

Cathodic Protection of Aluminium Sheathed Wooden Fishing Boats with Ternary Aluminium Anodes

A. G. GOPALAKRISHNA PILLAI, K. RAVINDRAN and R. BALASUBRAMONYAN

Central Institute of Fisheries Technology, Cochin-682 029

Results of laboratory and field trials on cathodic protection of aluminium sheathing in fishing boats by ternary aluminium anodes are presented. The high negative potential of 1.06 V with respect to saturated calomel electrode, its appreciably low anodic polarisation and high current output are favourable factors for using the ternary aluminium anodes. The low rate of consumption of the anode material under service trials attests its economic viability.

Corrosion is a major economic problem in fishing boats. Mechanised wooden fishing boats in India are either sheathed with copper or aluminium magnesium alloy. But frequent escalation in the price of copper coupled with its limited availability have necessitated the substitution of an alternate, equally efficient, readily available and cheaper material. Consequent on the studies in this direction (Balasubramonyan, 1965; Balasubramonyan *et al.* 1968), the use of aluminium magnesium alloy in fishing boats has been recommended and over thousand boats are sheathed with the low cost aluminium magnesium alloy in the country.

Aluminium magnesium alloy (Indal M 57 S) owing to its high potential, occupies an extreme position in the galvanic series of metals and alloys in sea water. This alloy is prone to corrosion and adequate protective measures by using anticorrosive paints and supplementary protection by galvanic anodes are to be resorted to for achieving an economic life span. This paper highlights the studies carried out with ternary aluminium alloy in the laboratory and on a 15.24 m fishing trawler.

Materials and Methods

Laboratory experiments were carried out using 22 SWG aluminium alloys Indal M 57 S (Indian Aluminium Company, Calcutta), Hindal 5052 and Hindal 5086 (Hindustan Aluminium, Renukoot), Brass (70/30), mild steel and cupronickel (70/30). The composition of the three grades of

Table 1. Composition of different aluminium magnesium alloys

	Chemical composition (%)	
INDAL M 57 S	Mg	2.0
	Cu	0.2
	Fe	0.2
	Mn	0.1
	Si	0.2
	Zn	0.1
	Cr	0.2
	Al	97.0
HINDAL 5052	Mg	2.2 to 2.8
	Si + Fe	0.45
	Cr	0.15 to 0.35
	Zn	0.20
	Cu	0.10
	Mn	0.10
	Others	0.15
Remaining Al		
HINDAL 5086	Mg	3.5 to 4.5
	Fe	0.5
	Si	0.4
	Mn	0.2 to 0.7
	Zn	0.25
	Ti	0.15
	Cr	0.05 to 0.25
	Cu	0.15
	Others	0.15
	Remaining Al	

Table 2. Composition and electrochemical characteristics of ternary aluminium alloy anodes

Composition %	Open circuit V SCE	Ampere hour out put/kg		Current efficiency %
		Theoretical	Practical	
Zn 4 to 7	Potential	2860	1590	90-95
Sn 0.08 to 0.22	1.06			
Remaining Al				

aluminium alloys are given in Table 1. Ternary aluminium alloy anodes (Indian Patent No. 129038) were used for laboratory and field trials.

The nominal composition and the electrochemical characteristics are presented in Table 2. Laboratory studies were conducted in natural sea water using metal panels of 15 x 10 cm after cleaning and degreasing as described by Champion (1952). The potentials of the metals with cathodic protection by ternary aluminium anodes were measured with respect to saturated calomel electrode using a D. C. microvolt meter (Philips model 6009). To minimise the potential drop during measurements the Haber Luggin tube was kept close to the test electrode. The potentials of the protected metals were recorded after 30 and 60 days interval.

Service trials were carried out for two years on MFV Sindhukumari (15.24 m OAL, Central Institute of Fisheries Technology) which undertook regular fishing voyages. The vessel was sheathed with M 57 S and the painting schedule consisted of a coat of wash primer followed by two coats of zinc chromate primer and a finishing top coat of antifouling paint.

