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Innovative Paper

Indicators for Determining Salt Harvest Time Based on Salinity and Liquid Viscosity Using Microcontroller

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Abstract

Background and Objectives: In general, traditional salt farmers determine the time to harvest salt by visiting and monitoring their salt ponds. Therefore, to assist salt farmers in determining the right time to harvest salt and determine the quality of the harvested salt, a wireless-based electronic device is needed that can monitor the salt content and viscosity of the brine.

Methods: An electronic device that is made to measure salt content (salinity) with a conductivity sensor and to measure fluid viscosity using a data processing method from sensor readings which is first converted to digital data with a program on the microcontroller. To find out whether the brine is ready to be harvested or not, the data obtained in the form of conductivity and stress are converted into percentages of NaCl and degrees of Baume. Then the data is sent to the ESP8266 Wifi module to be stored in a database and displayed on the Web.

Results: The results of the data obtained are based on testing in salt ponds for young water but it has been quite a long time the results have approached old water of around 64% and 14o Be. The results of the old water test that had just been moved to the last reservoir were close to harvest time of around 94% and 21oBe. If it has reached 25o Be then it is enough to be moved to the crystallization site. To determine the harvest period based on two parameters, namely the salt content and the viscosity of the liquid is 86-90% and the viscosity of the liquid is 20-24o Be. If you have reached both of these parameters, the salt can be harvested in about 7-10 days to make the water crystallize.

Conclusion: Equipment Indicators for determining salt harvest time based on salinity and liquid viscosity using a microcontroller that has been made have been successfully used to determine salt harvest time properly. The salt quality of this indicator tool is the salt content including the K-3 quality or the lowest quality of the 3 existing qualities.

Introduction

Advances in technology encourage humans to create equipment that can help humans simplify their work, making them more efficient and practical. In the industrial world, the process of making salt is produced using two methods of evaporation by sunlight in salt ponds and by boiling techniques. Salt is a very important commodity for people's lives, salt can not only be used as a consumption material but salt can also be categorized in industrial materials. This is stated in the Regulation of the Minister of Industry of the Republic of Indonesia Number: 88/M-IND/PER/10/2014 on the scope of salt it is stated that salt is the production of the Chlor Alkali chemical industry group which consists of consumption salt and industrial salt [1]. Based on the quality of salt production requirements, there are several methods of purifying in order to fulfilled the requirements, included chemical and physical method. The purification process of salt is done using a washing technique and evaporation (recrystallization). Washing technique is done with a nearly saturated brine while evaporation (recrystallization) process [25]. Salt is widely used in various products and it is estimated that around 14,000 products use salt as an additive [2]. This need has not been followed by an adequate quantity and quality of national salt production. In general, people's salt is grouped into three types [4], namely:

1. K-1 is the best quality that meets the requirements for industrial and consumption materials with the following composition: NaCl : 97.46 %, CaCl2 : 0.723 %, CaSO4 : 0.409 %, MgSO4 : 0.04%, H2O : 0.63%, and Impurities : 0.65%.
2. K-2 is a quality below K-1, this type of salt must be reduced in levels of various substances in order to meet the standards as industrial raw materials. This salt content ranges from 90-94%.
3. K-3 is the lowest quality salt for people's production. Usually the levels are between 88-90%, sometimes mixed with soil, so the color is slightly brownish.

Currently, the controlling, monitoring, and reporting systems have developed rapidly and are wireless-based. Usually this wireless is used in an area or location where the user is always on the move, or at that location there is no wired network for data distribution [15]. In addition, wireless communication is experiencing a fairly rapid development and is widely used as an interface on electronic devices or computers as a means of remote control [17]. Based on these developments, the world of agriculture must also keep up with the latest technological developments. However, to have a monitoring system requires a large cost. In addition, salt farmers always have to go to the pond and heat up to see the condition of the salt water. The impact of the production system using the evaporation method with sunlight, many have experienced crop failures. Because the manufacture of salt by the method of evaporation of sea water by utilizing sunlight energy is influenced by several factors including the rate of evaporation is related to the amount of salt obtained and seawater concentration, related to the amount of dissolved salt [3]. In addition, the tools used to determine the salt harvest time are expensive and are still offline. Therefore, it is necessary to have an online (wireless) tool to determine the salt harvest time. Made.

Making a tool to determine the salt harvest time by monitoring the salt content and the thickness of the brine. There are two parameters that can be used to measure whether the salt is ready to be harvested or to the next process. Brine must have a NaCl content above 90% to 97% for iodized salt. As explained in the Regulation of the Minister of Industry of the Republic of Indonesia, household salt is iodized consumption salt with a minimum NaCl content of 94% [1]. Until December 2019 there were 39 SNIs related to salt [10], the Indonesian National Standard SNI 3556:2016 stipulates a minimum requirement of 94% sodium chloride (NaCl) and a minimum of 30 mg/kg of iodine as KIO_3. And the viscosity or concentration of salt water reaches 24° Be to 29° Be unit degrees Baume, if it is more then it tastes bitter (contains MgCl) and if it is less then it precipitates gypsum, calcium carbonate so that the salt becomes brittle and opaque. Therefore, it is necessary to conduct a study in order to identify the causes of crop failure, determine the amount of salt (NaCl) and the viscosity of the brine. NaCl easily obtained by evaporation of seawater. The making salt from seawater evaporation carried out the public, in general, is still conventionally to produce salt with low quality [22]. Salt production depends mainly on high sunlight intensity and temperature and low relative humidity, thus is favored mainly by summer months with high temperatures [30].

