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Monitoring the Filtration of Brackish Water Into Raw Water by the Reserve Osmosis Method

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ABSTRACT

The need for raw water is still a serious problem for coastal communities, where groundwater obtained by coastal communities cannot be categorized as suitable for use, because the water tends to be brackish. Clean water that is suitable for consumption is not only clear, odorless, and tasteless, but must also meet health requirements. The urgency of the condition in the coastal area is that with the development of housing located on the coast, the need for clean water is very important for people living on the coast. The purpose of this study is to implement appropriate technology in the coastal area of the north coast with the hope of providing raw or usable water for the people of the north coast, especially for the people in the coastal area of Tegal City, Central Java. The appropriate technology that will be applied is to monitor the results of an internet-of-things based filtration system by reading the TDS and PH sensor values. The TDS sensor can detect a decrease in moisture content with an average decrease in PPM value of around 321 and salinity or salt levels, which is an average decrease of about 8.63%, while the PH sensor detects an increase in the sample, which is an average of 1.8 with a water filling speed of 9.03 L/min. Thus, the previously brackish water condition can be used as an effort to overcome the raw water crisis in coastal communities with the reserve osmosis filtration method.

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1. INTRODUCTION

The need for boiling water is a basic thing, basically many water sources can be used as suitable water, but what has been an obstacle so far is polluted water or brackish water conditions. This is common because Indonesia is an archipelagic country where the majority of people use groundwater supply. Changes in soil contours and soil conditions on the coast make water conditions unsuitable for use.

Tegal Regency is one of the districts in the administrative area of Central Java Province with the district capital in Slawi City, a strategic location for the development of the Jakarta – Semarang axis and the axis to the south of Purwokerto / Cilacap. The area of Tegal Regency covers the western north coast and part of the area bordering the Java Sea (pantura) with an area of 87,878 KM with an area divided into 18 sub-districts and 287 sub-districts, and topographically has 3 areas that have a category of areas located on the coast, including Kramat District, Suradadi District and Warureja District [1].

With part of the area being a coastal where the water condition tends to be brackish and even salty, this condition makes the community very dependent on the supply of clean water from PDAM, the water supply is not optimal, making the community have to use existing water sources where the water is not suitable for use with an average level of pollution and the salt content is between 0.5 to 30 grams of water per liter of water[2] And the problem of using water is quite serious, among others, skin disorders (diseases). Clean water that is suitable for consumption is not only clear, odorless, and tasteless, but must also meet health requirements. These health requirements include not containing toxic chemicals or bacterial germs that can interfere with health with several parameters including Temperature/Temperature, pH, Dissolved Oxygen (DO), Turbidity, Biological Oxygen Demand (BOD), Cund/DHL, Nitrate, Nitrite, Phospat, Iron, Sulfate and Ammonia [3] With the fulfillment of the standard of Permenkes No.32 of 2017, the safe pH of the use of water as sanitary hygiene is pH with a value of 6.5-8.5 [4].

Thus, for the formulation of the problem of this study, it is necessary to have a filtration system for brackish water into usable water as an effort to overcome the raw water crisis in Dampyak Village, Kramat District, Tegal Regency using the designed tool, to produce clean water that is suitable for use by the community.

Several previous studies that have changed brackish water to raw water have been carried out to reduce the crisis of raw water needs. Filtration media using activated carbon, silica sand, zeolite and gravel are effective in reducing salinity and turbidity in brackish water and The longer the contact in the filtration and adsorption process, the more effective it will be to increase the acidity (pH) of water with an average value (pH) of 7.9 [5] That the optimum value of reducing the salinity of brackish water using zeolite adsorbent media is 27.31% with an optimum discharge of 160 ml/min, the optimum zeolite particle size is 1.5 mm. The design model of the desalinator is designed using a discharge of 160 ml/min, a zeolite size of 1.5 mm with a tube diameter of 2 inches and a height of 1 m [2].

Reserve Osmosis-based brackish water filtration systems are widely used because of their effectiveness in the filtration process as a community-based water treatment as an effort to meet the needs of clean water / drinking water for areas with difficult clean water [6]. In addition to Reserve Osmosis-based flitlation, one of the things that can be applied is how we can check the capacity and water pressure when the pump is running with a low-pressure sensor to identify the pressure of the water so that the water discharge is appropriate.