The boat had a sheathed area of 93 m² which was protected with 12 kg anodes of type 1 and type 2 (Figs. 1 & 2). The anodes were fixed to the hull through iron inserts using galvanised iron screws. To ensure electrical continuity between the anodes and the hull, resistance measurements were made. The potential of the hull was kept at -1.0V SCE (Ravindran & Balasubramonyan, 1973). To counteract the corrosion by the gun metal propeller (1040 x 580 mm), stainless steel shaft, mild steel rudder and

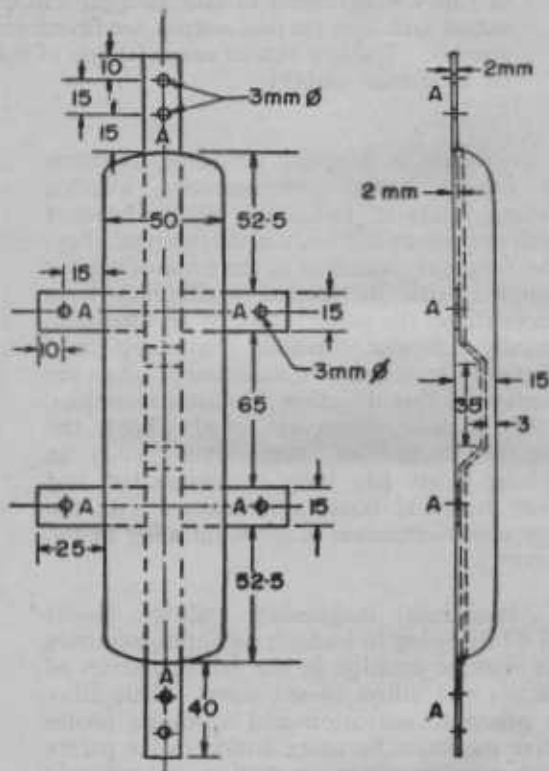


Fig. 1. Anode type 1. Ternary aluminium alloy anode
All dimensions in mm, A-mild Steel insert

cast iron shoe, 8 kg of the anodes were fixed at the stern area. The anodes and the hull were examined after 2 years.

Results and Discussion

The performance of different metals protected with the anodes is reported in Table 3, which shows that the potential of the cathode remained more or less constant indicating a steady driving potential and low polarisation of the anodes. The metals including

Table 3. Performance of cathodes

Metal	Electrolyte	Cathode potential volte		Observations
		After 30 days	After 60 days	
Al (INDAL M 57S)	Sea water	-1.00	-1.00	Free from pitting and general corrosion
Mild steel	Sea water	-0.80	-0.80	"
Cupronickel	Sea water	-0.35	-0.35	"

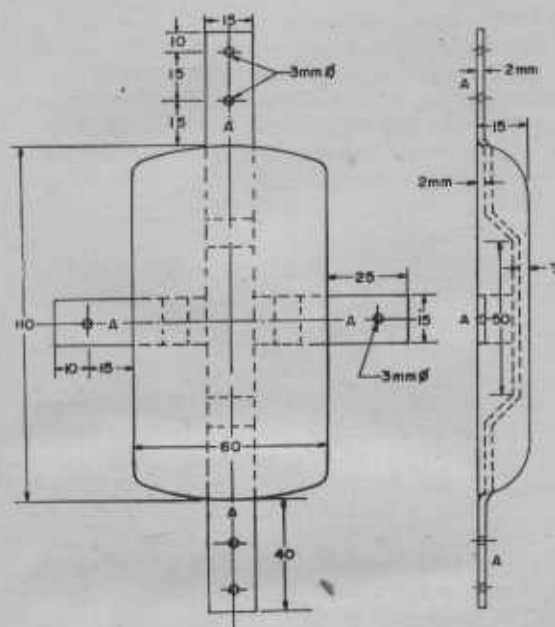


Fig. 2 Anode type 2. Ternary aluminium alloy anode. All dimensions in mm. A - mild steel insert

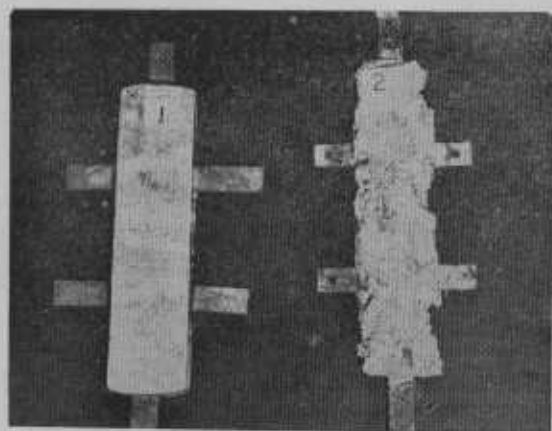


Fig. 3. (1) Anode before service trials
(2) Anode after service trials

aluminium magnesium alloys were all free from pitting corrosion evidencing cathodic protection by the anodes. The results also

show that the anode could deliver current for long duration needed for cathodic protection.

