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Renewable Energy Production–Hydrogen Fuel–by Using Water Extracted From Scavenger Wells

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Abstract *-The world today is looking for a source of renewable energy because it is cleaner than the normal energy which is produced from oil, coal, and natural gas. The disadvantages of traditional energy sources are that they produce carbon dioxide which creates global warming on the earth planet. The sources of renewable energy available around the world are wind, water, sun, tidal movement, wave movement, gravity, and Earth's heat like volcanoes. The top of these sources are the hydroelectric plants. In this research, scavenger wells will be investigated to production salt water, renewable energy produced by the water extracted from the wells. The heads of countries was attended Conference of Scientists in Tokyo, Japan to keep pace with the tremendous development in several countries around the world to use renewable energy as a source of energy by 12% in 2020. The heads of countries was agreed to reduce production of carbon dioxide in the coming years, to avoid the resulting risk that works on climate change for the worse. In this research, groundwater samples were taken from wells in the study area which is Egypt. Then the study area was divided into several regions according to the percentage of salinity in the groundwater. Laboratory experiments were carried out on all samples; the salinity percentages and the electrical conductivity ratio were measured. Then, graphs were made showing the relationship between groundwater salinity and electrical conductivity.*

Key Words: **Scavenger-wells, Renewable Energy, Saline-water, Conductivity, Costal Areas.**

1. INTRODUCTION

Most of the scavenger well drilling system designers aims to reduce and pump fresh water from salt water layer. The designers don't take into account the effort of saline water after production on fresh water in the aquifer by leaking peak into the ground towards fresh water [1]. It is known that scavenger wells consist of producing and detecting wells near shallow fresh water and deep slat water areas, respectively. These wells produce fresh water and salt water from the same site simultaneously [2]. Benefit of scavenger well is reducing the rise or up coning of saltwater towards fresh water.

Among the problems facing users of the scavenger wells system is the extraction of salt water to the surface of the earth in parallel with the extraction of fresh water from the same well. Fresh water does not cause problems for the well even if it was stored on the surface of the ground surface or part of it has been filtered into the ground.

While salt water extracting and storing above the ground surface causes problems for the aquifer and also alters the properties of the soil which affects the nature of the cultivated plants.

1.1 production of hydrogen fuel by solar cells

The idea of the research works to use salt water to generate renewable energy through electrolysis of water. By obtaining hydrogen fuel, although fresh water is not a good conductor of electric current, but by adding salt to fresh water, water becomes a good conductor of electrical current.

This is a double-edged sword to solve two problems at the same time 1 - get rid of the salty water resulting from the well and not affect the nature of the land and not filter it to the well 2 - generate renewable energy from hydrogen fuel through cheap electrodes without corrosion.

Bush KA, et al. (2019).Driving electrolysis with cheap solar cells is an attractive way to generate hydrogen using a carbon-free energy source. To achieve this end, an activated Ni3 anode was paired with a Ni-Nio-Cr2o3 cathode. The cell was operated for 5 hours at 20 MA/Cm^2 after which the electrolyser was connected in series with two 0.2 Cm^2 peroveskite solar cells. Fig (1) showing 876 Ma/cm2 electrical current through a solar cell into a polar anode consisting of nickel hydroxide covered with a nickel sulifade it produces 2.75 volts [3].

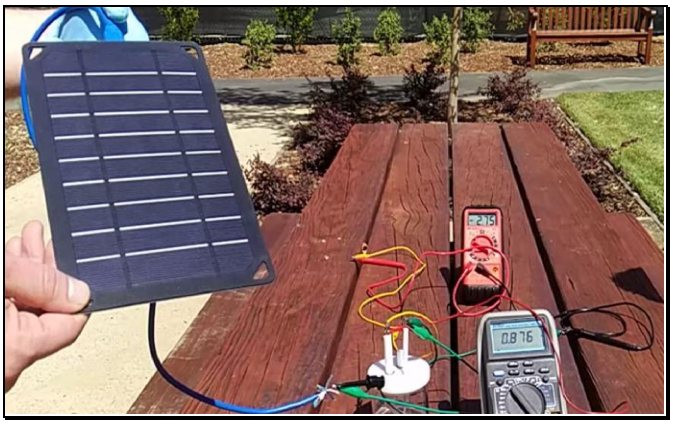

Fig -1: production of hydrogen by solar cells, Source - Bush KA, et al. (2019). [3]