Material and Methods

In the design of this system, a monitoring system for salt levels and fluid viscosity is described in salt water. Seawater has an average salt content of 3.5%. Seawater also has varying salt content. To measure the salt content, a conductivity sensor is used, the sensors conductivity/TDS/salt levels have a compact design [24]. Input data in the form of sensors mounted on the microcontroller. In this circuit, the sensors used are the conductivity sensor and the baume meter. The sensor reading data will be processed and converted into digital data with the program in the microcontroller. The data obtained in the form of conductivity (μS) and voltage (V), will be converted into percentage of NaCl and degrees of Baume, respectively. Sensor data and output obtained will be forwarded by the ESP to the access point for real-time pond monitoring. Access point as a connecting device serves as a bridge between wired and wireless communication [16]. In this paper, the interface between the ESP8266 Wi-Fi module and the Arduino MCU is studied for system monitoring applications. As shown in Fig. 1. Fig. 1 shows that in the design of the system for making this indicator tool. In general, the description of the system is that several sensors function to capture sensor signals in the room. In this circuit, the sensors used are the conductivity sensor and the baume meter. The PC server will be connected to the Wifi Access Point and the ESP module to connect the internet with the microcontroller.

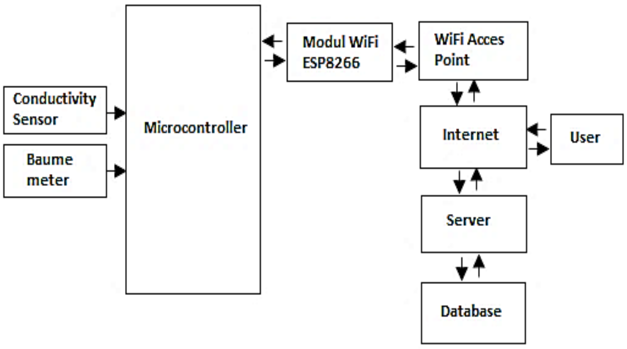


Fig. 1: System block diagram.

The ESP8266 Wi-Fi module is a self-contained system-on-chip (SOC) with integrated TCP/IP protocol stacks that can give any microcontroller access to a Wi-Fi network [13]. ESP8266 is a WiFi module that offers a complete and standalone Wi-Fi networking solution, enabling it to host applications or offload all Wi-Fi network functions from other application processors [21]. Parameter data obtained from the sensor will be stored in the database and can be accessed by the user. Systematics of making the system, adapted to the design that has been determined at the design stage.

Table 1: Salt condition parameters.

Condition	Parameters		
	Viscosity (°Be)	Salinity (%)	Description
Quality 1	24 - 29	<97	is the result of the crystallization process in solution
Quality 2	29 - 35	<94	is the remaining crystallization above in the solubility condition
Quality 3	>35	<90	is the remainder of the above concentrated solution at condition

The determination of the NaCl content was carried out using the Indonesian National Standard (SNI 01-3556-2016) method about consumption of iodized salt [5], the next calculation is as follows:

$$NaCl\ level = \frac{(V\ x\ N\ x\ fp\ x\ 58.5)}{W} x\ 100\% \quad (1)$$

where, V is the volume of $AgNO_3$ required in the titration (ml), N is the normality of $AgNO_3$, fp is the diluent factor, 58.5 is the molecular weight of NaCl and W is the weight of the test sample (mg).

In Fig. 2 is a system flowchart that contains an overview of the system starting from the microcontroller process until the data can be accessed via web hosting. The web is an information system technology that connects data from many sources and various services on the internet [18]. The working principle of the system from Fig. 2 is as follows: The program runs according to the sketch programmed into the microcontroller starting by setting the SSID, password and server address and setting the I/O port for sensors and libraries used by sensors. The microcontroller makes a connection between the ESP and the router according to the SSID that has been set in the sketch. In order for sensors to enter the hosting. The microcontroller reads data from the sensor via the I/O pins. The process of determining the parameters will process further I/O according to the program that has been sketched on the microcontroller.

