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"AN IMPROVED ALKALINE PRIMARY BATTERY CELL"

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH Rafi Marg, New Delhi- 110001, 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 :-

PRICE : TWO RUPEES

This invention is developed by Kanniya Balusamy Sarangapani, Verrachamy Balaramachandran, Vasudeva Sastri Kapali, Subramaniyan Venkatakarishna Iyer, Mahadev Govind Potdar and Kummittithidal Santhanam Rajagopalan, all of Central Electrochemical Research Institute, Karaikudi, Tamil Nadu, India all Indian citizens and relates to an improved alkaline primary battery cell.

Hitherto it has been proposed to employ super purity aluminium as anode in alkaline electrolyte in combination with suitable cathode material as single shot battery system or in Leclanche type wet cells.

These have the following drawbacks :

i) The cost of super purity aluminium is prohibitive.

ii) Further the anode efficiencies of aluminium in the prior art system are very poor due to self corrosion. In other words most of the aluminium is lost due to wasteful self corrosion rather than production of electric current in the battery system.

iii) Concentration of alkali used in the prior art is as low as IN sodium hydroxide with 5% sodium citrate as complexing agent and 0.1% calcium oxide as inhibitor which is not capable of sustaining high current drainage. In such weak electrolyte systems during discharge internal resistance will build up resulting in drop in cell voltage, draining up of the electrolyte due to high temperature evaporation and premature failure of the battery system.

iv) Further the above said concentration of complexing agent and inhibitor works only in low concentration of alkaline electrolyte namely in sodium hydroxide.

v) Only NaOH solution has been used in the prior art and the proable preparation of an electrolyte based on KOH has not been mentioned at all.

The object of the present invention is to obviate these drawbacks by employing commercially available 2S-aluminium (99% pure) as anode in the presence of trace quantities of the additives like metals and metal oxides including rare earth oxides, salts of metalloids, in the formulated electrolyte which is an alkali hydroxide containing complexing agent like sodium citrate and/or sodium tartrate and inhibitors like calcium oxide, barium oxide and strontium oxide.

Accordingly, the present invention provides an improved alkaline primary battery cell comprising an anode, cathode and an electrolyte characterised in that the anode used is a commercial 2S-aluminium (99% pure), and the electrolyte is an alkali hydroxide in concentration ranging from 2N to 5N, and containing-sodium citrate and/or tartrate as complexing agent, conventional additives such as metals, metal oxides including rare earth oxides and salts of metalloids; and conventional corrosion inhibitors.

The metal additives employed is selected from zinc, tin, arsenic, vanadium,

tungsten, selenium, and molybdenum and aluminium. The amount of the additives ranges from 0.01 to 2%. Preferably the amount is 0.05%.

As inhibitor, oxides of calcium, barium and strontium are used and they may be employed in the range of 0.1% to 5% by weight.

As complexing agent, sodium citrate and/or tartrate is used and their amount may range from 5 to 35%.

Further, the 2S-aluminium of commercial purity (99% pure) can be employed as anode by casting the same from commercial scraps.

The invention is illustrated further by the following examples which should not be considered to limit the scope of the invention.

Example-1

(Supression of self corrosion of aluminium in alkaline media)

Name of aluminium or aluminium alloy employed	= Aluminium = 2S of Indian Aluminium Co.Ltd.
Composition of aluminium 2S	= Contains not less than 99% of aluminium.
Volume of solution	= 300 ml
Duration of experiment	= one hour
Size of specimens	= 20 cm^2 (three numbers)

Sl.No.	Nature of solution.	Nature of the complexing agent used.	Nature of the inhibitor used	Nature of addition agent	% inhibition efficiency or % of metal saved from corrosion.
1.	2N NaOH/ KOH	..	Sodium silicate 1 to 5% (wt/v)	Nil	About 30 to 50%
2.	2N to 5N NaOH/KOH	5 to 35%	0.1% (wt/v) to 5% (wt/v) calcium oxide	Nil	90%
3.	2N to 5N NaOH.KOH	15 to 35% (wt/v) sodium citrate	0.1% to 5% (wt/v) calcium oxide	0.01% to 2% (wt/v) of salts like sodium arsenate	95%

Example-3

Anode efficiency at various current densities for 2S aluminium in base electrolyte containing different additives.