The service trials provided further corroborative evidence on the effectiveness of the ternary aluminium anodes. Examination of hull, rudder, propeller and cast iron shoe after two years showed that they were free from pitting and general corrosion, whereas the wearing of the anodes, in certain cases to the extent of exposure of the iron inserts, evidenced the sacrificial action of the anode. The condition of the anode before and after use in the fishing boat is shown in Fig. 3. The consumption of the anode was 3.2 kg/100m²/year. The high negative potential of -1.06 V with respect to saturated calomel electrode together with an appreciable low polarisation while acting as anode as observed in the laboratory experiments and a low rate of consumption of the anode materials under service are factors which would favour the use of ternary aluminium anodes for cathodic protection in fishing boats. It is seen, that with the right choice of anodes both quality and quantity wise, the service life of this new sheathing material can be enhanced further.

The authors are thankful to the Director, Central Institute of Fisheries Technology for permission to publish this paper.

References

- Balasubramonyan, R. (1965) *Res. & Ind.* 10, 163
- Balasubramonyan, R., Ravindran, K., Unnikrishnan Nair, N. & Gopalakrishna Pillai, A. G. (1968) *Proc. Int. nat. Congress Mar. Corr. Fouling, Athens*, p. 601
- Champion, F. A. (1952) *Corrosion Testing Procedures*, 1st edn., p. 16, Chapman & Hall, London.
- Ravindran, K. & Balasubramonyan, R. (1973) *Proc. symp. Cathodic Protection* 3, 8, Defence Research Laboratory, Kanpur

Effect of Colour on the Catch of Gill Nets

J. SITARAMA RAO, PERCY DAWSON* and Y. SREEKRISHNA**

Kakinada Research Centre of Central Institute of Fisheries Technology, Kakinada-533 003

The effect of white, green, blue and yellow coloured drift gill nets on their catch with respect to *Scomberomorus guttatus* (Schneider), *Scomberomorus commerson* (Lacepede), *Scomberomorus lineolatus* (Cuvier), *Parastomateus niger* (Bloch), *Euthynnus affinis* (Cantor) and sharks *Carcharius melanopterus* is discussed. White nets were more effective for *S. guttatus* while the coloured ones caught more of *P. niger*. Blue had no significant effect for sharks. In the case of *S. lineolatus*, *S. commerson* and *E. affinis* no preference to colour was noted.

As the visibility of the fishing net in the water has an effect on its catch, many workers studied the effect of coloured nets (Nomura, 1959, 1961; Von Brandt & Liepolt, 1955; Andreev, 1958; Levy, 1964). Nomura (1961) noted increased catch in dark coloured nets during day with no effect during night. Andreev (1962) found that nets dyed with light colour did not fish well. Jester (1973) indicated that colour is species specific. Attempts have not been made in India to study the effect of coloured gill nets on catch. This paper reports the attempt of the authors to study the effect of coloured gill nets on the catch of seer, pomfret, tuna and sharks along the Andhra coast.

Materials and Methods

The material was polyamide white twine of Nm 34/3/3 with a uniform mesh size of 50 mm bar, undyed and dyed with green, blue and yellow. The twines were kept for 20 min. at 60°C in a 1% solution of neutral soap and ammonia (1:1). Subsequently it was kept in a bath with material to dye bath ratio 1:10 at a dye concentration of 0.1%. To this, acetic acid was added to get a pH of 3-4. The solution was heated to 60°C and the material after thorough washing and drying is introduced to the dye solution and heated to boil for 30 min. The material was taken out, excess dye solution was drained, washed and dried. Dyes used

were manufactured by M/s. Sandoz (India) Ltd., Bombay. The net fleet had 16 units, the combination being four under each colour. Each net had 50 m mounted length and 6 m hung depth. The nets were operated in juxtaposition as surface drift at 20-65 m off Kakinada giving equal chances for all units.

Results and Discussion

Table 1 shows that in general, white nets caught more of *S. guttatus*, while blue and yellow caught more of *S. commerson*. It is seen that for *S. guttatus*, variation between days and colours is significant at 1% level. Critical difference in catch was worked out to be 0.09365 with the mean logarithmic catch of the four different coloured nets as 0.4012 (white), 0.2411 (green), 0.1679 (yellow) and 0.2300 (blue). Accordingly white nets gave significantly higher catch in comparison with the other three, which were more or less similar in their catching rate. As regards *S. commerson* and *S. lineolatus* the variance between nets and days was not significant even at 5% level indicating similarity of catch rate in all nets (Table 1). As only limited number of these species were caught further experiments are necessary for confirmation.