The condition of brackish water that tends to have a green color requires a turbidity sensor as an effort to detect the level of turbidity in the water produced during the filtration process. Adjusting the standard of Permenkes No.32 of 2017 which requires an average water pH of 6.5 -8.5 -8.5, it is necessary for the PH senor to find out how much ph is produced after the filtration process. With several sensors applied, it will make it easier to monitor, using the website as an implementation of monitoring sensors applied to this tool.

2. LITERATURE REVIEW

In previous research, filtration or filtration systems using reserve osmosis have been carried out a lot, but post-filtration monitoring systems and brackish water filtration results have not been carried out, therefore the addition of monitoring is considered quite relevant for the development and improvement of previously developed filtration systems.

Salt removal by reverse osmosis process reached 99.5%. The reverse osmosa membrane module has two output pipes, namely an output pipe for fresh water as a product and an output pipe for salt water that has been concentrated as a waste. In the reverse osmosis membrane, a filtration process occurs at the molecular scale, that is, particles whose molecules are larger than water molecules, such as salt molecules and others, will separate and will enter the wastewater. Therefore, the water that will enter the reverse osmosis membrane must have certain requirements, for example, turbidity must be zero, iron content must be < 0.1 mg/l, pH must be controlled so that calcium carbonate movement does not occur and others by measuring water parameters before and after the electrocoagulation process using different variations in electrical voltage and contact time. The research began by analyzing the [7].

The brackish water purification and monitoring system with IoT-based closed-loop control is a water purification system concept with a filtration method that is expected to monitor brackish water levels, either directly (viaLCD) or through smartphones. Some of the things that are monitored are pH, TDS, turbidity and water level. In addition to being able to monitor, this tool is able to perform automatic looping if the moisture content is not in accordance with expectations [8]

2.1 Filtrasi reserve osmosis

Reverse osmosis is one of the alternative technologies to overcome water problems with a molecular scale filtration method using a semipermeable membrane or what is called reverse osmosis hereinafter abbreviated as RO. This unit has important parts to support the unit's performance as a whole when filtering, several devices [9].

2.2 TDS Sensor PPM & PPT

A TDS sensor is an electronic device that has the ability to measure the concentration of solids dissolved in water using analog signals. This sensor is able to provide information about the number of particles dissolved in water with the number andsources of soluble and insoluble materials presentin water varies widely [10]. In its function, the particles measured by TDS sensors are PPM (Parts Per Million) and PPT (parts-per-thousand) or units to measure salinity, i.e. the amount of salt dissolved in water.

2.3 PH Sensor

A pH meter sensor is a tool used to measure the acidity or alkalinity level of a liquid or solution. The working principle lies in a sensor probe made of glass electrodes, where the tip of the electrode contains an HCl solution. Sensor electrodes on the The water pH sensor is formed from a sensitive glass coating material with a small impedance byTherefore, it can get stable and fast reading and assessment results at high or low liquid/solution. The results of the PH sensor value reading can be obtained by microcontroller using the existing PH 2.0 interface on the module water PH sensor. This water pH sensor is excellent for use in taking readings PH levels of liquids with long time intervals. Most pH sensors operate using the potentiometric method, where the sensor consists of a sensitive electrode paired with a reference electrode, with glass-based pH electrodes being a common example. Thin and thick films of metal oxides (MOx), often structured as nanomaterials like nanowires, nanotubes, or nanoflowers, are employed as sensitive electrodes. Due to their ease of production, ability to be miniaturized, and reliable performance, thick-film potentiometric sensors made using screen printing are widely utilized for pH measurement in solutions [11].

2.4 Flow Sensor

In general, a Flow sensor is defined as a type of transducer that converts mechanical, magnetic, heat, light, and chemical quantities into voltage and electric current, and is used to measure the volume of water flowing in a customer's pipe. The water flow sensor consists of several components, namely a plastic valve, a water rotor, and a Hall effect sensor. When water flows through the rotor, the rotor will rotate, and the speed of the rotor rotation is proportional to the flow of water passing through it. The pulse signal from the rotor is then captured by the Hall effect sensor and the magnetic rotor [12].