Area of the aluminium (2S) electrode exposed = 10 cm^2

Duration of experiment = 2 hours Base electrolyte: as in Example-2

Sl.No.	Electrolyte used	Anode efficiency at various current densities (%) (mA/cm^2)				
		50	75	100	125	150
1.	Base electrolyte alone	51	75	90	90	96
2.	"do" + zinc 0.05%	52	65	88	89	97
3.	"do" + tin 0.05%	56	80	85	88	94
4.	"do" + aluminium 0.05%	52	66	80	82	89
5.	"do" + arsenic 0.05%	56	72	84	85	89
6.	"do" + tungsten 0.05%	51	74	84	86	90
7.	"do" + vanadium 0.05%	52	73	84	86	91
8.	"do" + selenium 0.05%	52	54	78	80	84

Example-4

Characteristics of a model aluminium air cell.

Based on studies carried out using 2S-aluminium as anode in the alkaline citrate solution model cells have been assembled and they are found to have the following characteristics.

i) Cell Type - AW_4

Anode	- 2S aluminium (commercial purity)
Cathode	- Carbon element of AW_4 type manufactured and supplied by M/s. Carbon Industries, Madras.
Electrolyte	- Alkaline citrate based on 4N sodium hydroxide or KOH containing additives as mentioned in Examples (2) & (3)
O.C.V.	- 1.6V
Value of discharge resistor	- 10 ohms
Close circuit voltage	- 1.3 at the beginning
Duration of test	- 300 - 400 hrs.

The discharge was carried out as per I.S.I. specification for AW_4 type of zinc-air cell.

ii) Cell type - AWC_2

Anode	- 2S aluminium (commercial purity)
Cathode	- Carbon element AWC_2 cell manufactured and supplied by M/s. Carbon Industries, Madras.
Electrolyte	- Alkaline citrate (4N NaOH) or (4N KOH) + additives as in Examples (2) & (3)
O.C.V.	- 1.6V
C.C.V.	- 1.35V (at the beginning)
Discharge resistance	- 1 ohm

The discharge was carried out as per the I.S.I. specification for AWC_2 zinc-air cells.

Duration of test - 300 - 400 hrs.

The following are the main advantages of the invention:

a) The compounds that are found to be good suppressors of self corrosion of aluminium in alkaline media as mentioned in Examples 1-4 are required only in small quantities and are available indigenously at reasonable prices.

b) The presence of above compounds in 2N to 5N NaOH/KOH is found to reduce to a great extent self corrosion, improve the anodic polarisation characteristics and anode efficiency values of 2S-aluminium in 2N to 5N sodium or potassium hydroxide solution containing CaO and sodium citrate in right proportions.

We claim

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1. An improved alkaline primary battery cell comprising an anode, cathode and an electrolyte characterised in that the anode used is a commercial 2S-aluminium (99% pure), and the electrolyte is an alkali hydroxide in concentration ranging from 2N to 5N, and containing-sodium citrate and/or tartrate as complexing agent, conventional additives such as metals, metal oxides including rare earth oxides and salts of metalloids; and conventional corrosion inhibitors.

2. An improved alkaline primary battery cell as claimed in claim 1 wherein the alkali hydroxide employed is sodium hydroxide or potassium hydroxide.

3. An improved alkaline primary battery cell as claimed in claims 1 to 2 wherein the metal additives are selected from zinc, tin, arsenic, vanadium tungsten, selenium, molybdenum and aluminium.

4. An improved alkaline primary battery cell as claimed in claims 1 to 3 wherein the quantity of the additives ranges from 0.01 to 2%.

5. An improved alkaline primary battery cell as claimed in claim 4 wherein the quantity of additives used is 0.05.

6. An improved alkaline primary battery cell as claimed in claims 1-5 wherein the metal inhibitors employed are selected from oxides of calcium, barium and strontium.

7. An improved alkaline primary battery cell as claimed in claims 1-6 wherein the quantity of the inhibitors ranges from 0.1% to 5% by weight.

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8. An improved alkaline primary battery cell as claimed in claims 1-7 wherein the complexing agent is used in the range of 5 to 35%.

9. An improved alkaline primary battery cell substantially as herein described with reference to the examples.

Dated this 11th day of October 1985

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