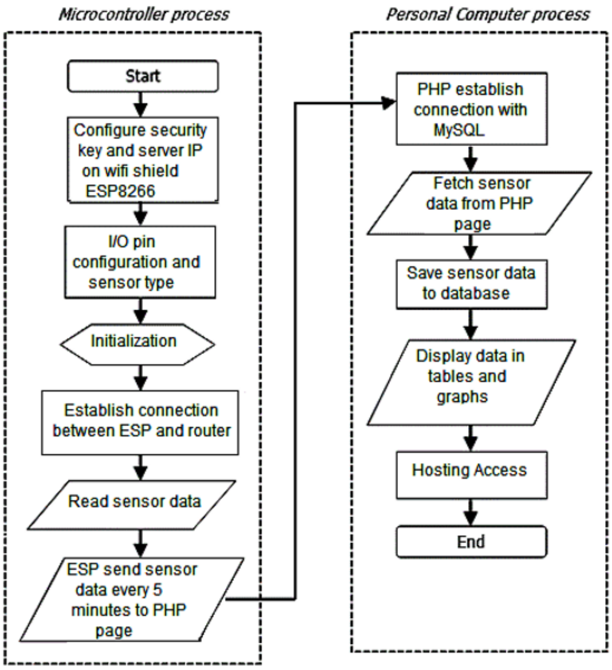


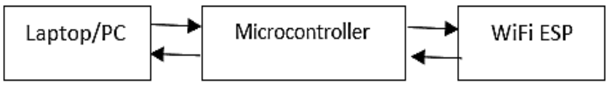
Fig. 2: System flowchart.

The ESP sends data from the microcontroller processing every few minutes to the server. PHP establishes a connection between Apache and MySQL. The dynamic web page captures the data sent by the ESP which is then stored in the database. Process average sensor on PHP data page. PHP retrieves sensor data from the database and then displays it in a line chart. Then accessing parameter results via hosting.

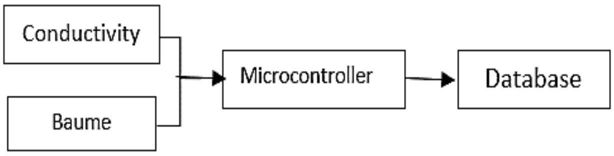
A. The Microcontroller Interface with The ESP8266 and The Conductivity Sensor and Baume

The equipment needed in the hardware design is an Arduino uno R3 microcontroller, ESP8266, a conductivity sensor, and a Baume meter. The block diagram of the microcontroller interface with the ESP8266 WiFi module, conductivity sensor and baume is shown in Fig. 3.

This sensor functions as a salt level or salinity reader. The sensor works by measuring the concentration of ions to conduct an electric current between two electrodes. As shown in Fig. 3 above, by connecting 5V, output, and ground to the Arduino, you can then see the sensor readings directly on the serial monitor. The results of the data obtained by this conductivity sensor are the Conductivity and Total Dissolved Solids (TDS). Then converted into a concentration of salt content (NaCl%). The value of salt content will be greater when measured in old water when compared to young water and fresh water. Later the data will be sent to the database using the ESP8266 module.



(a) Microcontroller with ESP8266.



(b) Microcontroller with conductivity sensor and baume.

Fig. 3: Microcontroller interface with ESP8266 and sensor.

Salinity is the level of saltiness or the level of salt dissolved in water. These dissolved salts include sodium chloride, magnesium sulphates, potassium nitrates, and sodium bicarbonate [11]. Salinity is used also to trace seawater masses and to model ocean dynamics [29]. That is the number of grams of salt dissolved for each liter of solution. Usually expressed in units of ‰ (parts per thousand). Parts per thousand is g/kg for liquids and for solids is mL/L for gas mixtures. Therefore, a 1000 gram seawater sample containing 35 grams of dissolved compounds has a salinity of 35‰. The following equation is for a 35‰ salinity solution containing 35 grams of salt per 1000 grams of saltwater.

$$35‰ = \frac{35\ gram\ salt}{1000\ grams\ saltwater} \quad (2)$$

According to the classification of high and low salinity, salinity is divided into three parts, namely fresh water, brackish water and sea water. The higher the concentration of a solution, the higher the absorption capacity of the salt to absorb water. Salinity also affects the osmotic pressure of water. The higher the salinity in a water, the greater the osmotic pressure.

The Electrical Conductivity (EC) was calculated to TDS because the conductivity measurement is measured by using probe dipped into the water to measure the dissolved charge which corresponds to the analysis [8]. Measurement of salinity is related to chlorinity. This chlorine includes chloride, bromide and iodide.

$$Salinity = \left(\frac{TDS}{10}\right) + \left(\frac{Conductivity}{100}\right) + 27.1024 \quad (3)$$

The measurement of the total salt concentration of the aqueous extracts of soil samples can be done either directly through chemical analysis of the chemical constituents that constitute the soil salinity (or mass of the TDS) or indirectly through the measurement of the EC [9]. The correlations between TDS and EC depend on the type of ions and their concentrations in the aqueous solution. Therefore, a specific correlation should be generated for each type of brine. The use of equations developed for model brines may carry substantial error, particularly when analysing high salinity brines [6]. In general [8], the TDS – EC relationship is given by (4).

$$TDS = (0.55\ to\ 0.7)\ EC \quad (4)$$

The TDS in water samples is estimated by multiplying EC by an empirical factor. This factor may vary from 0.55 to 0.90 depending upon the nature of soluble ionic components, their concentration and the temperature of water. Conductivity or electrical conductivity (EC) and total dissolved solids (TDS) are frequently used as water quality parameters, especially in the coastal area [20].