3. METHODS

In this study, the model used in the study was prototype modeling. The goal is to develop the model into an implemented system in the sense that the system will be developed faster and more effectively. The stages of this study are as follows:

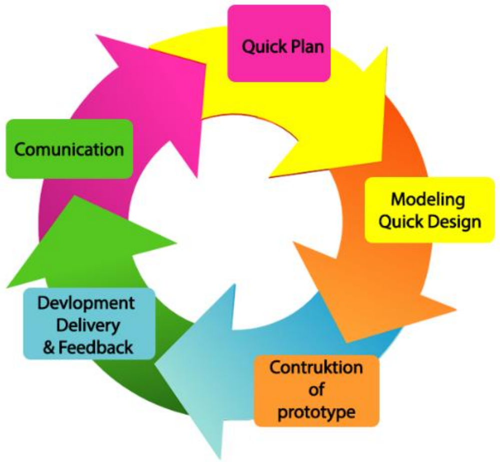

Figure 1 Protoype modeling flow

3.1 Comunication

The planning stage, system discussion, and implementation that will be carried out starting from sample billing to the final sample data that has been processed by the tool

3.2 Quick Plan

It is the earliest step in conducting research with data collection, the data in question is the collection of water samples in the coastal area of Tegal City and water quality testing Analytics

3.3 Modeling Quick Design

The design of monitoring filtration results with flowchar diagram and block diagram design schemes, the design of the tools, and the determination of the components used.

3.3.1 Diagram Blok

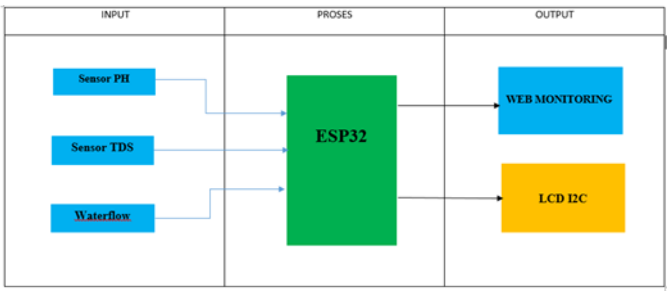

Figure 2 Block diagram of the monitoring system Brackish water filtration results

This block diagram explains the functions of several components and the resulting data flow. The main components in monitoring are PH and TDS sensors that function to measure molecules or particles contained in water. Meanwhile, the waterflow sensor is used as a measure of the speed of water discharge.

3.3.2 Flowchart Diagram

Flowcharts play an important role in deciding the steps or functionality of a program creation project that involves many people at once. In addition, using a process flow chart of a program will be clearer, more concise, and reduce the possibility of misinterpretation. In this study, flowchart was used as an illustration of the working design of the following PH and TDS sensors:

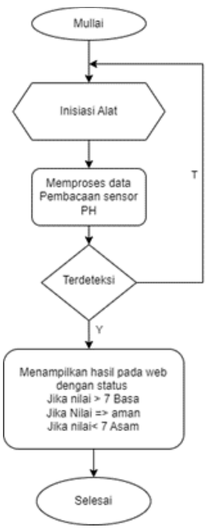

Figure 3 PH Sensor Value Reading

In Figure 3, it is a design of a PH sensor reading flow that measures the acidity value in water with a value status of more than 7, the stat is bas, if the value is more than 7, then the temperature is safe, and if it is less than 7, the status is acidic.

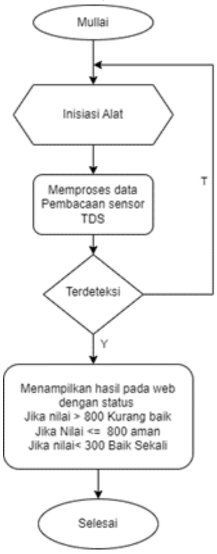

Figure 4 TDS Sensor Value Reading

In Figure 4 is the design of the TDS sensor reading flow that measures the value of the hazard level in water conditions with a status of more than 800 PPM eating the stat is not good and if the value is less than equal to 800 then the tau is safe and if it is less than 300 then the status is Very Good.

