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

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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	Ampere hour out put/kg		Current efficiency %
		Theoretical	Practical	
Zn 4 to 7	Potential V SCE	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 —1.0 V SCE (Ravindran & Balasubramonyan, 1973). To counteract the corrosion by the gun metal propeller (1040 x 580 mm), stainless steel shaft, mild steel rudder and

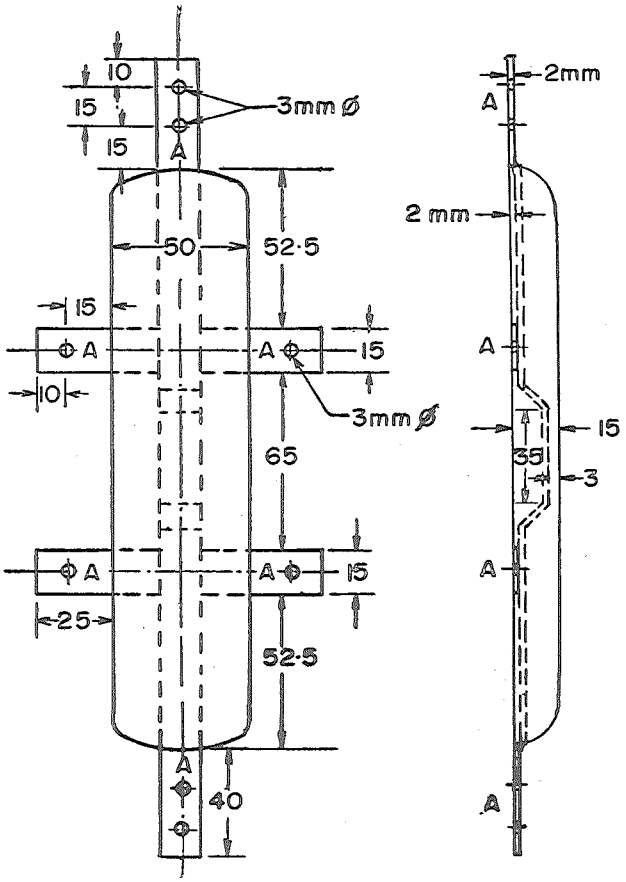

Fig. 1. Anode type 1. Ternary aluminium alloy anode
All dimensions in mm, A-mild Steel insert

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 After 30 days	After 60 days	Observations
Al (INDAL M57S)	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	,,

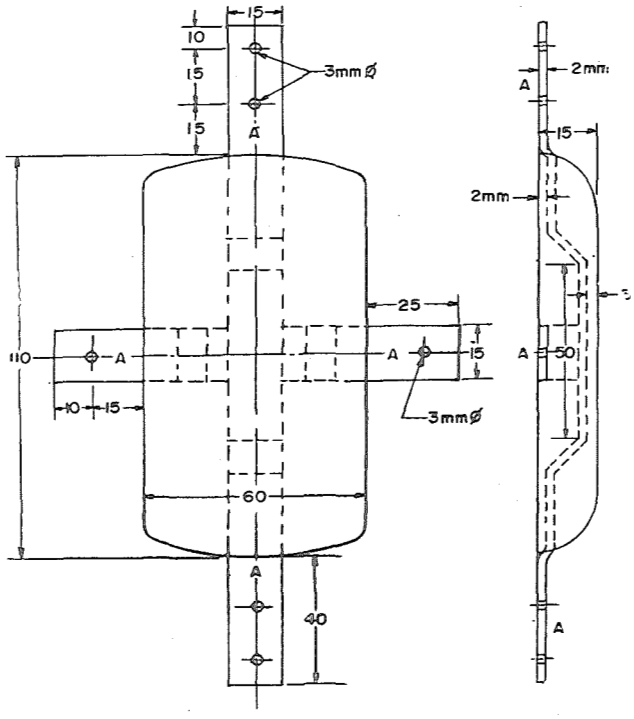

Fig. 2 Anode type 2. Ternary aluminium alloy anode. All dimensions in mm. A - mild steel insert

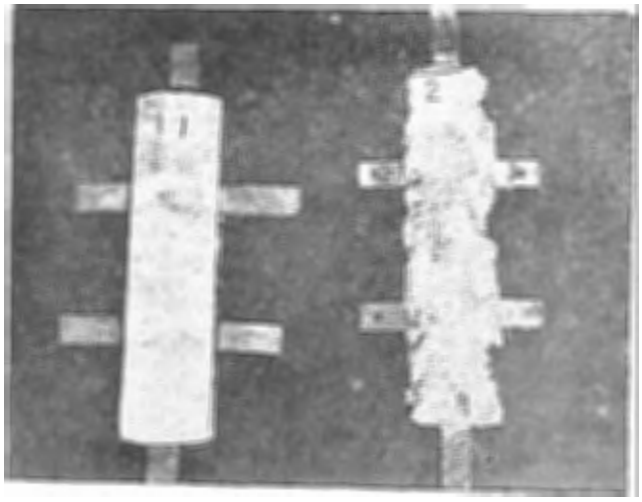

Fig. 3. (1) Anode before service trials
(2) Anode after service trials

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.

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