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PROTOTYPE OF HOSPITAL WASTE MEASUREMENTS INTEGRATED BASED ON ISO 14001

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Abstract

One of the water pollution is wastewater that comes from hospitals. The surrounding community can suffer from this disease because hospital wastewater contains quite high organic compounds also contains other chemical compounds as well as pathogenic microorganisms. stabilize the pH. The levels of pH, TDS, and TSS can also be affected by the concentration of wastewater. The higher the dilution rate of the wastewater, the lower the pH, TDS, and TSS levels will also be higher. The results of the test with 4 different water media showed that the pH, TDS and TSS sensors were able to work well where in tap water and coffee showed normal results and stale tea water and betadine water is not normal. The pH, TDS, TSS sensors are able to detect normal water conditions in tap water and coffee with a pH value of 6.89 to 5.41 TDS 179.71 to 279.41 ppm and TSS 1.00 ntu to 16.00 ntu. pH, TDS, and TSS sensors are also able to detect abnormal water conditions in stale tea water and betadine water with a pH ranging from 4.24 – 4.56 TDS 246.11 ppm – 1129 ,54 ppm and TSS 7 ntu – 13 ntu. These values are in accordance with the liquid waste quality standards that have been set in the regulation of the Minister of Health of the Republic of Indonesia number 7 of 2019 concerning hospital environmental health.

Keywords: *Hospital*, *Wastewater*, WWTP, pH, TDS, TSS

1. Introduction

The manager of the waste water management installation (WWTP) must be responsible for managing liquid waste before being discharged into the environment so that the quality of liquid waste discharged into the environment does not exceed the quality standard of liquid waste that has been stipulated by Decree of the State Minister of the Environment Number: 58 of 1995 (article 7) . Liquid waste management aims to reduce the pollutant content of liquid waste in order to obtain an effluent that can be accepted by water bodies. The pollutant content of liquid waste can be reduced if the liquid waste management used is in accordance with the characteristics. Hospital waste has toxic and non-toxic characteristics and contains waste from the laboratory[1]. Hospital wastewater management has an important meaning in order to secure the environment from pollutant disturbances caused by hospital discharges, because hospital wastewater is a waste product. infectious agent that is harmful to humans and the environment. With good management of hospital waste water can be minimized and if it is discharged into the environment it will not have a negative impact on the hospital environment and the environment around the hospital [2].Hospital activities also produce solid, liquid and gaseous waste with distinctive characteristics. In general, hospital wastewater contains high organic matter, suspended matter, fat and volume in large quantities. With such characteristics, the management of hospital effluent requires special plans and designs including efforts to minimize waste and waste water treatment through a Wastewater Treatment Plant (IPAL)[3]. and other living things[4] According to SNI 19-14001-2005 clause 4.2 regarding environmental policies, top management must establish environmental policies that include commitments to

prevent pollution, comply with laws and regulations[5] Hospitals are social facilities that cannot be separated from the community[6] Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 492/Menkes/Per/IV/2010 the requirements for drinking water quality, one of which states that drinking water consumed by the community does not cause health problems[7] Based on the existing problems and the importance of these parameters, then n The development of water quality measuring instruments with water quality parameters in the form of pH, turbidity level, temperature and total dissolved solid (TDS). With the measurement of these parameters, it is hoped that it will make it easier for the public to know directly the condition of the water used [8]. tools available in the market today can only measure 1 (one) waste parameter and have not been integrated, so they cannot make decisions quickly and accurately. The ISO 14001 standard[3], is one of the series of ISO 14000 which is a voluntary environmental management standard that includes tools and systems, developed and maintained by the International Standards Organization. The implementation of the ISO 14001 certification program can be said to be a proactive action from producers that can lift the company's image and gain the trust of consumers [9]. So the concept of environmental management as a system with various management processes in it is known as an Environmental Management System (Environmental Management System). Management System) and adopted by the International Organization for Standards (ISO)[10] Seeing the number of companies that have implemented ISO 9001 and ISO 14001 in one industry/company, this study is only focused on reviewing the elements of the requirements in the ISO standard. 9001 and ISO 14001[11].