The light-driven electrolysis rate corresponded to solar-to-hydrogen (STH) efficiency of (11.9 ± 0.1) %, comparable to similar systems that using purified water. The integrated solar-driven saltwater-splitting operated stable for 20 hours without obvious (STH) decay. [4]

1.2 Scavenger Well

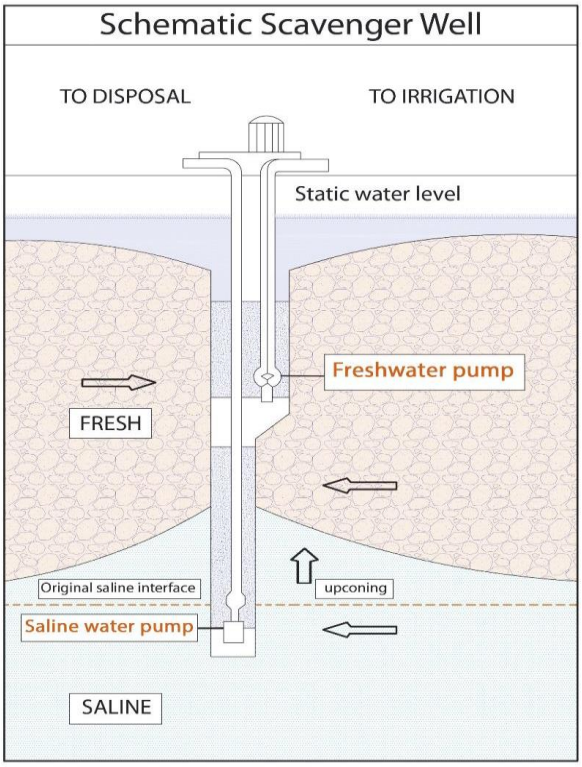

Fig –2: Mechanism of working of the scavenger well

Fig (2) shows that mechanism working of the scavenger well, freshwater was used to irrigate the lands and drinking, the saltwater was disposed to drains. The idea of the research is using saltwater to generate renewable energy and extract hydrogen fuel. Freshwater is not considered a good conductor of electricity this is not a problem in the case of using scavenger wells and extracting salt water which is a good conductor of electricity. *The significance lies in the fact that coastal areas in many cases consider the value of groundwater to be an important factor, and the distribution between freshwater and saltwater is a source of concern to scientists.*

Groundwater qualities in general and hydraulic heads are of importance in costal areas. In the worst circumstances, the saline groundwater extraction operations should be closed when seawater intrusion occurs and the saline water reaches suitable wells. To counter these threats, steps must be taken to protect water abstraction, such as the following methods mentioned in previous researches: Artificial recharge (Asano 1992 [5]; Van Breukelen et al. 1998 [6]; Bouwer 2002 [7]; Greskowiak et al. 2005 [8]; Massmann et al. 2006 [9]) is one option. Other options are the reduction of extraction rates, deep well injection (Roosma and Stakelbeek 1990 [10]), land reclamation (Guo and Jiao 2007 [11]), the building of physical barriers, or working with scavenger wells (Mushtaha et al. 2000 [12]) among other methods.

2. STUDY AREA

2.1 Groundwater in Egypt

Groundwater in Egypt is one of the largest water sources; it is ranked the second position after the Nile River. 26% of the Egyptians use groundwater. The current population of Egypt is 100 million, according to the latest report of the Egyptian Statistics and Population center for January 2020,. In this study samples were taken from groundwater wells in Egypt. Study area was divided into several regions as follows: (1) - starting from the coasts in the north to Upper Egypt in the south, (2) - the Western Desert in the west and Sina in the east, (3) - the middle we find the Nile Delta.

Fig –3: The Nile river Basin countries and the downstream state is Egypt

2.2 Groundwater Salinity in Egypt

An overview of the samples studied in Egypt shows that the salinity level in the groundwater extracted from the groundwater wells in the Western Desert does not exceed 1500 ppm. Also the percentage of salinity around the Nile Basin from Upper Egypt to Fayoum Governorate does not exceed 2000 to 2500 ppm. Whereas salinity levels in the groundwater wells around the Nile Basin from Beni Suef Governorate to Cairo Governorate range from 2500 to 3500 ppm. As for the Nile River Delta, it reaches 1500 ppm. In view of the salinity ratios on the groundwater wells on the northern coast, it may reach 9500 ppm, especially in Marsi Matruh Governorate, all information of salinity shows in table-1.

Water salinity is measured by a device (TDS) that the researcher used to measure the salinity in each sample by passing an electric current between two electrodes in a sample of water. The electrical conductivity of the water sample is affected by the concentration and composition of dissolved salts. The salts increase the ability of the solution to conduct an electrical current show in Fig-4.