B. The Baume Meter

Baume meter is a tool used to read viscosity. The trick is to modify it in such a way as to get the desired result. Measuring the Density of Liquids expressed in degrees Baume (Be). It is important to measure the density of liquids. Density is an important characteristic possessed by a substance [14]. There are 2 types that are used Bé Heavy for liquids that are heavier than water and Light Be for liquids that are lighter than water. For Bé a weight of 0 degrees is equal to a solution having a relative density of 1.842. As for light Bé, 0 degrees Bé is equal to the density of a 10% NaCl solution and 60 degrees Bé is the same as a solution having a relative density of 0.745.

The baume meter is mounted with copper wound around 25°Be. Then next to the paralon pipe a voltage reading indicator is installed. The blue wire is connected to the 5V Arduino and the green wire to the Arduino A1. So that the Arduino can detect the movement of the copper in the baume meter. Later the voltage will be converted to Baume degrees then the data is sent to the database. Fig. 4 shows the design of the baume meter that has been inserted into the paralon pipe.

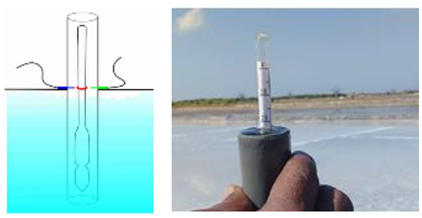


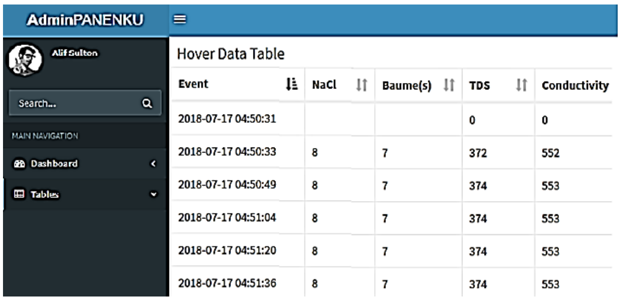
Fig. 4: Baume meter design.

Fig. 5 shows the indicator equipment for determining the salt harvest time that has been made.

Fig. 5: Salt harvest indicator equipment.

C. Web Server

Number Software realization by building a web server using XAMPP. In XAMPP there are Apache and MySQL which will be a local web server system. Web monitoring display as shown in Fig. 6.



Event	NaCl	Baume(s)	TDS	Conductivity
2018-07-17 04:50:31			0	0
2018-07-17 04:50:33	8	7	372	552
2018-07-17 04:50:49	8	7	374	553
2018-07-17 04:51:04	8	7	374	553
2018-07-17 04:51:20	8	7	374	553
2018-07-17 04:51:36	8	7	374	553

Fig. 6: Host's web view.

By using the internet or an online monitoring system, the monitoring process can be done anytime and anywhere and the data can be known more quickly and accurately [18]. Process monitoring on server is done at real time. Another monitoring service is to display the process database with immediate values [19].

D. Plans and Plots of Salt Ponds

In general, salt production models in Indonesia use evaporation, which is evaporation of seawater in shallow ponds by considering the thickness of seawater in these ponds [26].

Indonesia has a long coastline, potentially for salt pond. Salt Pond is an artificial shallow pond designed to produce salt from sea water or salt water [27]. The salt pond used in the research is located in Pandan Village, Galis District, Pamekasan Regency, Madura, East Java, Indonesia. Shown in Fig. 7.

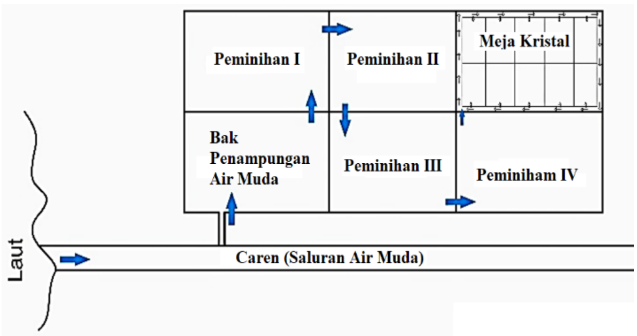


Fig. 7: Salt pond floor plan.

The process of making salt is carried out in the dry season, where the evaporation area (peminihan) is drained by seawater using a pump as shown in Fig. 7. In general, it consists of 6 plots of ponds, including Young water reservoir, Peminihan pool 1, Peminihan pool 2, Peminihan pool 3, Peminihan pool 4, Peminihan pool 5 and Crystal table or crystallization table.

While the map model and its size are shown in Fig. 8.