System Model of Hospital Waste Measuring Instruments

The development of an integrated waste measuring instrument model based on test parameters for hospital wastewater was made by integrating the pH sensor, TDS sensor, and TSS sensor, TDS sensor. The sensor works and is integrated using the Arduino microcontroller [12]. The pH measurement is done by comparing the voltage value on the sensor based on the potentiometer value (VR1) in the circuit that regulates the dark/light character on the LCD. [13] pH or the potential of hydrogen is the degree of acidity. Its value ranges from 1-14, and the pH of neutral water is 7[14]. The content of solid material in waters can be measured based on total dissolved solids (Total Dissolve Solid (TDS) and total suspended solids (Total Suspended Solid (TSS). TDS contains various dissolved substances (both organic, inorganic, other materials) with a diameter < 10-3 m contained in a solution dissolved in water [15]. Evaluation of wastewater quality is calculated using standard stream evaluation calculations and standard effluent evaluations. Standard flow evaluation is calculated to determine the concentration of mixing of domestic wastewater with receiving water bodies before water the waste is treated. While the evaluation of the standard effluent is calculated based on the percentage of reduction that must be achieved after being processed. The calculation formula can be seen in equations (1) and (2)[16]. The amount of conductance value depends on organic ions, temperature and ion concentration (Mahid, 1986). The greater the conductivity value indicates the more minerals contained in water. The relationship between TDS and conductivity is expressed in the equation 1 TDS (ppm) = EC (µS/cm at 25oC) x 0.641 where TDS is the amount of solute in units (ppm), and EC is the electrical conductivity measured at 25oC in units (µS/ cm)[17].This study discusses the development of an efficient wireless sensor-based water quality monitoring system in the form of a tool that can be used to measure water quality, focusing on the measuring instruments used are temperature, pH, turbidity, conductivity, and TDS for several purposes such as household, irrigation. , fisheries, industry[18]

2. Method

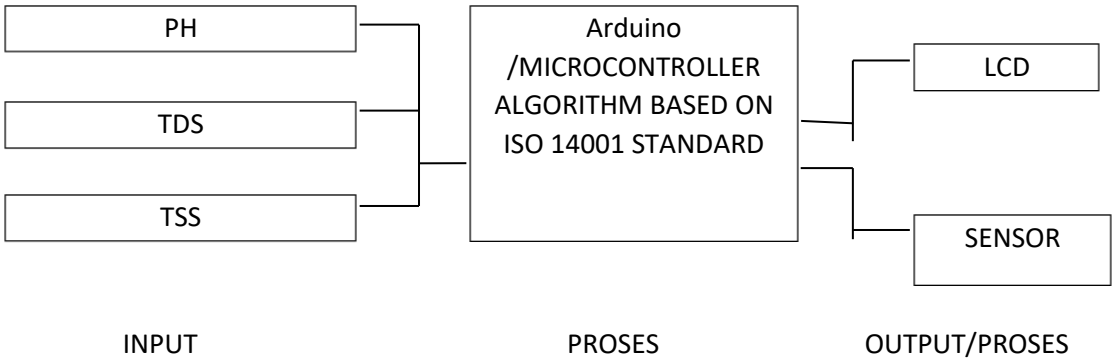

Figure 1. Hardware block diagram[8]

Figure 1 describes 3 sensors as inputs, namely: pH, TDS, and TSS in programming using Arduino as the brain to control a system, the parts of this tool for the white sensor are TDS, for the middle sensor is pH while the large sensor is the TSS sensor then this tool is equipped with a power button, power supply charging line, arduino uno programming line, 20 x4 LCD in the tool there is a large red LED light that functions as the final result, while the large green serves as sensor data plus a 3-color LED light namely the yellow color serves to provide normal information, the red light provides abnormal information while the green color provides information above norm. Waste testing is divided into several parts, namely signal conditioning testing, sensor testing and overall system testing.

