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Exploring the Potential of Wasted Air Conditioning Water for Hydrogen Production as Eco-Friendly Approach

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Abstract: "Green as grass, Egypt faces many challenges which negatively affect the economy, environment, social life, and health among these problems is address and reduce pollution fouling our air, water, and soil. By reusing aluminum, paper, glass, plastic, and other materials, we can save production and energy costs and reduce the negative effects of extracting and processing virgin materials on the environment. Egypt started looking for an alternative to fossil fuels, galvanic cell, and thermoelectric generator, going a little further and use something neglected, and no one uses it. we used conditioning water and reacted it with NaOH and Al. we used real amounts which are 108 milliliters of water, 80grams of sodium hydroxide and 53.964 grams of aluminum in closed glass. We cut the sheet of aluminum and all aluminum reacted and produce 67.2 liters of hydrogen and now hydrogen is considered the future energy and as some companies use hydrogen as fuel for cars, as the burning of hydrogen experimentally produces 286 kJ approximately. We used chemical simulation programs. starting by Avogadro software as we draw the chemical structure of reactants and product then, from gaussian to calculate the thermochemistry of chemical structure as we made optimization + frequency to calculate the total energy, the optimization for calculating the minimum limit of energy that make the compound at stable state as number of constraints equals zero. And the summation of two energies by EES. Then, repeated all methods on the reactants. And finally, we produced 134 volts for electricity.

Keywords: *wasted water, air conditioner, energy generation, green hydrogen, electricity*

1. INTRODUCTION

Energy problems are one of the most serious among the top 10 problems of humanity for the next 100 years. Egypt has been plunged into energy crisis since year 2008 due to raising electricity demands. According to the international energy Agency (IEA), the electricity demand is growing at a rate of 8% per year in Egypt and 15.5 GW of additional generation capacity will be required by 2030. Egypt is mainly depending on fossils fuels for the energy production especially in generating electricity. This led to a great change in the climate that was obvious due to pollution generated by burning these fuels. This change has affected all the Living creatures in Egypt. Which led to more infection disease. The world is facing an unprecedented challenge in the form of a looming energy crisis. With the ever-increasing demands for energy, coupled with the finite nature of traditional energy sources such as fossil fuels, the problem of lacking or limited energy sources has become a pressing global concern. And there are many Causes of Energy Source Scarcity: 1. Depletion of fossil fuels: Fossil fuels, including coal, oil, and natural gas, have been the primary sources of energy for centuries. However, their limited supply and the detrimental environmental effects associated with their extraction and consumption have prompted the urgent need for alternative energy sources. 2. Population growth and urbanization: The world's population is expanding at an unprecedented rate, leading to increased energy consumption. Moreover, rapid urbanization in developing countries has resulted in a surge in energy demand for infrastructure, transportation, and industrialization.

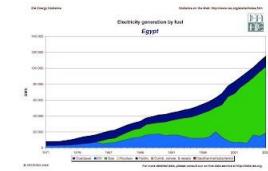


Figure 1

3. Inefficient energy use: Wasteful and inefficient energy consumption practices exacerbate the problem of energy scarcity. From inadequate insulation in buildings to outdated industrial processes, a significant portion of energy is wasted, putting unnecessary strain on limited resources.

And the Consequences of Energy Source Scarcity are:

1. Environmental degradation: Traditional energy sources, such as fossil fuels, contribute to air and water pollution and are major contributors to greenhouse gas emissions. The overreliance on these sources not only depletes natural resources but also accelerates climate change and environmental degradation.
2. Economic instability: Energy scarcity can lead to economic instability as industries heavily reliant on energy struggle to operate efficiently. Rising energy costs can also burden consumers, leading to reduced purchasing power and hindered economic growth.
3. Geopolitical tensions: Limited energy sources can create geopolitical tensions as nations compete for access to scarce resources. This competition can lead to conflicts, political instability, and hinder international cooperation on crucial issues such as climate change mitigation.

Conclusion: The problem of lacking or limited energy sources is a critical issue that requires immediate attention and action. By embracing renewable energy sources, promoting energy conservation, and investing in research and innovation, we can mitigate the consequences of energy scarcity and build a sustainable future. It is imperative for governments, industries, and individuals to work together to ensure a reliable and diverse energy supply that can meet the needs of the present and future generations.

Equations:

1. $(2Al + 2NaOH + 6H_2O \rightarrow 2Na + 2[Al(OH)_4] + 3H_2)$
2. $(V) = \text{mass flow}(M) * \text{work net} = X * 244 = 244X$
3. $CPair * T1 [Bc^{(Kair-1/Kair)-1}] / mc = 1.005 * 293 [16.1^{(1.4-1/1.4)-1}] / 0.85 = 420 \text{ kJ/kg}$

Tables:

Table (1): Prices of Materials

No.	Item	Prices
1	Sodium hydroxide (NAOH)	10 LE/kg
2	Aluminum Foil	nothing
3	Water Glass jar	10LE
4	beaker	20LE
5	Turbine fan	10LE
6	Glass pyramid	60LE
7	Motor	45LE/kg
8	Walled capillary.	25LE/kg
9	Cannula hose	5LE