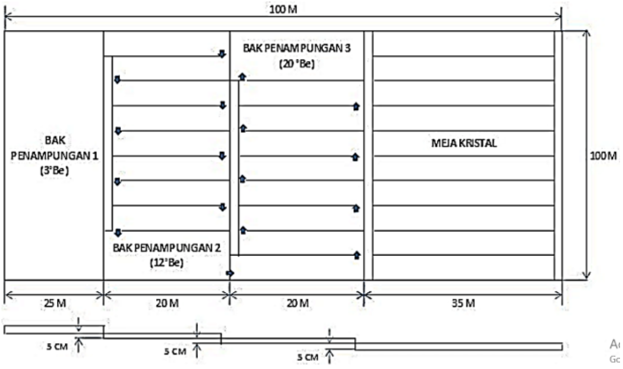


Fig. 8: Map and size the salt pond.

In this land seawater is evaporated so that it becomes old water. The old water flows to the crystallization table where later the salt will crystallize. In salt production process, besides producing salt also produced the liquid remaining crystallization called bittern [27]. The quality of the salt is controlled by removing or separating the bittern, which only crystallizes the salt at a concentration of 25^{O} to 30^{O} Be [7]. The harvested salt crystals are transported and taken to storage warehouses. The process can be continued by washing or can be directly sold as crushed salt. The resulting salt is in the form of white crystals which in addition to containing NaCl also contains other salts which are impurities.

Sea water (called young water) that flows into the salt pond will be accommodated in the young water reservoir, in the pool it is expected that as much sea water is accommodated depending on the area of land owned. In the holding pool the water depth is at least 1 meter, because the reservoir is a stock or supply of young water during the salt making process. In the pool the seawater that is accommodated is allowed to stand for a minimum of ten days, where as long as the young water is stored there will be deposition of impurities that are not needed during the crystallization process. The problems found in this process are low quality of raw sea water, open transport of concentrated sea water into crystallization pond, high penetration of pre-crystallized water into the soil in crystallization pond and batch crystallization process [12]. In addition to this, there will also be a process of increasing the density of seawater, namely when seawater is flowed into a young water reservoir, the density is only 3° Be, after being stored for approximately ten days there will be an increase in the density of the seawater to 7° Be to 10° Be. This is because of the influence of the sun's heat, wind and geothermal heat.

After the young water circulates from the young water reservoir to the purification pond V, the brine solution will increase its density by approximately 20° Be to 22° Be (called old water), this happens because of the evaporation process during which the brine solution is transferred. and the concentration of the brine solution must really be reached in the purification pond V, and if the concentration is not sufficient, the brine solution should be held for a few days so that the concentration reaches 20° Be to 22° Be, after the concentration of the brine solution is sufficient, then old water was released onto the Crystal table [3].

Results and Discussion

Testing of the indicator equipment to determine the time of salt harvest is carried out by placing it on the salt pond to several points that are easily accessible. The types of water tested are young water and old water, where young water is water in the channel originating from sea water. While old water is water that has undergone several processes and has been moved from 1-4 purification which is then put into old water reservoirs. Old water is the last water before it is put into the crystal table and becomes salt.

A. Testing Process on Salt Pond

Steps for testing equipment on salt ponds. The first is the placement of the equipment in the planned place, to find out whether the sensor data is appropriate or not. In this test, the reading data from the sensor is displayed on the LCD. As shown in Fig. 9.

Fig. 9: Laying equipment on salt pond

Then from the sensor it is displayed in the database, by removing the LCD it is replaced with a configured ESP8266 module.

A. 1. Conductivity Sensor Test

In this test, water is added with iodized and non-iodized salt. Each was tested 5 times.

Table 2: Conductivity test data with iodized salt

No.	Iodine salt (g)	Water (ml)	ADC sensor	Conductivity (µS)
1	4	100	431	588
2	12	100	453	589
3	20	100	466	593
4	28	100	482	598
5	36	100	496	601

The conductivity value is obtained by the following equation:

$$y = 0.2142x + 494.93 \quad (5)$$

where : x = ADC value, and y = conductivity

Table 3: Conductivity test data non-iodized salt

No.	Iodine salt (g)	Water (ml)	ADC sensor	Conductivity (µS)
1	50	100	456	588
2	100	100	498	589
3	150	100	518	593
4	200	100	537	598
5	259	100	561	601

To get the percentage of salt content in the water, the results from the conductivity sensor are used, namely TDS and Conductivity. The equation is as follows:

$$y = 0.3417x + 281.08 \quad (6)$$

where : x = ADC value, and y = TDS

A. 2. Baume Sensor Testing

Tests were carried out on old water, young water, and fresh water.

To verify the long-term stability of the standard seawater composition, it was proposed to perform measurements of the standard seawater density. Since the density is sensitive to all salt components, a density measurement can detect any change in the composition [28].

As well as knowing what the density of each degree Baume.

Table 4: Baume relationship data with density

Baume (°Be)	Density
60	0.745
55	0.683
50	0.621
45	0.559
40	0.497
35	0.435
30	0.373
25	0.310
20	0.248
15	0.186
10	0.124
5	1.062

It is found that 0 degrees Bé is equal to the density of a 10% NaCl solution and 60 degrees Bé is the same as a solution that has a relative density of 0.745. So, it can be concluded that the relationship between °Be and density is x = 0.0124166667.