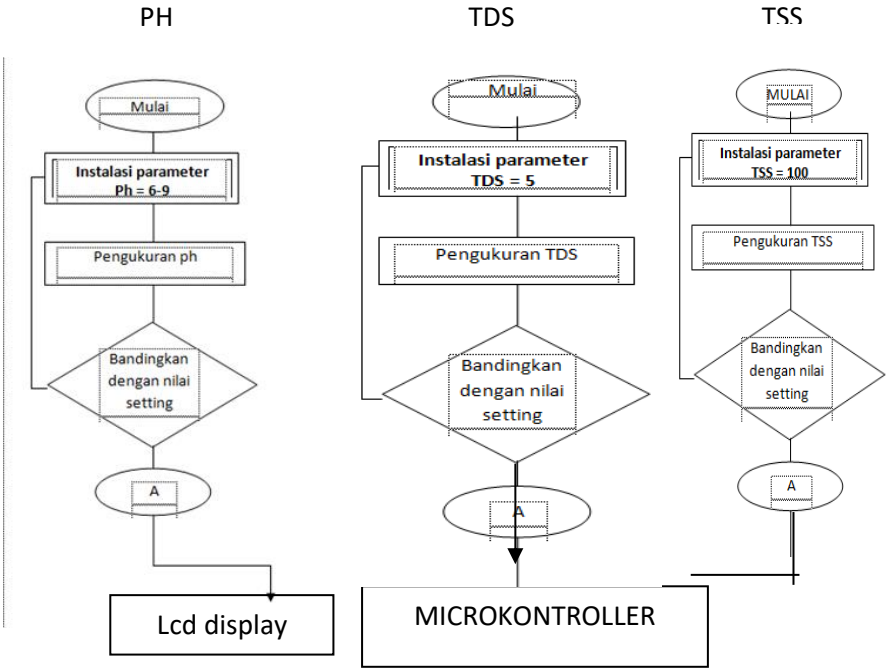

Figure 2. Program Diagram

Liquid waste released by hospitals comes from the results of various activities, including kitchen activities, laundry, inpatient care, operating rooms, offices, laboratories, septic tank runoff, rainwater and others. Basically, home wastewater management[19] The stages of wastewater treatment include the main treatment stage (secondary treatment) and advanced treatment (advanced treatment). The processing system does not apply the pre-treatment stage, which is to separate floating objects and fat catchers so that blockages in the pipes often occur. The liquid waste entering the control reactor is continued to the terminal reactor then

enters the main treatment reactor and is discharged to the city riol. can settle directly, such as organic matter contained in wastewater. The organic material in question consists of various types of compounds such as cellulose, fat, protein or it can also be in the form of microorganisms [20].

Hardware Design

In this study, a drinking water TDS (Total Dissolved Solid) data acquisition system was designed which was connected to a conductivity sensor. The working principle of the conductivity sensor is based on the flow of current into the liquid by using two probes made of stainless with a distance of 1 cm which serves to get the value conductance of a solution

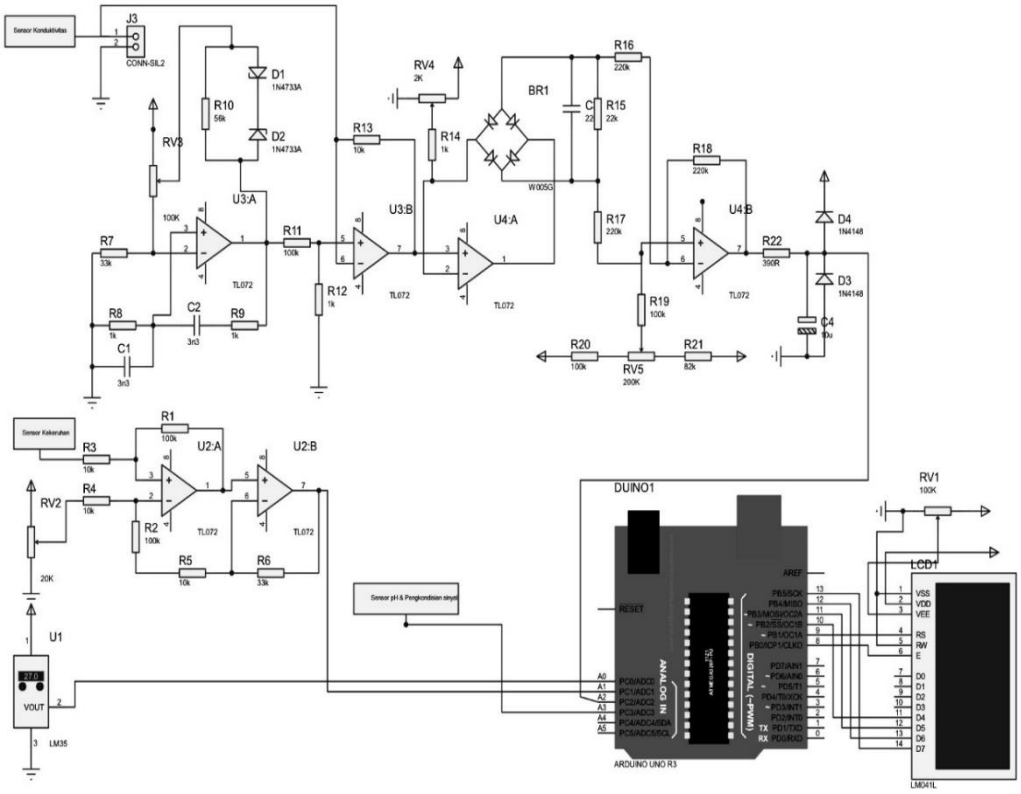

Figure 3. Hardware circuit diagram [8].