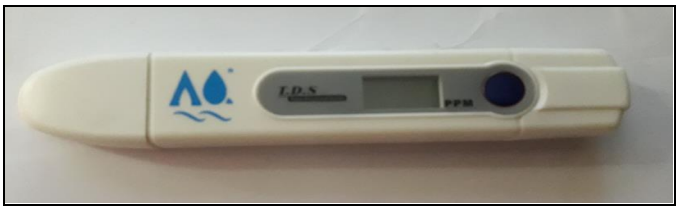

Fig –4: The device (TDS) that used to measure the salinity

Table -1: Location Wells and Corresponding Salinity

No.	Region	Location	Salinity(ppm)
1		kharga	600 - 1000
		Dakhla	600 - 950
	West Desert	Bahariya	500 - 950
		Farfra	600 - 1000
		East Qeueinat	550 -1000
2		Nile Valley	900 - 1400
	Delta	Nile Delta (South)	1000 - 1500
		Nile Delta (North)	5000 - 6000
3		Nakhla	1500 - 2000
		Oyun Mousa	1000 - 4000
	SIna	Netron & Qattara	1000 - 1400
		Wadi Arabia	1000 - 1300
		South Sina	1000 - 2000
4		Minya	900 - 1100
	Upper Egypt	Asuit	1100 - 2500
		Souhaj	1100 - 2500
		Qena	1500 - 2500
5		El Arish Aquifer	1500 - 6000
	The Coast	Marsi Matrouh	9000 - 15000
		Alexandria	4500 - 6500
		Demitta	5000-6000

3. METHODOLOGY

Different saline water samples were taken to the laboratory (irrigation and hydraulics experiment – Fayoum University) and experiments were performed to extract the renewable energy (hydrogen fuel). Salty water is the only water that can conduct electrical conductivity, scavenger wells water is the only water that is suitable for producing hydrogen fuel, as it is the unique quality of wells that freshwater and saltwater are extracted.

4. EXPERIMENTS

In the laboratory, the samples were putted in a 1-liter container volume bottle and used a variable electrical conductor DC, and it was connected to two different metals, aluminum and copper, and put them in the water sample and tightly closed from the top of the container to measure the electrical conductivity.

Once the electricity is connected to the aluminum and copper metal legs, hydrogen fuel will be produced. The avometer device was used to measure the resistance of the electrical current, thus obtaining the electrical conductivity of each sample used in this research. By the following relationship, the inverted current resistance is equivalent to the electrical conductivity.

Electrical resistivity and conductivity is an important property for materials. Different materials have different conductivity and resistivity. Electrical conductivity is based on electrical transport properties. These can be measured with multiple techniques by using a variety of instruments. If electricity easily flows through a material, that material has high conductivity. Some materials that have high conductivity include copper and aluminum. Electrical conductivity is the measure of how easily electricity flows through a material. Conductivity and resistivity are inversely proportional to each other. When conductivity is low, resistivity is high. When resistivity is low, conductivity is high [13]. The equation is as follows:

$$\rho=\dfrac{1}{\sigma} \quad (1)$$

Where:

- Resistivity is represented by ρ and is measured in **Ohm-meters** (Ωm),
- Conductivity is represented by σ and is measured in **Siemens** ($1/\Omega m$).

Resistivity Vs Resistance

Resistivity and resistance are two different things. Resistivity does not depend on size or shape. Resistance, however, does. You can calculate resistance with the equation below.

$$R=\dfrac{V}{I} \quad (2)$$

R refers to resistance and is measured in Ω. V is the voltage and is measured in volts. {I} measures the current and its unit is amps (A). [13]

5. RESULTS

To analyze water utilizing a constant DC electric current through oxidation and reduction (by placing different poles such as aluminum or zinc, copper and aluminum (zinc) is a negative electrode that produces hydrogen and copper a positive electrode gives oxygen.

Hydrogen is a flammable gas with a crackle and therefore needs to be regulated to be semi-combustible and to do that we need a constant current source by using a DC battery and a copper pole and an aluminum pole and then put saltwater (saltwater extracted from scavenger wells) and connect the two poles in the water and then the electrical current is connected and then the hydrogen gas is released from the negative electrode and then stored the rising gas in a small tube.