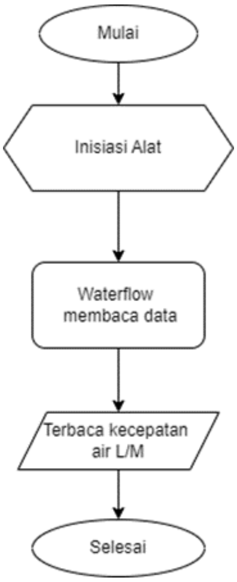

Figure 5 Flowchart Displays the water velocity value on the waterflow

Flowchart diagram 5 describes the process of waterflow reading the speed of water pressure flowing into the filter and RO membrane

3.4 Construction of prototype

For implementation, several components are needed to create an Internet of Things-based filtration system, including:

- ESP32
- PH Sensor
- Sensor TDS Meter V1.0
- Waterflow
- FRP 4040 RO Membrane Housing
- Ro membrane 2000gpd Keensen Bw 4040
- Filter Chamber

The stage of making a filtration system begins with the installation of an Osmosi reserve-based tilter with an internet of things-based monitoring system, from several installations several sensors are applied to measure water quality, ranging from water PH, Turbidity and pressure sensors whose results from the measurement will be monitored through the website

3.4 Development delivery and feedback

After carrying out the implementation and testing stage of the system, the next stage is maintenance in the form of errors that were not found in the previous step.

4. RESULTS AND DISCUSSION

The monitoring system detects the results of filtration of brackish water into usable water. The system can monitor the water speed to find out the accuracy of the water speed when filtered. PH and TDS sensors are used to test the quality or feasibility of the resulting water from filtration.

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1. **Hardware Results**

Monitoring the results of filtration of brackish water into raw water based on reserve osmosis is the implementation stage, a process of installing a tool or assembling a tool in the form of a prototype. The tools used in hardware implementation include preparing the components used such as, ESP 32, PH sensor and TDS sensor, Waterflow and 16 x 4 LCD as well as other supporting components.

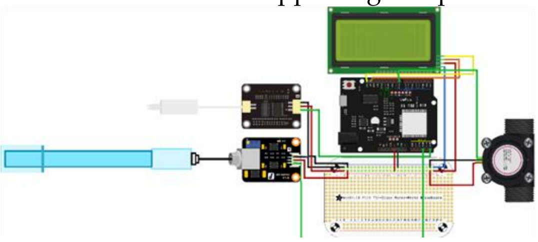

Figure 5 System of Components Monitoring Water Filtration Results

The filtration device uses 3 filtration housings, namely a 0.5 micron cotton filter is used to filter the condition of sandy water, psir manganese is used to reduce iron levels and odors in the water, and carcol or charcoal is used as a filter to remove dirt and odors. Ro BW membrane is used to reduce the salt content contained in brackish water.

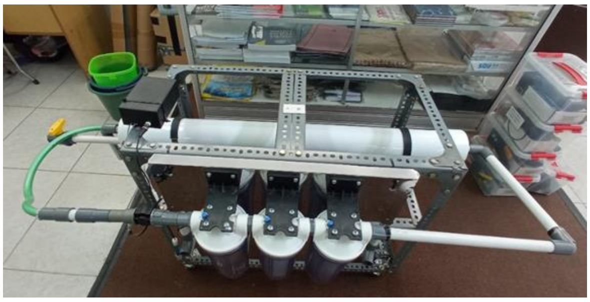

Figure 6 Brackish Water to Raw Water Filtration System

2. **Software Results**

Software implementation is needed to monitor the data results provided from the sensor, display the monitoring results of the PH and TDS sensors with the status given, among others, for PH is acidic, safe and alkaline, for TDS is not good, safe and very good, salinity with fresh or brackish water value conditions.