2. DISCUSSION

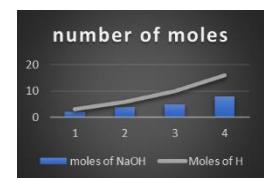
From Waste to Power, it's sure that energy production is a great challenge facing Egypt. Therefore, we tried harder to generate energy from nothing (wasted-air conditioner water) as we convert wasted air conditioning water into Green Energy through Hydrogen. We made a chemical reaction by reacting sodium hydroxide (NaOH) with aluminum (by-product or recycling aluminum sheet) and condition water (by-product). $2\text{Al} + 2\text{NaOH} + 6\text{H}_2\text{O} \rightarrow 2\text{Na} + 2[\text{Al}(\text{OH})_4] + 3\text{H}_2$ by converting the number of mol into gram by this law "mass= molar mass*number of moles". The mass of the reactants: $[2\text{Al} = 2*26.982 = 53.964\text{g} / 2\text{NaOH} = 2(22.99+16+1) = 80\text{g} / 6\text{H}_2\text{O} = 6(2*1+16) = 108\text{g}]$ produce 6 liters of hydrogen (mass of $3\text{H}_2 = 3*1*2 = 6\text{ g}$ / the volume of hydrogen = moles* molecular weight= $3*22.4 = 67.2\text{ L}$).

the first trial :the amount was very huge, so we divided all this number over 2 so, we put 40 grams of sodium hydroxide, 54 milliliters of water and approximately 27 grams of aluminum in closed glass and there is a hole in the top and connected with very small tube to get a small amount of hydrogen out to be ensure that there is no risk while burning it. Let reaction for 5 minutes, then hydrogen gas began to rise. the results were amazing as the amount of hydrogen was the opposite of what we expected they are less than 33.6 liters because all aluminum did not react as its volume was large and did not reach to water at the bottom.



figure 1

The second trial: We used the real amounts which are 108 milliliters of water, 80grams of sodium hydroxide and 53.964 grams of aluminum in closed glass. And the results were better because we cut the sheet of aluminum and all aluminum reacted and produce 67.2 liters of hydrogen. The second part in prototype is burning hydrogen but it so dangerous so we used simulation programs [Gaussian – Avogadro – EES32] to calculate the amount of heat from burning hydrogen and we will convert it into electricity.



Graph 1

Work done by the compressor(w_c)= $\text{CPair} * T_1[Bc^{(Kair-1/Kair)-1}/mc. = 1.005*293[16.1^{(1.4-1/1.4)-1}/0.85 = 420\text{ kJ/kg}$

Work done by turbine= $\text{CPgas} * T_3[BT^{((Kgas-1)/Kgas)-1}/ [BT^{((Kgas-1)/Kgas)*yt. = 1.112*1400[15.2^{((1.33-1)/1.33)-1}/ 15.2^{((1.33-1)/1.33)*0.87=664\text{ kJ/kg}$

Work net= $w_t - w_c = 664 - 420 = 244\text{ kJ/kg}$.

After that we calculated the mass flow of hydrogen by this law $M=Q/H.V$.the programs calculated it.the amount of electrical energy (V)= mass flow(M)*work net= $X * 244=244X$.

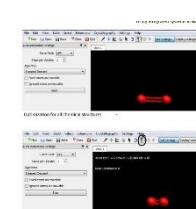


figure 2

Then, The amount of electricity was from 100 volt to 150 volt because there is a lot of factors effect on the value of " X ".

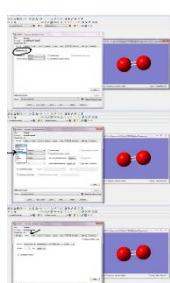


figure 3

NOTE "hydrogen is a clean source of energy because its burning equation is $2\text{H}_2 + \text{O}_2 = 2\text{H}_2\text{O}$ " The third part:

We did test plan to the prototype to know how many volts will it rise so, we do methods to connect the materials with each other and we made pyramid of glass by tilted face To get the distilled water out and we put the turbine in the pyramid and then connect the motor with the turbine and all of this is supported on a piece of wood then we started the test plan. The steam enter the pyramid and move the turbine which move the motor and the motor change the mechanical energy to electricity and the motor outputs 1.5 volts which light the LED bulb then the test plan succeeded

3. CONCLUSIONS

From the previous data and results, we can conclude that the project succeeded in solving the challenge and can be considered an effective solution on a large scale, the project succeeded in make the best use of wasted air conditioning water, energy generation, hydrogen production as renewable energy source also it did not affect the health of people, soil or crops so we take the challenge of health in consideration while solving this problem, compared to the prior solution, producing 67 liters of hydrogen , producing about 120 to 140 volts of electricity . we conclude that our project have achieved our target as our project is eco-friendly, safety, available, have low cost and producing energy from by-product.

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Symbols and Abbreviations

M	mass flow of hydrogen	H.V	heating value
Q	amount of heat	wc	Work done by compressor
X	amount of electrical energy	kgas	Gas expansion coefficient

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