A. 3. Baume and Sensor Conductivity Testing

The results of the conductivity sensor and baume meter readings are as shown in Table 5. This test is carried out on young water that has been around for a long time. So, the results are close to old water around 86% and 20° Be. This water is taken and a sample is made to test the equipment for determining the salt harvest time.

Table 5: Young water test results data

Conductivity (µS)	Baume (°Be)	NaCl (%)	TDS
651.94	20	86.78	531.55
651.94	20	86.78	531.55
651.94	20	86.78	531.55
652.15	20	86.81	531.89

From the data table above, it shows that the salt is not ready to harvest because the NaCl value is less than 90% and the baume value 20° Be.

Table 6: Old water test results data

Conductivity (µS)	Baume (°Be)	NaCl (%)	TDS
656.40	24	90.52	537
656.08	24	90.48	529
656.30	24	90.52	520

From the data Table 6 above, it shows that the salt is ready to harvest because the NaCl value is more than 90% and the baume value 24° Be.

B. Test Results on Salt Ponds with Young and Old Water in Real Time

Data taken in the morning, afternoon and evening. In general, watering is done 2 times a day, namely in the afternoon and evening. Therefore, the test data was taken with 2 different water samples, namely young water and old water. For young water but it's been long enough. So, the results are close to old water around 64% and 14°Be. The test data with young water are as in Table 7. while the test data with old water are shown in Table 8

Table 7: The test data with young water

Id	Time	NaCl (%)	Baume (°Be)	TDS	Conductivity (µS)
142	2018-07-19 07:02:31	65	14	519	644
141	2018-07-19 07:02:15	64	15	521	645
140	2018-07-19 07:01:59	64	14	521	645
139	2018-07-19 07:01:44	64	14	520	645
138	2018-07-19 07:01:28	64	12	520	645
137	2018-07-19 07:01:12	64	14	520	645
136	2018-07-19 07:00:57	63	14	518	643
135	2018-07-19 07:00:41	66	14	520	645
134	2018-07-19 07:00:26	64	14	520	645
133	2018-07-19 07:00:10	62	13	520	645
132	2018-07-19 06:59:39	64	14	520	645
131	2018-07-19 06:59:23	61	14	518	643
130	2018-07-19 06:59:07	64	14	518	643
129	2018-07-19 06:58:52	62	15	518	643

This test is carried out for old water that has just been moved to the last reservoir. So, the results are close to harvest time of around 94% and 21° Be.

Table 8: The test data with old water

Id	Time	NaCl (%)	Baume (°Be)	TDS	Conductivity (µS)
127	2018-07-19 06:57:36	94	21	530	655
126	2018-07-19 06:57:21	92	19	530	655
125	2018-07-19 06:57:05	94	21	530	655
124	2018-07-19 06:56:49	92	24	537	653
123	2018-07-19 06:56:34	94	21	530	655
122	2018-07-19 06:56:18	93	20	530	655
121	2018-07-19 06:56:03	94	21	537	653
120	2018-07-19 06:55:47	95	22	537	653
119	2018-07-19 06:55:31	94	21	537	653

If it has reached 25° Be then it is enough to be moved to the crystallization site and salt can be harvested approximately 7-10 days to become crystals. As shown in Fig. 10. Salt harvest as shown in Fig. 11. Salt is a white crystalline solid which is the dominant group of compounds consisting of sodium chloride (> 80%) and other compounds such as magnesium chloride, magnesium sulfate, and calcium chloride [23].

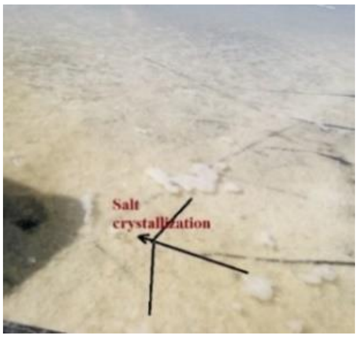


Fig. 10: Salt crystallization state.

Fig. 11: Salt harvest.

C. *Test Display of Test Result Data on the Web*

In this test, the microcontroller has been given an ESP8266 module that has been configured and connected to an access point, so it can be a server and connect to the localhost database. Then it has also been hosted on a website. The test results data on salt ponds are carried out in real time with a display on the web shown in Figs. 11 to 13 and a graphic display in Fig. 14.

From this system, every data taken from the process is displayed on the screen as text, including date and time data, NaCl value, Baume value, TDS and conductivity value.

NaCl	Baume(s)	TDS	Conductivity
64	14	520	645
64	14	518	643
64	14	520	645
64	14	520	645
64	14	520	645
64	14	521	645
64	14	521	645
64	14	519	644
64	14	519	644
64	14	521	645

Previous 1 … 6 7 8 9 10 Next

Fig. 11: Young water test results data on the web.

NaCl	Baume(s)	TDS	Conductivity
94	21	520	645
95	21	520	645
94	21	518	643
94	21	517	643
94	21	517	643
94	21	517	643
94	21	517	643
94	21	520	645
94	21	520	645
94	21	517	643

Previous 1 … 6 7 8 9 10 Next

Fig. 12: Old water test results data on the web.