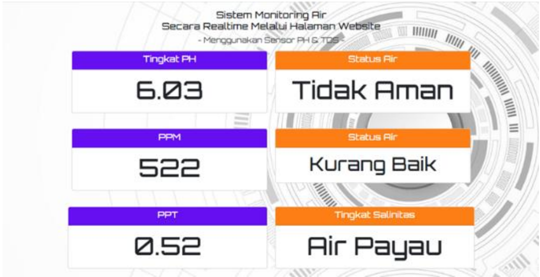

Figure 7 Web-based monitoring view of water conditions

The results of the implementation will be read and displayed on a website-based monitoring with the function of measuring TDS or ppm, namely if the value is more than 800 PPM, the condition is declared less good or unsafe, if the value is between 300 and 800 PPM, the water condition is declared safe, and if the value is below the value of 300, the water condition is declared very good. Meanwhile, salinity measurement is if the value is between 0 to 0.5 then the status is freshwater, if the value is 0.5 to 30 then the status given is brackish water, and if the value is between 30 to 50 then it is classified as seawater and if the value is more than 50 then it is classified as saltwater.

The pH level of water is measured by the acidity and alkalinity of water conditions with a limit value such as, among others, if the PH value is more than 7 then the water condition is declared alkaline, if the value is between 7 then the water condition is declared safe or good, and if the value is below 7 water conditions is declared acidic.

Table 1 Testing of sensor readings on samples

Water Condition Assessment	**Sample Before Filtering**		**Water Speed**	**Samples After Filtering**	
Sample	Sample 1	Sampe1 2		Sample 1	Sample 2
TDS Value (PPM)	514	738	9.03 L/min	300	310

Status PPM	Not good	Bad		Excellent	Not Good
Salinity Value (PPT)	0.52	0.70	9.03 L/min	0.043	0.063
Status PPT	Brackish Water	Brackish Water		Fresh water	Fresh water
PH Value	6.03	5.17	9.03 L/min	7.5	7.3
Satus PH	Insecure	Insecure		Safe	Safe

The test table presented shows that the results of filtration improve the quality of water into raw water suitable for use. The test was taken with 2 samples of brackish water taken in different locations, in the measurement the sensor succeeded in measuring the condition of water that had not been filtered using the reserve osmosis method, in this case the TDS on the water showed a PPM value of 514 for sample 1 and with a PPM value of 738 for sample 2 which in this condition the water was declared to be in poor condition for sample 1 and not good for sample 2 because the PPM standard for raw water was stated good is below 300 PPM. while the sanitation value shows a PPT value of 0.52 for sample 1 and nili PPT 0.70 for sample 2, thus the condition of the water contains quite high salt and can be called the condition of the water brackish which should be water that can be used, namely having a PPT value below 0.50. In the niai ph in sample 1 shows a number of 6.03 and sample 2 shows a value of 5.17, this condition is not safe to use because the PH level in the water is too low which should be above 7 water ph level.

After sensor filtration was carried out to detect with monitoring results on both samples, which showed that the water TDS value had decreased for up to 1, namely the PPM value of 300 in water conditions was declared very good to be used while sample 2 showed a PPM value of 320 in this condition the water was still declared to be not good, the main factor in sample 2 was that the initial sample showed a very high PPM value of 738. Meanwhile, the salinity or salt content in the water decreased, namely for sample 1 had a PPT value of 0.043 and sample 2 had a PPT value of 0.063, both of which experienced a significant decrease in the decrease in salt content and the water was declared salty. And for the PH of the water, the water quality has improved in both sensors, namely for sample 1 at 7.5 and sample 2 at 7.3.

5. CONCLUSION

Based on the results of the research, analysis, design, and implementation of the system that has been carried out, as well as based on the formulation and limitations of the existing problems, several conclusions can be drawn that:

1. Prototype of a brackish water filtration system based on Reserve osmosis type membrane BW 4040 with testing of 2 samples taken in different locations.
2. The sensor used can detect and read the particle value in the water, namely the TDS sensor and the PH sensor and monitored using the website.
3. The test results showed a decrease in water content in sample 1 and sample 2 with an average decrease in PPM value of around 321 at TDS after filtration using the Reserve Osmosis method with a water pushing speed of 9.03 L/min.
4. Meanwhile, the salt content in the test haslil also experienced a significant decrease, namely an average decrease of around 8.63% after filtration using the Reserve Osmosis method with a water pushing speed of 9.03 L/min.
5. The PH value experienced a good increase, namely the PH value of the two samples was average, which was 1.8 after filtration using the Reserve Osmosis method with a water pusher speed of 9.03 L/min.

REFERENCES

[1] Bappeda Kabupaten Tegal, "RPJMD Kota Tegal 2019-2024," pp. 1–6, 2019.

