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Design and Fabrication of Local a Solar-Powered device to evaluate of Water Temperature, TDS and pH values in Shatt Al-Arab River

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Abstract

In this study, a solar-powered Water Temperature (WT) , Total Dissolved Solids (TDS) and Hydrogen Ion Concentration (pH) devices was designed, fabricated and tested to evaluate its performance with measuring Water Temperature (WT) , Total Dissolved Solids (TDS) and Hydrogen Ion Concentration(pH) values in the three stations along the Shatt Al-Arab River extended from (Qurna , Ashar and Fao districts) during the tidal conditions in Winter 2023.The major components of the design are the Solar Panel cell , Solar Charge Controller, Power Solid Battery (GEL) , DC – DC buck converter , WT ,TDS and pH meters and plastic container. WT, TDS and pH meters which are operated and controlled by buck converter which runs by battery as power source. The results showed that there is an increase in WT at three stations were ranged between (9 - 17 °C). due to the WT which is impacted directly by climate change of the region, The daily fluctuations of TDS and pH of the average spatial values varied from 1237.33 to 214514.66 ppm and 7.96 to 8.04 respectively . the daily fluctuations of pH values in the river was small, while the daily fluctuations of TDS values were showed high in all samples which are exceeding the allowable limit according to (WHO). due to spatial variations in internal environmental conditions. This affirms the impact of sewage water and salinity on the quality of the river water. Thus exceeding the permissible international environmental determinants where river water was classified as hard water and the intensity of radiation was measured over time during the day during

measurement of total melting salts, pH and heat of river water directly for three locations (Qurna, AShar and Fao)

Keyword: Solar Panel cell, DC – DC buck converter, WT,TDS and PH meters, Shatt Al-Arab River.

Introduction:

Shatt Al-Arab River in Basrah Governorate Southern Iraq, consider the main and important rivers which is utilizes for drinking water, irrigation, navigation, fisheries and industry. Now days in this river suffers from high amounts of (TDS) and dangerous pH values in the water due to reducing the incoming fresh water from the sources and increasing discharge of wastes from industries, domestic sewage and agricultural activities to the river directly which is caused the salts accumulation into the river. (Abdullah et al., 2015). in other hand, in Iraq, the advent for utilizes solar energy has lately appear .its an important alternative to compensate the increase of the energetic consumption of the planet. Iraq has long times of sunshine. Solar Panel cell when exposed to light are capable of producing electricity without any harmful effect to the environment. (Hameed H and Aljorany YS ,2011). The recent technological evolution Solar energy sources, has made possible the development of low-cost scalable and replicable systems which lead to design and fabricate and testing of local devices for evaluate of WT, TDS and pH values in Shatt Al-Arab river using solar energy obtained from Solar Panel cell and Li-ion battery (GEL) ,in the same time , measurement the intensity of sunlight solar with time a approach that can be used for in-situ continuous monitoring of the most important parameters related to water quality, allowing to improve the efficiency in the use of the water resources. (Li and Liu 2019; Park et al., 2020; Tiyasha et al., 2020; Topp et al., 2020).

Working Methodology

The device is powered by solar energy. Components used in this device are solar panel above on cover plastic container , while Solar Charge Controller, Power Solid Battery (GEL) , step-down DC – DC Buck converter , WT, TDS and pH meters include plastic container . Solar panel is used to convert solar energy (sunlight) into electrical energy by means of photovoltaic effect. The electrical energy generated is stored in the battery for through Solar charge controller which prevents from overcharging and power fluctuations. As WT, TDS and pH meters are used for testing of water , so we need to convert DC load from the battery(12 V) to DC load (WT ,TDS and pH meters) (6 V) by using the help of step-down DC-DC Buck inverter. In addition for measuring the intensity of sunlight by using Digital Solar power meter type (SM206-solar). All instruments and reagent were calibrated by using a standard solution before the measurement.

Figure 1 : shows the schematic diagram of the study which entails the layout of each component.