The measuring instrument for water acidity (pH) in question is a pH sensor that can function as an alternative measuring tool if one day the pH meter is not available and becomes a reference for measuring instruments for people who do not have a pH meter measuring instrument [21]. The degree of acidity (pH) of water that is less than 6.5 or acidic pH increases the corrosiveness of metal objects, causes bad taste and can cause some chemicals to be toxic that interfere with health [21]. Overall, the results of the water quality analysis showed that the physical and chemical parameters of all water samples met the quality standards set by the government[21]. The details of the series are described below. In measuring the pH level, a pH sensor module is used. This pH sensor module consists of 2 parts, namely the pH sensor and the pH sensor signal conditioning circuit. Signal conditioning using an analog pH meter kit from Dfrobot. pH sensor module. The way this module works is that the pH sensor circuit will read the pH value from the sensor electrode in the form of an analog voltage value. The output from the sensor is received by the signal conditioning circuit and then amplified so that the output voltage value from this pH sensor will be more easily read by Arduino for the process of converting the

voltage to a temperature value in Celsius. Alkaline water is water that is alkaline and has a pH generally ranging from 7 to 9.5. Ionized alkaline water (AAT) is water that has a high redox potential value (i.e. it is a good antioxidant due to its very negative ORP (Oxydation Reduction Potential) value) and has water molecules in smaller clusters than ordinary water (micro-clustered). (Rosa et al., 2012)[22]

TDS is a dissolved solid that is all minerals, salts, metals, and cations dissolved in water. Including all that is dissolved outside of pure water molecules (H2O). In general, the concentration of dissolved solids is the sum of cations and anions in water. TDS is measured in units of Parts per Million (ppm) or the ratio of the weight ratio of ions to water[23]. There is a clear link between measuring resistance (electrical), conductivity (electrical), and TDS of water. When viewed from the units in a row and parts per million (ppm) [24]. In measuring the TDS level, a series of TDS sensor modules are used. This module. consists of a series of sensor modules and a TDS sensor signal conditioning circuit as shown in Figure 6. The way the circuit works is to start with the generation of a sine wave by the Wien Bridge Oscillator circuit with an oscillation frequency of 5.3 kHz then amplified by a non-inverting amplifier whose gain is based on the magnitude of the value. resistance obtained from the conductivity sensor output. The AC signal that occurs is converted into a DC signal to be processed by the microcontroller through an AC to DC signal converter circuit. The software design for this automation system is made using the Arduino IDE (Integrated Development Environment) application.

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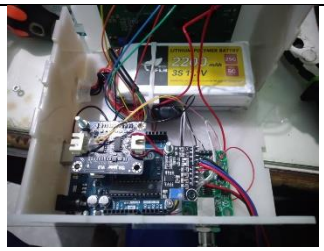
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>1. 2 x 4 . lcd screen</td><td>2. Power supply circuit and arduino</td><td>3. Ph, TDS, and TSS sensors</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>4. Separate Ph, Tds and Tss Measuring Instruments</td><td>5. power button and LED light</td><td>6. Measuring Tool Ph, Tds And Tss</td></tr>
</table>

Figure 4. Prototype of integrated hospital waste measuring device[8]

3. Result and Discussion

The stages of data collection (observation) in the field are then carried out measurements to strengthen the data obtained from the measurements. The test measurement data in the laboratory are adjusted to the results of measurements of pH, TSS, TDS, Potential Wastewater from each trial including well water, Coffee Water, Stale Tea Water, and Betadine Water

		
1. Well Faucet Water Measurement	2. Pen Coffee Water Measurementi	3. Stale Tea Measurement
		
4. Betadine Water Measurement	5. Measurement of 4 Types of Water	6. Results of measuring Ph, Tds and Tss

Figure 5. Measurement of 4 Types of Water

Table 1. Measurement

NAME	1.WELL FAUCET WATER	2. COFFEE WATER	3. TEA WATER	4. BETADINE WATER
pH	6,89	5,41	4,56	4,24
TDS	179,71 ppm	279,41 ppm	246,11 ppm	1129,54 ppm
TSS	1,00 ntu	16,00 ntu	7,00 ntu	13,00 ntu
Results	Normal	Normal	abnormal	abnormal

4. Conclusion

From the results of the prototype design of the RS waste measuring device, the following conclusions can be said that the pH, TDS, TSS sensors are able to detect normal water conditions in tap water and coffee with a pH value of 6.89 to 5.41, TDS 179.71 to 279.41 ppm and TSS 1.00 ntu up to 16.00 ntu. The pH, TDS, and TSS sensors are also able to detect abnormal water conditions in stale tea water and betadine water with a pH ranging from 4.24 – 4.56, TDS 246.11 ppm – 1129.54 ppm and TSS 7 ntu.– 13 ntu. Thus the prototype of the integrated hospital waste measuring device can work well.

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