

GOVERNMENT OF INDIA : THE PATENT OFFICE, 214, LOWER CIRCULAR ROAD, CALCUTTA-17.

Specification No. 104522. Application No. 104522, dated 25th March 1966. Complete specification left on 14th November 1966. (Application accepted 3rd November 1967.)
Index at acceptance—155F2 [XXIII], 14D2 [LVIII(1)], 70B [LVIII(5)], 103 [XLV(1)].

PROVISIONAL SPECIFICATION.

IMPROVEMENTS IN OR RELATING TO THE INHIBITION OF SELF-CORROSION OF ALUMINIUM AS A GALVANIC ANODE IN ALKALINE MEDIA.

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH, RAJI MARG, NEW DELHI-1, INDIA, AN INDIAN REGISTERED BODY INCORPORATED UNDER THE REGISTRATION OF SOCIETIES ACT (ACT XXI OF 1860).

The following specification describes the nature of this invention.

This is an invention by NARAYANSWAMI SUBRAMANYAN, Scientist, and VASUDEVA SASTRI KAPALI, Senior Laboratory Assistant, of the Central Electrochemical Research Institute, Karaikudi, India, both Indian citizens.

This invention relates to improvements in or relating to the inhibition of corrosion of aluminium as a galvanic anode in alkaline media.

Hitherto it has been proposed that the inhibition of corrosion of aluminium in alkaline solutions can be effected by silicates, chromates, etc.

These are open to the objections that :

- (i) these inhibitors generally passivate the surface ; and
- (ii) the current delivered is thereby considerably reduced.

The object of this invention is to effect inhibition of corrosion of commercial aluminium when it is used as a galvanic anode even in dilute sodium hydroxide solutions by the following approaches :

- (i) reducing or eliminating the use of passivating type of inhibitors ; and

- (ii) employing a substance as an addition agent, which will inhibit self-corrosion of aluminium and at the same time will not stop the delivery of current or make it negligibly small, while it is used as a galvanic anode in sodium hydroxide solution.

To these ends, the invention broadly consists in :

- (a) the addition of cathodic inhibitors ;
- (b) facilitating the complexing of aluminium.

The following typical examples of experiments are given in tabular form :

Performance of aluminium (2 sq. in) as galvanic anode in sodium hydroxide solution when coupled to a cylindrical graphite electrode (8.3 cms dipping and 1.7 cms dia.).

No.	Composition of the electrolyte	Duration of experiment (in hrs.)	Current delivered in mA	Corrosion current in mA	Anode efficiency %
1	2	3	4	5	6
1	0.1 M. NaOH +0.3% NaCl	3.0	15.2	139	10.9
2	0.1 to 0.4 M. NaOH +0.3% NaCl + up to 20 p.p.m. of addition agent magnesium	3.0 6.0	70.0 78.0	116 138	53.3 54.0
3.	0.1 to 0.4 M. NaOH +0.3% NaCl + up to 20 p.p.m. of addition agent magnesium + 100 to 200 p.p.m. of addition agent calcium	3.0 6.0	80 to 120 75 to 120	105 to 190 94 to 171	67 to 85 69 to 85

The following are among the main advantages of the invention :

(i) Commercial aluminium can be used as a galvanic anode in alkaline media. Since high efficiency has been got in solutions containing sodium hydroxide, it may be possible to use commercial aluminium in some D.C. power sources instead of zinc or magnesium, thereby leading to import substitution and a saving of foreign exchange.

(ii) By employing cathodic inhibitors, the loss of anode by local cell action is considerably reduced and reasonably good anode efficiency is obtained, and

(iii) The inhibitors recommended are also indigenously available and cheap.

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Dated this 15th day of March 1966.

COMPLETE SPECIFICATION.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, RAJI MARG, NEW DELHI-1, INDIA, AN INDIAN REGISTERED BODY INCORPORATED UNDER THE REGISTRATION OF SOCIETIES ACT (ACT XXI OF 1860).

The following specification particularly describes and ascertains the nature of this invention and the manner in which it is to be performed.

This is an invention by NARAYANASWAMY SUBRAMANYAN, Scientist and VASUDEVA SASTRI KAPALI, Senior Laboratory Assistant, of the Central Electrochemical Research Institute, Karaikudi, India, both Indian citizens.

This invention relates to improvements in or relating to the inhibition of corrosion of aluminium as a galvanic anode in alkaline media.

Hitherto it has been proposed that the inhibition of corrosion of aluminium in alkaline solutions can be effected by silicates, chromates, etc.,

There are not convenient for employing aluminium as a galvanic anode because—

- (i) these inhibitors generally passivate the surface ; and
- (ii) the current delivered is thereby considerably reduced.

Price : TWO RUPEES.

The object of this invention is to bring down the waste of material by self-corrosion of commercial aluminium (2S) in alkaline solution and thereby facilitate the use of commercial aluminium as a galvanic anode in DC power sources.