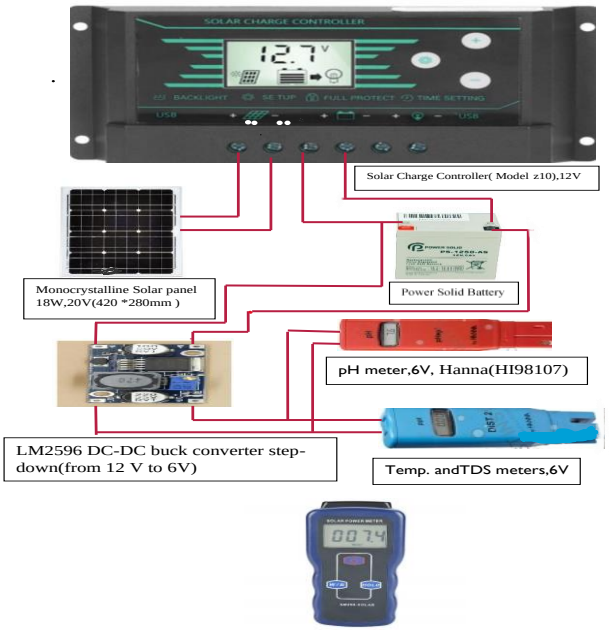


Figure 1: Schematic Diagram of the Design and Fabrication of Local a Solar-Powered device to evaluate of WT, TDS and pH values in the river water.

Results and Discussion :

WT, TDS and pH values were measured in the field by using fabricate of local solar a device Figure.2 , for three important stations along the region extended from (Qurna , Ashar and Fao Town) during the tidal conditions in winter 2023.

Figure 2: Testing of the Fabricate of Local a Solar-Powered device to evaluate of WT , TDS and pH values in - situ three stations a long Shatt Al-Arab river .

The results in Table (1-3) showed the WT, TDS and pH parameters of studied water samples in the Qurna , Ashar and Fao stations along the Shatt Al-Arab river. the values revealed that there is increase through WT at Qurna , Ashar and Fao stations were varied from (9 - 17 °C). this increment in WT maybe because affected directly by climate change of the province of Basrah,

Tables (1,2 and 3) show that the average of the values of pH and TDS in the river water varies from 8.04 at Qurna to 7.96 at Ashar to 8.003 at Fao and 1237.33 ppm at Qurna to 2422.04 ppm at Ashar to 214514.66 ppm at Fao respectively. This variation in the average of pH and TDS values ,may be due to the difference of internal environmental conditions between the Qurna , Ashar and Fao stations , may be come back to effected by the factories waste and residential waste ,agriculture waste that is discharged directly into river water and tides respectively . that can be observed through changes in pH values at the Qurna , Ashar and Fao stations were slightly alkaline.

This is attributed to the same ionic structure of the river water .may be due to the balance between the seawater which contributes to the increase of pH values and sewage effluent of human activities that contributes to the decrease of pH value (chenl and durbin,1994).when discharge of freshwater in the river decrease the impact of seawater and sewage effluent increasing . (EPA,2001)

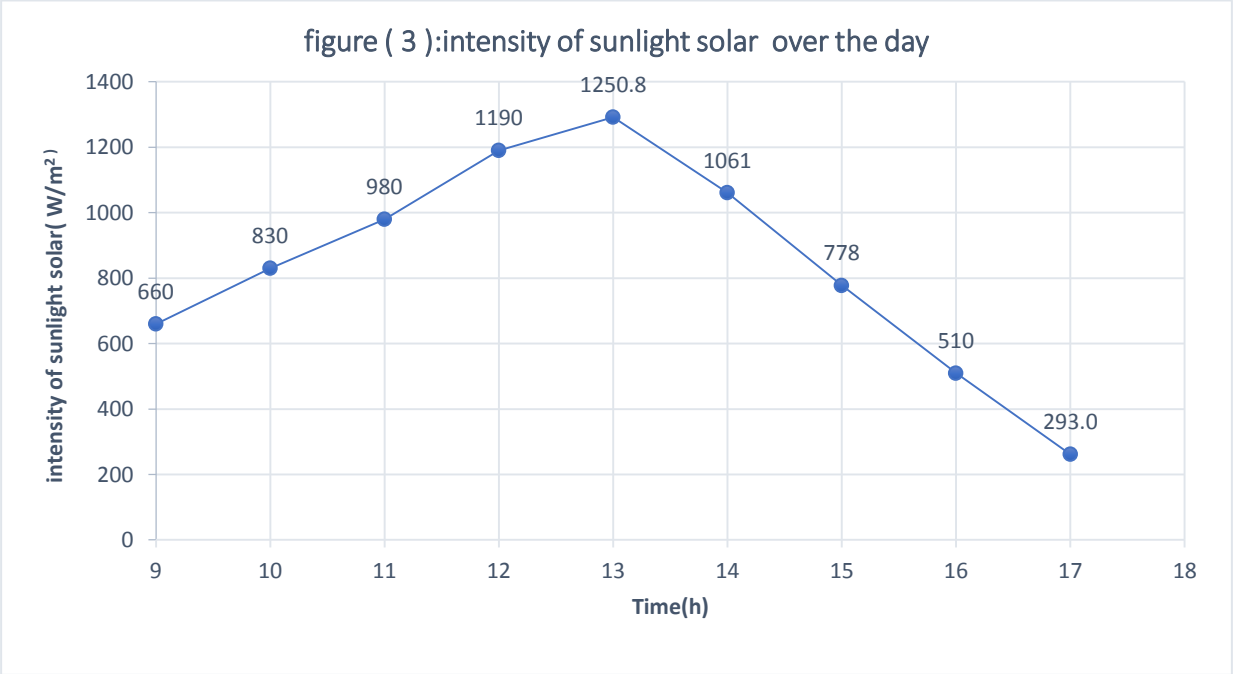
The observation of daily fluctuations of pH values in the river water at Ashar station showed small pH change (0.44 unit).the pH values may decrease to 7.76 in the early morning at 6.30 AM and increase to 8.2 in the afternoon at 10.30 PM (Table 2) .this daily pH change gives an indication of the limited impact of aquatic organisms on pH change which may be due to the significant change of daily cycles in the river flow and large flow from 742 m/s at flood to 882 m/s at Ebb .(Al-Asadi,2012).The pH values in the Ashar station were within the allowable limit recommended by (WHO, 2017)