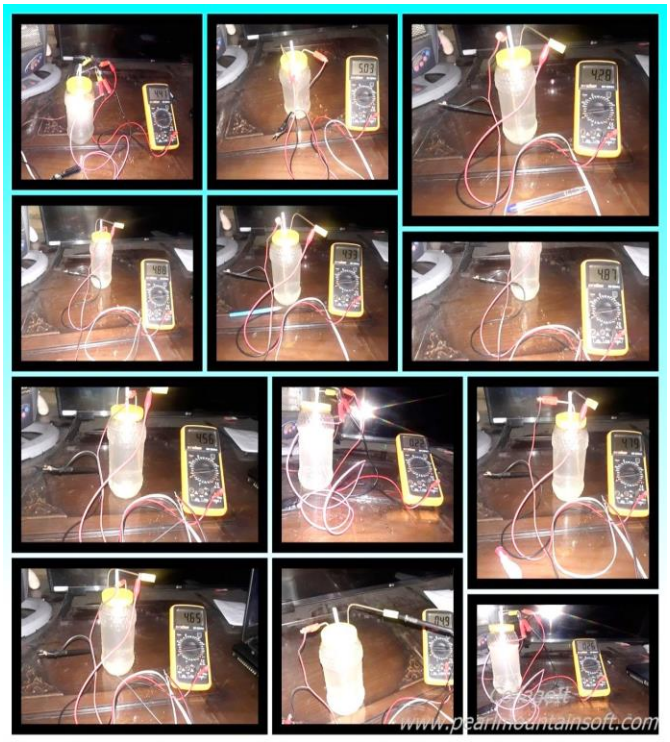

Fig – 5: The results of the experiments on the samples from the first sample to twelfth samples

By experimenting with all samples, a relationship can be obtained between the salinity and electrical conductivity ratios, which helps to produce different amounts of hydrogen fuel as a result of the change in salinity and electrical conductivity.

In the future part of an analysis of results, the relationship will be concluding by graphically and theoretically, the researcher devises a new equation between conductivity and salinity.

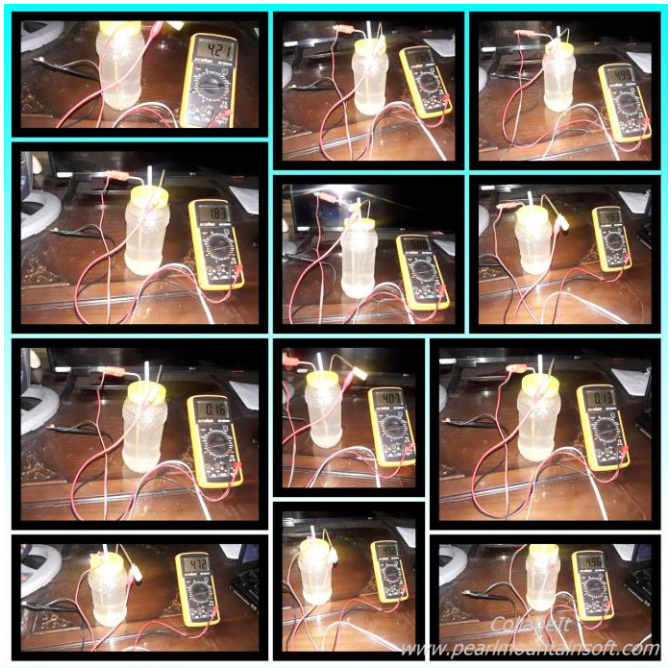

Fig -6: The results of the experiments on the samples from the thirteenth sample to the twenty-fourth sample

6. ANALYSIS OF RESULTS

The statistical analysis were applied to the results that extracted from of the experiments, changes of salinity give changes of conductivity; therefore relationship can be founded between salinity and conductivity.

The amounts of salinity and conductivity fit in the charts, by analytical of this chart the equation of relationship between salinity and conductivity founded it.

Conductivity (moh/ cm) = {1.5625 to 1.4864} * salinity (p.p.m) this equation produced from the research is named (Bayomy Derar) formula.

