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3,469,074

METHOD OF ELECTRICALLY HEATING AN AQUEOUS ELECTROLYTE

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3 Claims

ABSTRACT OF THE DISCLOSURE

There is provided an electrode and process of using the electrode as a heating element in boilers. The electrode consists of a coating of iridium, rhodium or alloys thereof, especially alloys with platinum, painted or plated on a titanium base. The electrodes are for use with an alternating current and have the advantage that the electrode will not corrode even if the said coating is pervious and contains pores. When water containing chlorides is used in such a boiler, it is preferred that a soluble alkali metal phosphate be dissolved in the water.

This invention relates to electrode boilers and in particular to electrodes for use in and a method of operation of such boilers.

Electrode boilers are usually operated by alternating current and the electrodes must be constructed of a material which is capable of passing a high current to the electrolyte, usually water, without corroding. Among the materials which have been proposed for use as electrodes for such boilers are cast iron, silicon-iron, nickel-copper alloys, copper-base alloys, aluminium and stainless steel, but it has been found that corrosion in various degrees occurs dependent upon the characteristics of the water.

According to the invention there is provided an electrode in which at least the surfaces for passing a current into an electrolyte consist of iridium or rhodium or of an alloy of iridium and rhodium or of an alloy of iridium or rhodium and platinum or of an alloy of iridium and rhodium and platinum.

Conveniently, such an electrode may comprise a construction of titanium or a titanium-base alloy coated at least on such surfaces with one of said metals or alloys hereinafter referred to as "iridium, rhodium or their specified alloys."

An alloy of 30% iridium and 70% platinum has been found to be satisfactory.

Platinum itself is effective as an electrode surface for only a short time because the metal oxidises and it is clearly uneconomic.

Platinum coated by either plating or painting titanium is likewise unsatisfactory, because the platinum film quickly strips off. If partially coated titanium anodes are used, the bare titanium corrodes, particularly in the presence of chlorides.

An electrode in accordance with the invention may be constructed by making the electrode shape from titanium or titanium-base alloy and coating the surfaces from which the current is to pass to the electrolyte by plating or painting with iridium, rhodium or their specified alloys. Such alloys are commercially prepared as paints.

The electrode may be in the form of a wire mesh or a sheet of iridium, rhodium or their specified alloys.

The immersed portions of the conductors to the electrodes may be made from titanium or titanium-base al-

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loy provided the method of operating the boiler is modified as hereinafter described to prevent corrosion of the titanium, particularly in the presence of chlorides. The use of titanium conductors which act also as supports for the actual electrodes clearly is advantageous and simplifies construction.

When an alternating current is being conducted between two titanium electrodes immersed in water, the protective film on the surface of the titanium will break down and corrosion will ensue when appreciable quantities of chlorides are present and voltages are greater than 8-10 volts D.C. or between 100-250 volts A.C. These A.C. voltages are those most frequently met with commercially and would normally be used for electrode boilers at a fairly high current density.

By the modification of the method of operating an electrode boiler referred to above, water containing chlorides can be heated or boiled at commercial voltages without corrosion of uncoated titanium used in the construction of the electrodes occurring and this is achieved by providing conditions in the boiler in which a protective film is maintained on the titanium. Such conditions prevail when the water contains a soluble phosphate.

A suitable soluble phosphate is an alkali metal hexametaphosphate, preferably the sodium compound commercially available under the registered Trademark "Calgon." An addition of 0.2% w/v (2 gms./litre) of sodium hexametaphosphate has been found to be satisfactory. Where it is desired to boil deionised water, the same amount of sodium hexametaphosphate may be used to impart sufficient conductivity to the water without risk of corroding the electrodes.

Tests have been carried out on a water having the following composition:

	Parts per million
Total dissolved solids	415
SiO ₂	11.5
Ca	91
Mg	35
NO ₃	32
SO ₄	107
Cl	51
Total alkalinity	210
Total hardness	373
pH value	7.5
Conductivity 680 recip. megohms.	

When such a water is boiled using A.C. at 240 volts and a current of 2.0 amps. corrosion of a pair of titanium electrodes occurs.

In an example of the invention an electrode boiler having 1/8" diameter commercially pure titanium electrodes completely coated with iridium spaced 6" apart and immersed 3" was used. Three litres of water of the above compositions was boiled efficiently and maintained at boiling point for 300 hours using an A.C. 240 volt, 50 cycles/second supply at a current of 0.8 amp. when cold rising to 2.0 amps. at boiling point. No corrosion of the electrode occurred.

A similar procedure was carried out using electrodes completely coated with 70% platinum, 30% iridium and electrodes completely coated with rhodium without corrosion occurring. The rhodium-coated electrodes were tested for more than 2000 hours.

Other conventional electrode materials, as before mentioned, corrode under such conditions even in the presence of the soluble phosphate.

We claim:

1. A method of heating an aqueous electrolyte comprising at least partially immersing in said electrolyte at

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least two electrodes which have a base support material selected from the group consisting of titanium and titanium-base alloys, and a coating on said base support material selected from the group consisting of iridium, rhodium, and alloys thereof, and iridium, rhodium and alloys thereof further alloyed with platinum, and applying an alternating current to the electrodes, and wherein a soluble phosphate in an amount of at least about 0.2% weight/volume is added to the aqueous electrolyte when chlorides are contained in the electrolyte.

2. A method as claimed in claim 1 in which the soluble phosphate is an alkali metal hexametaphosphate.

3. A method as claimed in claim 2 in which sodium hexametaphosphate is present in an amount equivalent to 0.2% weight in volume.

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