TDS concentration of Shatt Al-Arab river at Ashar station .it showed decrease to 2336 ppm in the early morning at 10.30 AM (Ebb)and increase to 2534.4 ppm in the afternoon at 2.30 PM (flood) (Table 2) . because, the a large amount of sewage water discharged to the Ashar station directly compared to Qunra station .(Table 1). (Wetzel , 2001; Al-Saadi et.al.,2000 ; Hassan et.al.,2001; Al-Mousawi et.al.,1994;Maulood and Hinton, 1979).

daily fluctuations of pH values in the river water at Fao station. It observed decrease to 7.96 in the afternoon at 4.00 PM and increase to 8.06 in the early morning at 10.00AM ,The pH values of Fao station were within the allowable limits recommended by (WHO, 2017).(Table 3) . while daily fluctuations of TDS values in river water at Fao station. it observed fall to 17984 ppm in the afternoon at 2.00 PM (Ebb)and increase to 29696ppm in the early morning at 1.00 AM (flood)(Table 3) .This may be attributed to the values of high connection in the Fao station compared to the Ashar and Qunra stations respectively. The (WHO) (2017) has set TDS, standards for suitability of water for drinking purposes. The

results show that have been in three stations are exceeding the allowable limit and hence, all of the three stations along the river found to be unsuitable for drinking purposes, (Table 1-3).

Also ,in the same time , It showed that have been observed of The average intensity of sunlight solar in the Qurna , Ashar and Fao stations along river in the month of January as measured with a Digital Solar Power Meter is shown in Figure: 3. It can be noticed that intensity of sunlight solar increases in the early morning at 8 AM to fall in the afternoon at 1 PM. The maximum radiation received was 1250.8W/m^2 in the afternoon at at 1 PM , whereas it was 293.0 W/m^2 in the early morning at 5 PM.



Conclusion

In Basrah province Researchers working in a environment field are facing the major problem due to through going to trips field of scientific for long days , In particular for assessment of WT, TDS and pH properties in directly at stations different along the Shatt Al-Arab , which using devices of measuring WT ,TDS and pH used to non-rechargeable batteries with lifetime limited and limited energy and expensive cost which causes problems during the measurement through the weakness of the battery and its stoppage , in additions to the cut of electric current in the stations during the measurement, whether it is at night or daily. Researchers can carry the A local solar-powered WT,TDS and pH meters was designed and fabricated in this study, using cheap locally available materials to examine the WT,TDS and pH in the SAR with them wherever they go, but electricity may not always be available. This solution can be used to solve this problem in many places that do not have electricity.