The catching rate is different for different coloured nets (Table 2). *P. niger* was caught more in green nets, whereas *E. affinis* was relatively more in green nets followed by white and sharks in yellow. The chi-square test (Table 2) reveals that in *P. niger* and sharks, the colour of the net has

Present address: *Burla Research Centre of Central Institute of Fisheries Technology, Burla-768017

**Central Institute of Fisheries Education, Versova, Bombay-400058

Table 1. Analysis of variance

	White		Green		Yellow		Blue		SS	DF	MS	F
	no	wt	no	wt	no	wt	no	wt				
<i>S. guttatus</i>	69	71.95	39	43.00	26	34.05	38	40.90	Total	8.8956	143	—
									Between	1.0790	3	0.3563
									nets			8.67*
									Between	3.5047	35	0.1001
									days			2.47*
									Error	4.3218	105	0.0411
												—
<i>S. commerson</i>	6	13.50	3	9.05	10	30.65	11	38.00	Total	1.9892	67	—
									Between	0.1262	3	0.0421
									nets			1.30
									Between	0.3112	16	0.0194
									days			0.60
									Error	1.5513	48	0.0323
												—
<i>S. lineolatus</i>	10	18.40	3	4.50	5	11.20	6	10.70	Total	1.3570	27	—
									Between	0.1722	3	0.0574
									nets			1.02
									Between	0.1705	6	0.0284
									days			0.50
									Error	1.0143	18	0.0563
												—

* Significant at 1% level

Table 2. Chi-square analysis for *P. niger*, *E. affinis* and shark

Species	White		Green		Yellow		Blue		Calculated X ²	DF	Remarks
	no	wt	no	wt	no	wt	no	wt			
<i>P. niger</i>	69	52.00	119	72.13	102	65.77	113	71.99	14.78	3	0.01 < P < 0.001
<i>E. affinis</i>	59	97.30	63	106.20	49	86.10	40	63.60	6.08	3	0.20 < P < 0.10
Sharks	62	216.65	58	150.95	71	271.95	39	170.20	9.48	3	0.05 < P < 0.02

Table 3. *Chi-square analysis for P. niger and shark*

	Colour	X	DF	Remarks
<i>P. niger</i>	Green, blue and yellow	1.34	2	0.70 P 0.50
Sharks	White, green and yellow	1.39	2	0.50 P p.30

significant effect on the catch, but not in *E. affinis*. Hsiao (1951) while studying the response of five tunnies to artificial light by confining them in a tank illuminated with two 60 W bulbs and coloured lights of moderate intensity, observed that they were equally attracted by coloured and white lights. But Hsiao & Jester (1952) found that white lures were slightly superior to coloured ones, white was not significant to *P. niger* and blue to sharks and hence chi-square was applied for the three coloured nets leaving the one with less catch in the case of *P. niger* and sharks (Table 3). The chi-square test indicated that for *P. niger* the effect of green, yellow and blue was the same while for sharks white, green and yellow was equal.

The authors wish to express their gratitude to Shri. G. K. Kuriyan, Director, Central Institute of Fisheries Technology, Cochin and Shri A. V. V. Satyanarayana, Scientist for their guidance, suggestion, and reading the manuscript and to the Statistical Section for the help in the statistical analysis.

References

Andreev, N. N. (1962) *Hand Book of Fishing Gear and its Rigging*. Cat.

No. 654, Israel Programme for Scientific Translation, Jerusalem (Translated from Russian)

Hsiao, S. C. (1951) *U.S. Fish and Wild Life Service Spec. Report*. 91, p. 36, Bureau of Commercial Fisheries, Washington

Hsiao, S. C. & Jester, A. L. (1952) *U.S. Fish and Wild Life Service Spec. Report*. 130, p.63, Bureau of Commercial Fisheries, Washington

Jester, D. B. (1963) *Trans. Amer. Fish. Soc.* 1, 109

Levy, H. (1964) in *Modern Fishing Gear of the World*. (Kristjonsson, H., Ed.) Vol. 2, p. 582, Fishing News (Books) Ltd., London

Nomura, M. (1959) in *Modern Fishing Gear of the World*. (Kristjonsson, H. Ed.) Vol. 1, p. 550, Fishing News (Books) Ltd., London

Nomura, M. (1961) *Bull. Tokai Reg. Fish Res. Lab.* 30, 1

Von Brandt, A. & Liepolt, R. (1955) *Oesterreichs Fischerzi*, 8, (9/10), 93