CONFERENCE PROCEEDING

Salt-water Heater

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ABSTRACT

Salt-copper electrolysis is a new innovation in the field of renewable green energy. It can be implemented in operating various electrical appliances. The aim of this research is to create a salt-water heater that is environmentally friendly, affordable and transportable. The heater works by having copper and zinc plates submerged in salt water to generate electricity through a process called electrolysis. In this process, the zinc electrode is dissolved (corroded or oxidized) and the copper electrode accepts copper atoms from the electrolyte (electroplating or reduction). This continues as long as the circuit is closed. The electrical energy is converted into heat energy, heating the nichrome wire in an electric circuit. This heater not only require zero power charging process, it also produces electricity without generating any negative carbon effects on the environment. Utilisation of a catalyst and adjustable temperature switch may improve this product in the future.

Keywords: *Salt-water, Heater, Zinc, Copper, Electrolysis*

INTRODUCTION

Since the Industrial Revolution, humans have released over 1.5 trillion tons of carbon dioxide into the Earth's atmosphere. Combining all of our greenhouse gases, we are emitting 51 billion tons of carbon dioxide equivalents each year (Maslin, 2021). In recent years, we have had more heat waves, the most glaciers melting, and the lowest amount of ice ever recorded at the North Pole (Engelmann *et al*., 2021).

37% of CO_2 equivalent emission came from the food and agriculture sector (Rosenzweig *et al*., 2020). Various factors contribute to this such as exposure to dangerous levels of nitrogen dioxide, carbon monoxide and formaldehyde when using gas burners (Mingle, 2020). The release of these harmful pollutants into the air from the gas burner not only impacts the environment, it is also toxic to both people and animals. Health issues include eye irritation, skin rashes and memory lapse (Seals &Krasner, 2020).

In this study, we aim to construct a salt-water heater by applying the concept of electrolysis. This heater will be able to replace gas burners especially when needed outdoors. With that, we can reduce the environmental and health defects from greenhouse gases produced from gas burners and the food and agriculture sector as a whole.

MATERIALS AND METHOD

Assemble of Salt-water Heater Mug

Materials used for the mug are:

- Copper Plate (1 × RM8)
- Zinc plate (1 × RM2)
- Nichrome (1 × RM2)
- Copper switch (1 × RM2)
- Switch (1 × RM1)

To operate the heater (Figure 1), turn the switch on and place the mug on the heater. Wait for the water to heat up.

