaculture is a fast growing sector to meet the increasing demand of high value fishes. Biofouling is a major concern in cage aquaculture where the infrastructure is exposed to a diverse array of fouling organisms with significant production impacts. Biofouling in cage netting causing clogging of meshes leading to increase in weight and drag, reduction of volume, restriction of water exchange, anoxic condition, increased stress, retarded growth of fish all of which adversely impact fish health and thereby increase the mortality rates also (Lai *et al.*, 1993; Hodson and Burke, 1994). It has been reported that fouling in aquaculture adds 25% of the total project budget only for maintenance (Braithwaite *et al.*, 2007).

ICAR-CIFT interventions in prevention of biofouling in aquaculture cages

Aquaculture cages are fabricated primarily with high density polyethylene (PE) webbings

whose non-polar nature makes incorporation of antifouling biocides difficult. The surface of PE needs to be modified to develop strategies against fouling. Hence, antifouling formula of polar/ conducting molecule over PE was synthesized in our laboratory. Polyaniline (PANI) is a well-known conducting polymer since it is easy to synthesise, cheaper, has excellent stability, ability to sense and good adhesion with organic films (Arenas *et al.*, 2012; Ullah *et al.*, 2013).

Nanotechnology to prevent of biofouling in aquaculture cages

Polyethylene nettings (PE) of 25 mm mesh size were treated with freshly purified aniline. The polyaniline coated nettings (PE-PANI) were immersed in 0.02% aqueous nano copper oxide for 24 h, and air dried. The treated nets were exposed in open sea and estuarine environment to study the biofouling resistance.

Multi-location trials on biofouling resistance in polyethylene nettings

a) **Open sea:** Field exposure studies were conducted at Visakhapatnam (Open sea). Two treated webbings with its control were exposed in the open sea for a period of six months. After the exposure, treated webbing with its control was retrieved. The results showed significant biofouling resistance between the treatment and control samples (Fig 1). The control net was attacked by foulers (almost 80%), mainly the barnacles. The results reveals that PANI-nano copper oxide coated polyethylene as an excellent composition for antifouling in open sea.

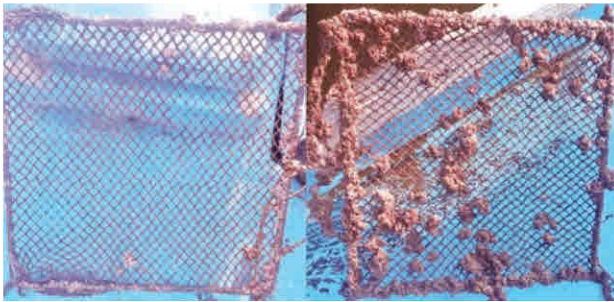


Fig. 1. Treated and control nets

b) **Aquaculture farm:** Field exposure studies on PANI-nano copper oxide coated polyethylene for antifouling was conducted at an aquaculture pond in Kuzhippally, Vypeen. A polyaniline copper oxide composite was synthesized *in situ* and coated over polyethylene webbings used for cage nets. The webbings with its control were exposed in the aquaculture ponds for a period of seven months.

Initially the algal fouling was significantly more in treated than in untreated sample. Polyaniline with ammonia may act as an initial source of nitrogen for the algal growth. But gradually in the succeeding months algal fouling showed a declining trend in the treated sample. However control showed a steep rise in algal biomass (Fig.2 and 3). Same trend was observed in the seventh month also.

Conclusion

The study emphasized the importance of

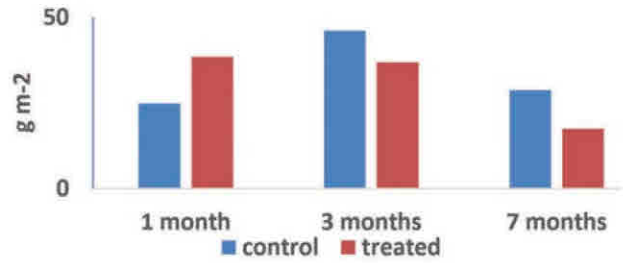


Fig. 2. Accumulation of biomass over the exposed aquaculture cage nets at Kuzhipally, Vypeen

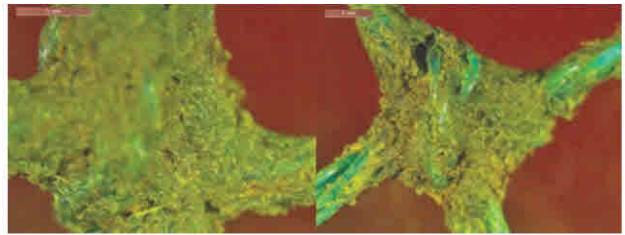


Fig. 3. Control and treated mesh after field exposure (16 X)

in situ synthesis of PANI over PE nettings (PE-PANI) and application of nano copper oxide as a biocide to combat marine biofouling. The nano copper oxide present in the matrix acted as a point source above the electron clouds of polyaniline, preventing initialization of biofilm. The results highlighted the potential application of polyaniline to modify the non-polar surface of polyethylene to load active biocides to prevent fouling in cage aquaculture. The results of the field exposure studies, revealed a great potential for polyaniline with nano copper oxides against biofouling in aquaculture cagenets in sea/estuarine conditions. This technology has to be further promoted for commercialization.

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Adoption of square mesh codends for the trawl fishery: A success story along Sindhudurg coast, Maharashtra

Madhu V.R., ¹Vasudevan, N. and Leela Edwin

ICAR-Central Institute of Fisheries Technology, Cochin

¹Office of the Additional Principal Chief Conservator of Forest and Mangrove, East Mumbai

With over 24,000 tonnes of fish catch, the Sindhudurg coast of Maharashtra is an important fishing ground along the Indian coast. Trawlers (314 Nos. in total) operating from three landing centres viz., Vengurla, Malvan and Devgad, contribute to the bulk of the landings from this region (CMFRI, 2012). The trend of increasing the length of the vessels with concurrent increase in the engine power is not reported in this region. The L_{OA} of the trawlers ranged between 12-15 m and are fitted with 104 HP marine diesel engines. Though, there are no reports of bycatch generated by trawlers at Sindhudurg, Pramod (2010) reported that nine lakh tonnes of discards is generated along Maharashtra coast, which is 12 percent of weight of the total landings. A project funded by United National Development Programme (UNDP), catering to all aspects of the economy of Sindhudurg District was taken up by the Government of Maharashtra and was implemented by the Mangrove Cell of the Forest Department. As part of this project ICAR-CIFT was asked to take up a project to address the problem of high bycatch incidence in trawlers in the region.

The study started with an initial survey covering all the trawl landing centres of the region to collect details regarding the

specifications of the most common gears used and other operational parameters in the trawl fishery. It was observed that the trawl nets of this region are smaller in size when compared to the dimensions of trawl nets used along the west coast of India (Saly N. Thomas *et al.*, 2015). The mesh size of the webbing used in the codend ranged from 15 to 25 mm. The composition of bycatch consisted of 70-75 % of juveniles of ribbonfish, sciaenids and squids (Fig. 1), depending on the season of operation. The highest bycatch was noticed during January (56 kg/ haul), followed



Fig. 1. Juveniles of commercially important species in the bycatch