Data Tables advanced tables

Hover Data Table

Event	NaCl	Baume(s)	TDS	Conductivity
2018-07-19 06:54:29	94	21	520	645
2018-07-19 06:54:44	95	21	520	645
2018-07-19 06:55:00	94	21	518	643
2018-07-19 06:55:16	94	21	517	643
2018-07-19 06:55:31	94	21	517	643
2018-07-19 06:55:47	94	21	517	643
2018-07-19 06:56:03	94	21	517	643
2018-07-19 06:56:18	94	21	520	645
2018-07-19 06:56:34	94	21	520	645
2018-07-19 06:56:49	94	21	517	643

Showing 61 to 70 of 93 entries

Previous 1 … 6 7 8 9 10 Next

Fig. 13: Display the overall data of the test results on the web.

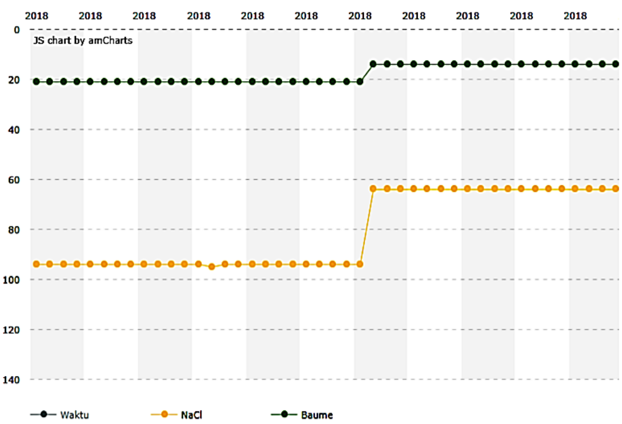


Fig. 14: Display of graphic data on the web.

In the graphic display there are 2 sensor parameters observed, namely NaCl and Baume. For a description of the parameter units, see the left of the graph and the time of data entry at the bottom of the graph.

Conclusion

From all the data obtained to determine the harvest period based on two parameters, namely salt content and liquid viscosity. Where the value of the salt content obtained is 86-90% and the fluid viscosity is 20-24^{o} Be. If you have reached these two parameters, salt can be harvested in about 7-10 days until it becomes crystals. Parameter data access can be through localhost or hosting in real time.

Equipment The indicator for determining salt harvest time based on salinity and viscosity of the liquid using a microcontroller that has been made has been successfully used to determine the salt harvest time properly.

Salt quality is based on data that has been successfully retrieved by an indicator tool for determining the time of harvesting, its salt content includes K-3 quality or the lowest quality of the 3 existing qualities.

To further improve and perfect the equipment for determining the salt harvest time, it is necessary to use a mobile application to more easily monitor the condition of the salt pond water.

Author Contributions

The author's role in research participation is as follows:

Akuwan Saleh. Data analysis, interpreting the results and writing the manuscript, Alif Sultonul Arifin. designing experiments and collecting data.

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Conflict of Interest

We declare that we do not have any conflict of interest. In this regard, I as the author fully disclose these interests to the Journal of Electrical and Computer Engineering Innovations (JECEI), and I have a plan to manage any potential conflicts that arise from the writing of the manuscript.

Abbreviations

Define abbreviations and acronyms in the text:

SNI	Indonesian National Standard
NaCl	Natrium Chloride / Sodium Chloride
CaCl	Calcium Chloride
MgCl	Magnesium Chloride
PHP	Hypertext Preprocessor
$AgNO_3$	Silver Nitrate
TDS	Total Dissolved Solids
EC	Electrical Conductivity
LCD	Liquid Cristal Display
SOC	Self-contained system-On-Chip
MCU	Microcontroller Units

References

[1] Regulation of the Minister of Industry of the Republic of Indonesia Number: 88/M-IND/PER/10/2014 concerning the Road Map for the Development of Salt Industry Clusters., Chapter-I, 1-3, 2014.

[2] B. Suwasono, A. Munazid., et al., “Strategic planning for capacity building production and salt farmer in region of surabaya city east java Indonesian,” ASRJETS J., 12(1:) 53-65, 2015.

[3] A. Arwiyah, M. Zainuri, M. Efendi, “Studi kandungan nacl di dalam air baku dan garam yang dihasilkan serta produktivitas lahan garam menggunakan media meja garam yang berbeda,” J. Kelautan, 8(1): 1-9, 2015.

[4] Y. U. Hoiriyah, “Peningkatan kualitas produksi garam menggunakan teknologi geomembran,” Jurnal Studi Manajemen dan Bisnis, 6(2): 35-40, 2019.

[5] Badan Standardisasi Nasional, Standar Nasional Indonesia (Indonesian National Standard)., “Garam Konsumsi Beriodium,” SNI 3556:2016, 2016.

[6] L. R. B. Rebello, T. Siepman, S. Drexler, “Correlations between TDS and electrical conductivity for high-salinity formation brines characteristic of south atlantic pre-salt basins,” Water SA, 46(4): 602-609, 2020.