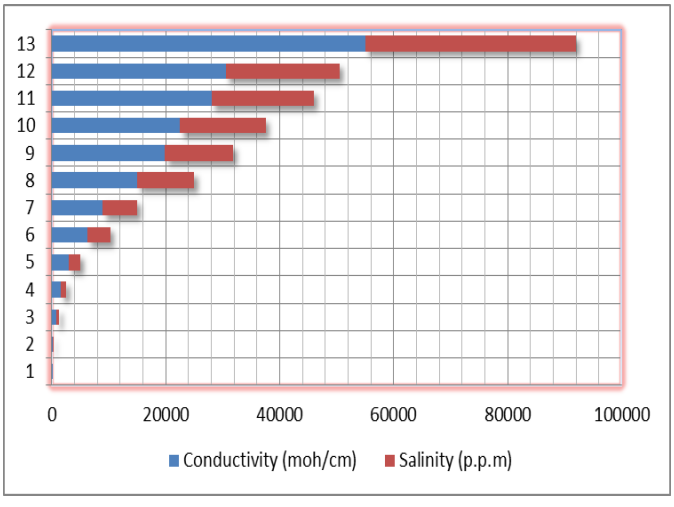

Fig – 7: The relationship between conductivity and salinity

Table -2: Values of conductivity depends on salinity

Salinity (p.p.m)	Conductivity (moh/cm)
0	1.75
50	80
500	780
1000	1500
2000	2950
4000	6250
6000	8950
10000	15000
12000	19850
15000	22500
18000	28000
20000	30500
37000	55000

7. CONCLUSIONS

This paper is an output of the science project, the paper summarized the following mentioned:

1- The electrical conductivity is found equivalent to each well that has a salinity level and thus forecasting the amount of its production of hydrogen fuel.

2- The discharge Saline water reduces to drain in case of salty water is using to generate renewable energy.

3- Re-use the wastewater after treating it to agriculture again.

4- Saltwater intrusion will be reducing by extracting freshwater for agriculture, and saltwater to generate renewable energy.

5- Derivation of the linear relationship between conductivity and salinity of the water extracted from scavenger wells.

REFERENCES

[1] K Saravanan, Deepak Kashyap and Anupma Sharma., (2014). "Model assisted design of scavenger well system". Journal of hydrology, vol. 510, pp. 313-324.

[2] Glulam Ali, Muhammad Nadem Asgher, Muhammed Latif and Zakir Hussien (2004). "Optimizing operational strategies of scavenger wells in lower Indous basin of Pakistan" Agricultural water management, vol. 66, pp. 239-249.

[3] Bush KA, et al. (2019). "Compositional engineering for efficient wide band gap perovskites with improved stability to photoinduced phase segregation". AC.S Energy Lett vol.3, pp. 428-435.

[4] Luo J, et al. (2014). "Water photolysis at 12.3% efficiency via perovskite photovoltaic and earth-abundant catalysts". Science, vol. 345, pp. 1593-1596.

[5] Asano T (1992). "Artificial recharge of groundwater with reclaimed municipal wastewater: current status and proposed criteria". Water Sci Technol 25:87–92.

[6] Van Breukelen BM, Appelo CAJ, Olsthoorn TN (1998). "Hydrogeochemical transport modelling of 24 years of Rhine water infiltration in the dunes of the Amsterdam water supply". J Hydrol 209:281–296.

[7] Bouwer H (2002). "Artificial recharge of groundwater: hydrogeology and engineering". Hydrogeol J 10:121–142.

[8] Greskowiak J, Prommer H, Massmann G, Johnston C, Nu¨tzmann G, Pekdeger A (2005). "The impact of variable saturated conditions on hydrochemical changes during artificial recharge of groundwater". Appl Geochem 20:1409–1426.

[9] Massmann G, Greskowiak J, Du¨nnbier U, Zuehlke S, Knappe A, Pekdeger A (2006). "The impact of variable temperatures on teh redox conditions and the behaviourofpharmaceutical residues during artificial recharge". J Hydrol 328:141–156.

[10] Roosma E, Stakelbeek A (1990). "Deep-well infiltration in the northHolland dune area". Ground Water 28(5):778–782.

[11] Guo H, Jiao JJ (2007). "Impact of coastal land reclamation on ground water level and the sea water interface". Ground Water 45(3):362–367.

[12] Mushtaha A, Aliewi A, Mackay R (2000). "The use of scavenger wells to control saltwater upcoming in Gaza, Palestine". Proceedings 16th Salt Water Intrusion Meeting, Miedzyzdroje–Wolin Island, Poland, pp 109–116.

[13] Levy, Peter M., and Shufeng Zhang. (1990). "Electrical Conductivity of Magnetic Multi-layered Structures". Physical Review Letters, vol 65. pp. 1643-1646.

BIOGRAPHIES

The author of this paper graduated from civil department faculty of engineering Cairo university, Demonstrator: From 2004 -2008. Assistant Lecturer: From 2009 – 2014. Lecturer: From 2014 Up Till Now. The author had awarded the best master's and PH.D thesis in field of irrigation and hydraulics in the Arab Republic of Egypt.