[2] P. Salinitas *et al.*, "DESALINASI AIR PAYAU DENGAN MEDIA ADSORBEN ZEOLIT DI DAERAH PESISIR sebagai air bersih . Pengaruh air laut terhadap tata air amat kuat di wilayah pesisir dan sumur untuk kebutuhan sehari- hari seperti mencuci , mandi dan lain-lain . Berdasarkan filtrasi d," pp. 1–10.

[3] I. Afriliana, "Prediksi Indeks Kualitas Air Sungai Pemali Comal Dengan Menggunakan Adaptive Neuro Fuzzy Inference System (Anfis)," pp. 58–62, 2016, [Online]. Available: www.grinningplanet.com.

[4] Menteri Kesehatan Republik Indonesia, "Peraturan Menteri Kesehatan Republik Indonesia Nomor 32 Tahun 2017 Tentang Standar Baku Mutu Kesehatan Lingkungan Dan Persyaratan Kesehatan Air Untuk Keperluan Higiene Sanitasi, Kolam Renang, Solus Per Aqua dan Pemandian Umum," *Peratur. Menteri Kesehat. Republik Indones.*, pp. 1–20, 2017.

[5] S. Mulya Ivana and M. Abdul Wahid, "Pemanfaatan Filtrasi Multimedia Dalam Mengolah Air Payau Di Desa Gosong Telaga Barat Kabupaten Aceh Singkil," *Lingk. J. Environ. Eng.*, vol. 2, no. 1, pp. 16–28, 2022, doi: 10.22373/ljee.v2i1.1865.

[6] O. Mubin, C. J. Stevens, S. Shahid, A. Al Mahmud, and J.-J. Dong, "a Review of the Applicability of Robots in Education," *Technol. Educ. Learn.*, vol. 1, no. 1, 2013, doi: 10.2316/journal.209.2013.1.209-0015.

[7] H. Prastya, M. M. Danial, and D. Lestari, "DESALINASI AIR PAYAU MENGGUNAKAN METODE REVERSE OSMOSIS (RO) DENGAN VARIASI TEKANAN POMPA memaksa air keluar dari bagian yang terkonsentrasi melalui proses osmosis balik . Dari mikro lebih sedikit volume yang disaring melalui membran daripada reverse os," vol. 12, no. 2, pp. 433–442, 2024.

[8] P. D. A. N. Pengabdian, P. Rahmawaty, M. Si, D. Respati, S. Sumunar, and M. Si, "PROSIDING SEMINAR NASIONAL Prosiding Seminar Nasional," vol. 2, no. January, pp. 978–979, 2023.

[9] O. Sulaeman and C. Ardiana, "Aplikasi Teknologi Pengolahan Air Asin Menggunakan Membran Reverse Osmosis Di Pulau Barrang Caddi, Makassar," *J. Rekayasa Lingkung.*, vol. 13, no. 1, pp. 71–84, 2020, doi: 10.29122/jrl.v13i1.4294.

[10] H. Priyatman, S. Supriono, and A. Irwanto, "APLIKASI TEKNOLOGI IOT PADA WTP(WATER TREATMENT PLANT) SISTEM PENDINGIN AIR PADA MESIN PEMBANGKIT GUNA MENJAGA NILAI pH DAN TDS UNTUK KUALITAS AIR.," *Transmisi*, vol. 24, no. 3, pp. 106–113, 2022, doi: 10.14710/transmisi.24.3.106-113.

[11] L. Manjakkal, D. Szwagierczak, and R. Dahiya, "Metal oxides based electrochemical pH sensors: Current progress and future perspectives," *Prog. Mater. Sci.*, vol. 109, no. February 2019, p. 100635, 2020, doi: 10.1016/j.pmatsci.2019.100635.

[12] V. Kurnia Bakti, R. Rais, A. Basit, W. E. Nugroho, and M. Nishom, "Perbandingan Hasil Nilai Baca Konsumsi Air Antara Sensor Water flow YF-B6 dan YF-S201 dalam Penggunaan Internet of Things," *J. Inform. J. Pengemb. IT*, vol. 9, no. 1, pp. 7–11, 2024, doi: 10.30591/jpit.v9i1.6530.