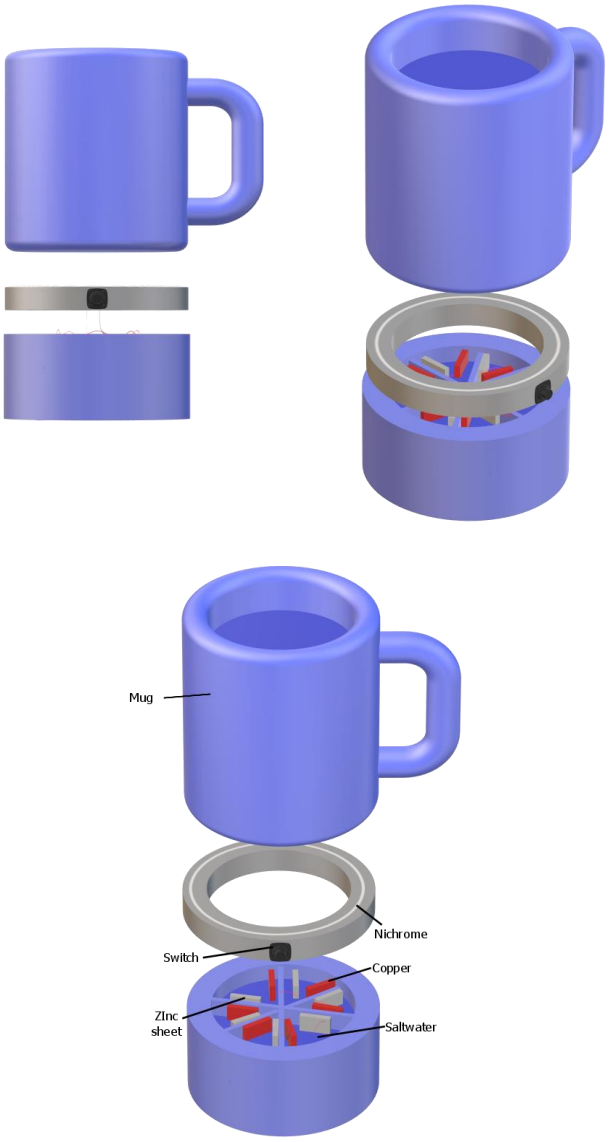

Figure 1. Components of the salt-water heater

Electrolysis Process of Salt-water Heater

The heater works by having a current flowing between the two electrodes in a closed circuit. Zinc behaves as the anode (supplying electrons) of the galvanic cell and the copper as the cathode (consuming electrons).

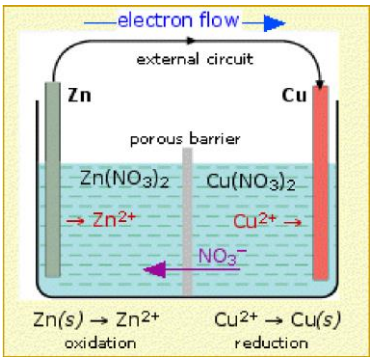

Figure 2. Illustration of electrolysis process between zinc and copper (Lower, 2021)

Based on the Figure 2, the zinc electrode is dissolved (corroded or oxidized) and the copper electrode accepts copper atoms from the electrolyte (electroplating or reduction). This process continues if the circuit is closed.

RESULTS AND DISCUSSION

Electrolysis Process

The zinc and copper were connected by means of a metallic conductor, in which the excess electrons that remain when Zn^{2+} ions emerge from the zinc in the left cell flew through the external circuit and into the right electrode, where they were delivered to the Cu^{2+} ions which become "discharged", that is, converted into Cu atoms at the surface of the copper electrode (“Preferential discharge of cations during electrolysis”. 2012). The net reaction is the oxidation of zinc by copper(II) ions is as shown in the form of equation below:

$$Zn_{(s)} + Cu^{2+} \rightarrow Zn^{2+} + Cu_{(s)}$$

However, this time, the oxidation and reduction steps (half reactions) take place in separate locations:

Table 1. Half Reactions of Left and Right Electrode

	Chemical Equation	Chemical Process
Left electrode	$Zn_{(s)} \rightarrow Zn^{2+} + 2e^-$	Oxidation
Right electrode	$Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$	Reduction

To heat up, we use nichrome, where both ends are connected to the positive and negative charged wire from the zinc and copper. Due to its high resistivity, it does not allow the electric energy to easily pass through it (Kazi *et al.*, 2006). This electrical energy is changed into heat energy. Therefore, nichrome wire gets heated in an electric circuit.

Electricity Produced from Electrolysis Process

We use a 22 gauge of nichrome wire with a length of approximately 75 mm for the heater. This will require around 110 to 120 V of electricity. With 0.5 amps to increase its temperature by 20C°, it takes about 57.5 watts to heat the nichrome wire.
The electrode potential for copper is +0.34 V and for zinc -0.76 V. The voltmeter measures the sum of these two voltages, 1.10 V with each electrode behaving anodically in open circuit (Lower, 2021).

CONCLUSION

Conclusively, our salt-water heater not only is affordable and convenient, it also does not require power charging and produces electricity without negatively impacting the environment. Our innovative idea will be able to reduce the percentage of gas emissions and promote environmental sustainability and good well-being.
In the future, we could implement and improve this concept of electrolysis to widen the horizon of usage in electrical appliances by using a catalyst to speed up the process, making the sheets thinner so that it would be compact, and by experimenting with different kinds of metals and salt solutions. The salt-water heater model can also be enhanced by allowing users to control the amount of heat energy produced by the zinc and copper plates.

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