We have found that the inhibition of self-corrosion of commercial aluminium in alkali or alkaline chloride solutions can be brought about by the use of cathodic inhibitors such as compounds of metals like alkaline earth metals, magnesium, manganese or chromium which have valencies greater than one but will not get reduced to the corresponding metals.

We have found that by combining the compounds of metal, like alkaline earth metals, magnesium, manganese or chromium which have valencies greater than one but will not get reduced to the corresponding metals with an agent for facilitating the complexing of aluminium such as sodium, potassium or other metallic salts of organic carboxylic acids with or without hydroxyl groups, high anode efficiencies can be attained when commercial aluminium is used as a galvanic anode in alkaline media containing alkali or alkali and NaCl.

We have found that high anode efficiency of the order of 70 to 95% can be obtained for commercial aluminium surrounded by sodium carbonate-sodium chloride mixture containing sodium and/or potassium or other metallic salts of organic carboxylic acids with or without hydroxyl groups such as, for example, gluconic, tartaric, citric acids.

The above observations are illustrated by typical examples given in Table 1 herein below.

According to the present invention, the method of inhibition of self-corrosion of aluminium as a galvanic anode in alkaline media consists in adding to the alkaline media (i) cathodic inhibitors such as compounds of metals like alkaline earth metals, magnesium, manganese or chromium, which have valencies greater than one, but will not get reduced to the corresponding metals and (ii) addition agents for facilitating the complexing of aluminium such as sodium, potassium, or other metallic salts of organic carboxylic acids with or without hydroxyl group.

The process enables the use of commercially available aluminium effectively and efficiently as an anode in galvanic power sources.

TABLE I
Performance of 2S aluminium (2 sq. in) as galvanic anode in alkaline media coupled to graphite rod (1.7 cm dia. and 8.3 cms dipping in solution)

No.	Composition of the electrolyte	Duration of experiment in hours	Potential of aluminium vs. saturated calomel electrode	Current delivered in mA	Galvanic corrosion as current in mA	Anode efficiency (%)
1	2	3	4	5	6	7
1	0.1M. NaOH+0.3% NaCl	3	-1.2 to -1.4	15.2	139.0	11
2	0.1 to 0.4M. NaOH+0.3% NaCl+5 to 20 p.p.m. of magnesium	3 6	" "	70.0 78.0	116.0 138.0	53 54
3	0.1 to 0.4M. NaOH+0.3% NaCl+5 to 20 p.p.m. of magnesium+100 to 200 p.p.m. of calcium	3 6	" "	80 to 120 75 to 120	05 to 190 94 to 171	67 to 85 69 to 85
4	1.0M. NaOH+0.3% NaCl +1 to 20% w/v calcium gluconate	24	"	120	240	50
5	0.5M. NaOH+0.3% NaCl +5 to 20 p.p.m. of magnesium+100 to 200 p.p.m. of calcium	24	"	100	320	31
6	0.5M. NaOH+0.3% NaCl +1 to 5% sodium-potassium tartarate	24	"	8 to 12	196	4
7	0.5M. NaOH +0.3% NaCl + 5 to 20 p.p.m. of magnesium + 100 to 200 p.p.m. of calcium + 1 to 5% sodium-potassium tartarate	24	"	100	136	73
8	1.0M NaOH + 0.3% NaCl + 5 to 20 p.p.m. of magnesium + 100 to 200 p.p.m. of calcium + 1 to 5% sodium-potassium tartarate	24	"	100	210	50
9	1.0M. NaOH + 0.3% NaCl + 5 to 20 p.p.m. of magnesium + 100 to 200 p.p.m. of calcium + 1 to 10% sodium citrate	24	"	140	216	65
10	2M. NaOH+0.3% NaCl+ 5 to 20 p.p.m. of magnesium+100 to 200 p.p.m. of calcium + 1 to 10% sodium-potassium citrate	24	"	100	270	45 to 50
11	0.25M. Na ₂ CO ₃ + 0.3% NaCl + 1 to 5% sodium-potassium tartarate	6 to 240 hrs	-0.98 to -1.17	7 to 12	11 to 13	70 to 95

We claim :

1. A method of inhibition of self-corrosion of aluminium as a galvanic anode in alkaline media which consists in adding to the alkaline media (i) cathodic inhibitors such as compounds of metals like alkaline earth metals, magnesium, manganese or chromium which have valencies greater than one but will not get reduced to the corresponding metals and (ii) addition agents for facilitating the complexing of aluminium such as sodium, potassium or other metallic salts of organic carboxylic acids with or without hydroxyl group.

2. A method as claimed in Claim 1, wherein commercially available aluminium is used as anode.

3. A method as claimed in Claim 1 or 2, wherein commercial aluminium is surrounded by sodium carbonate-sodium chloride mixture containing sodium and/or potassium or other metallic salts of organic carboxylic acids with or without hydroxyl groups, such as, for example, gluconic, tartaric, citric acids.

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Dated this 4th day of November 1966.