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Table (1) daily variation in WT, TDS and pH values in Shatt Al-Arab during January (10-12/2) at Qurna station during 2023, compared with WHO,2017,permissible limits for drinking water

Time (Hour)	River state	WT °C	TDS ppm	pH value	parameters	WHO,2017 ppm
8.00 AM		15	1209.6	7.99	T	35
10.00 AM		16	1241.6	8.01	pH	6.5-8.5
12.00 AM		16.5	1286.4	8.13	TDS	1000
2.00 PM		17	1254.4	8.09		
4.00 PM		16	1248	8.07		
6.00 PM		14	1184	8.0		
Mean			1237.33	8.04		

Table (2) daily variation in WT, TDS and pH values in Shatt Al-Arab during January (10-12/2) at Ashar station during 2023, compared with WHO,2017,permissible limits for drinking water

Time (Hour)	River state	WT °C	TDS Ppm	pH value	parameters	WHO,2017 ppm
6.30 AM	Ebb	14	2348.8	7.76	T	35
8.30 AM	Ebb	15	2476.8	7.87	pH	6.5-8.5
10.30 AM	Ebb	16	2336	7.78	TDS	1000
11.30 AM	Slack					
12.30 PM	Flood	16.5	2368	7.97		
2.30 PM	Flood	17	2534.4	7.99		
4.30 PM	Flood	16	2470.4	8		
6.30 PM	Ebb	14	2451.2	8.02		
8.30 PM	Ebb	13	2374.4	8.13		
10.30PM	Flood	11	2438.4	8.2		
Mean			2422.04	7.96		

Table (3) daily variation in WT, TDS and pH values in Shatt Al-Arab during January (10-12/2) at Fao station during 2023, compared with WHO,2017,permissible limits for drinking water

Time (Hour)	River state	WT °C	TDS Ppm	pH value	parameters	WHO,2017 ppm
2.00PM	Ebb	17	17984	8.01	T	35
4.00PM	Ebb	16	19136	7.96	pH	6.5-8.5
6.00PM	Ebb	15	18944	8.02	TDS	1000
8.00PM	Slack	13				
9.00PM	Flood	13	18496	8.03		
11.00PM	Flood	10	24832	8.04		
1.00AM	Flood	10	29696	8.06		
2.00AM	Slack	9				
Mean			21514.66	8.003		

تصميم وتصنيع جهاز محلي يعمل بالطاقة الشمسية لتقييم درجات الحرارة والمواد الصلبة الذائبة والاس الهيدروجيني في مياه نهر شط العرب

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المستخلص :

في هذه الدراسة تم تصميم وتصنيع جهاز محلي لاختبار وتقيم مستويات الاملاح الذائبة الكلية والاس الهيدروجيني وحرارة مياه شط العرب لثلاث مواقع (القرنة والعشار والفاو) بشكل مباشر حيث يتكون الجهاز المصنع محليا من مواد رخيصة الثمن ومتوفرة عن طريق ربط كل من لوح الطاقة الشمسية المثبت على السطح الخارجي للحافظة بلاستكية والى داخلها بوحدة التحكم بالشحن وبعدها الى البطارية ومن ثم الى خافض الفولتية حيث يعمل كمصدر للطاقة (بطارية) الذي يقوم بتجهيز كل من أجهزة قياس حرارة الماء والاملاح الذائبة الكلية والاس الهيدروجيني ب ٦ فولت لكل منهما والتي من خلالها يتم قياس تلك المستويات في مياة شط العرب في المواقع المختارة واظهرت النتائج اليومية تحت ظروف ظاهرة المد والجزر لمياه شط العرب حيث لوحظ أن الزيادة الملحوظة في درجة حرارة الماء في جميع المواقع المختلفة تفاوتت من (٩ – ١٧ درجة مئوية). ويرجع ذلك إلى درجة حرارة المياه تأثرت بشكل مباشر بمناخ مدينة البصرة.

قد أظهرت ان قيم الاس الهيدروجيني متعادلة تميل الى القاعدية الضعيفة في جميع المواقع (٨.٠٤-٧.٩٦) والتي كانت ضمن المحددات البيئية الدولية

كما لوحظ الزيادة الواضحة في قيم الاملاح الذائبة الكلية لمياه البحر في موقع الفاو بالمقارنة بمياه شط العرب في موقعي العشار والقرنة

(ppm ١٢٣٧.٣٣ to ٢١٤٥١٤.٦٦)

مما يؤكد تأثير تلك المياه على نوعية مياه شط العرب بالإضافة إلى مطروحات مياه الأنهر الفرعية التي تطرح مباشرة الى شط العرب باعتبارها ابرز وأكثر تأثير في النهر والتي تحتوي على نسب عالية من الملوثات العضوية واللاعضوية، ومتجاوزة بذلك محددات البيئة الدولية المسموح بها حيث تصنف مياه شط العرب بانها مياه عسرة وكما تم قياس كثافة شدة الاشعاع مع مرور الوقت خلال اليوم الواحد اثناء القياس الاملاح الذائبة الكلية ودرجة الحموضة وحرارة مياه شط العرب بشكل مباشر لثلاث مواقع (القرنة والعشار والفاو)