[7] A. L. Rositawati, et al., “Rekristalisasi garam rakyat dari daerah demak untuk mencapai SNI garam industri,” Jurnal Teknologi Kimia dan Industri, 2(4): 217-225, 2013.

[8] S. Choo-in, “The relationship between the total dissolved solids and the conductivity value of drinking water, surface water and wastewater,” in Proc. the 2019 International Academic Research Conference: 11-16, 2019.

[9] D. L. Corwin, K. Yemoto, “Salinity: Electrical conductivity and total dissolved solids,” Methods Soil Anal., 2: 1-16, 2017.

[10] A. Wibowo, “Potential of developing Indonesian national standards (SNI) for yodium salt products to increase competitiveness,” in Proc. PPIS 2020 – Tangerang Selatan, Indonesia: 79-88, 2020.

[11] L. N. Nthunya, et al., “Spectroscopic determination of water salinity in brackish surface water in nandoni dam, at vhembe district, Limpopo province, south Africa,” Water, 10(8): 1-13, 2018.

[12] H. Susanto, N. Rokhati, G. W. Santosa, “Development of traditional salt production process for improving product quantity and quality in jepara district, central java, Indonesia,” Procedia Environ. Scie. 23: 175-178, 2015.

[13] T. G. Oh, C. H. Yim, G. S. Kim, “Esp8266 Wi-Fi module for monitoring system application,” Global J. Eng. Scie. Res., 4(1): 1-6, 2017.

[14] H. Putranta, et al., “A simple liquid density measuring instrument based on Hooke’s law and hydrostatic pressure,” Phys. Educ., 55(2): 1-9, 2020.

[15] M. Abadi, A. Saleh, “Rancang bangun alat pengukur langkah kaki dengan sensor accelerometer dan fasilitas komunikasi wireless 2, 4 GHz,” EEPIS Final Project, 2013.

[16] A. Saleh, A. Haryadi Amran D., Suwito, “Kendali Gerak Robot Berdasarkan Isyarat Tangan Menggunakan Komunikasi Nirkabel,” In Proc. SENTIA 2014-Politeknik Negeri Malang, 6: 73-78, 2014.

[17] T. A. S. Wibawa, Arifin., A. Saleh, “Rancang bangun robot soccer wireless berbasis mikrokontroller,” EEPIS Final Project., 2012.

[18] A. Saleh, “Implementasi pengolahan citra pada sistem pemantau level cairan berbasis Web,” in Proc. SENTIA 2014-Politeknik Negeri Malang, 6: 1-6, 2014.

[19] C. Bayrak, et al, “Web-Based System Monitoring and Control,” Arkansas, [Online].

[20] A. F. Rusydi, "Correlation between conductivity and total dissolved solid in various type of water: A review," in Proc. IOP conference series: earth and environmental science, 118(1), 2018.

[21] T. Perets, “Investigation of wi-fi (esp8266) module and application to an audio signal transmission,” University of Buea, Cameroon, [Online].

[22] T. Sulistyaningsih, D. Alighiri, "Quality monitoring of salt produced in Indonesia through seawater evaporation on HDPE geomembrane lined ponds," J.Phys. Conf. Ser., 983(1): IOP Publishing, 2018.

[23] P. Nugroho, A. Susandini, D. Islam, "Development of madura salt industrialization amid the covid-19 pandemic," PalArch's Journal of Archaeology of Egypt/Egyptology 17(9): 1621-1636, 2020.

[24] A. Ubaidillah, D. Rahmawati, R. Aiman, "Architecture tools measure the levels of salt and ph of seawater using a fuzzy logic-based android," JEEMECS (J. Electr. Eng. Mechatron. Comput. Scie.), 1(2): 46-51, 2018.

[25] T. Widjaja, et al, "Iodization of local salt based on purification technique using saturated brine washing method," in Proc. IOP Conference Series: Materials Science and Engineering, 543(1): IOP Publishing, 2019.

[26] M. Z. Mahasin, Y. Rochwulaningsih, S. Tri Sulistiyono, "Coastal ecosystem as salt production centre in Indonesia," E3S Web of Conferences, 202. EDP Sciences, 2020.

[27] S. M. Purnama, A. Cahyawati, D. Y. Hutapea, "Salt pond analysis using ALOS PALSAR case study Sampang, Madura-Indonesia," in Proc. IOP Conference Series: Earth and Environmental Science., 162(1): IOP Publishing, 2018.

[28] H. Schmidt, et al., "The density–salinity relation of standard seawater," Ocean Sci. Discuss., 14(1): 15-40, 2018.

[29] M. L. Menn, et al., "The absolute salinity of seawater and its measurands," Metrologia, 56(1): 015005, 2018.

[30] M. Śmiechowska, M. Ruszkowska, O. Olender, "Selected quality characteristics of sea salt important during transport and storage," TransNav, Int. J. Mar. Navig. Saf. Sea Transp., 15(3): 659-665, 2021.

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