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Research Paper

Comparative Study on Measurement of Water Absorption Rate Using Analog and Digital Percolation Meters

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ABSTRACT

A percolation test is a test to determine water absorption rate of soil in preparation of septic drain field (leach field) or infiltration basin for the building. The problem manually percolation is difficult to determine the water level in the test hole because it relies on visual observation and wet-looking tools as a guide in determining water level positions. The new device named Digital Percolation Meter, can be read directly on the monitor screen. Results of the measurement using Digital Percolation Meter was compared with the results of measurement using manual percolation test method. Both measurements were subsequently analyzed using the AUC curve. Testing data delivery time (ON) at different recharge levels was carried out at a depth of 1 inch, 3 inches and 5 inches. During the study the initial sensor was placed at the top. The results on timing were compared to an ordinary stopwatch measurement as the gold standard. The time data submitted showed that the 5 and 3 inch level have shown a 100% sensitivity level, and the 1 inch level has shown a 98% sensitivity. Infrared and photodiode were used for lower water level sensors. Test data on delivery time were completed at different recharge levels conducted at 5 inches, 3 inches and 1 inch levels, The water level sensor was placed at the bottom. The results showed that the 5 inch level has a 98% sensitivity, the 3 inch level has 96% and the 1 inch level has 92% sensitivities.

Keywords: Percolation, Soil, absorption time, Water Level

INTRODUCTION

Percolation Test is a method of measuring the power of soil absorption to obtain percolation rate in an area that will be used as infiltration. The percolation test is carried out through experimental activities in the field as the planned area for a recharge area, i.e. an experiment conducted to determine the soil's ability to pass water expressed in units of minute per inch (minute / inch). [1]

The problem in the trial is the difficulty of determining the limit of the water level in the test hole because it is based on visual and wet-looking tools as a water level position. The wet sections are still influenced by the capillary system of objects used as a measuring instrument so that it still contains the risk of error. Required tools that can help the accuracy and ease in the process of measurement that until now does not exist.

Percolation Meters in the form of tubes still have weaknesses if the meter does not concentrate on watching the water level drop on the monitor tube, so it needs to develop better tools and work automatically. Digital Percolation Meters in the study are

designed to facilitate their use as soil remapping devices so they can be used as a tool to assist in the measurement of absorption numbers in the field and automatically. The result of digital percolation is read on the monitor screen. Digital Percolation Meter is a new tool that has not existed so far.

Research conducted by san ming ke and hau Ding Ku in 2012 under the title "Research on percolation model and criticality of seismicity" has developed analog percolation technique to transmit time monitoring information still using stopwatch. The system only monitors water absorption and records it manually only. [2]

Subsequent research was conducted by [1] made a study entitled "EPA research options for low-percolation sites" that led to a percolation system on slowly groundwater soil with manual monitoring. This system will monitor percolation continuously to monitor the movement of the soil with slow percolation. [3]

By looking at other percolation system opportunities that have been further developed by Legger researchers in 2014 taking a research entitled "Percolation and Universal Scaling in Composite Infiltration Processing" introduced a percolation system to perform universal data analysis. Two devices are used into the ground area to create a percolation system. [4]

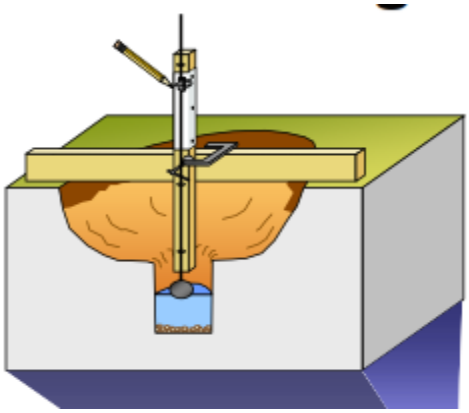

Fig.1 Manual Percolation

With the limitations on the percolation system that is only developed manually on one time monitoring alone, then in this study, researchers will make a Digital Percolation Meter. Digital percolation meter can detect soil absorption in real time and send information to microcontroller system. Digital Percolation meter not only monitors the conditions of the recharge time but also gives a decision when the system should stop so that the time of soil absorption can be known with certainty.

MATERIALS & METHODS

The percolation process is the process of moving water through the soil profile due to gravitational forces. Calculation of time data to calculate automatically when water starts to drop digitally using arduino microcontroller system. Arduino Uno is a microcontroller based board on ATmega328. Arduino Uno is built from every component needed to support the function of a microcontroller. Arduiono microcontroller system uses two sensors. This first sensor is used to set the start time to be calculated when the water starts to drop from the starting point until the time will stop at the last point indicated on the second sensor when the water has decreased. The sensor will detect the movement of water into the ground through the cracks and pores of the soil and rocks towards the groundwater level. When the second sensor then the water can move due to capillary action or water can move vertically or horizontally below the soil surface until the water reenter the surface water system see in figure 2.

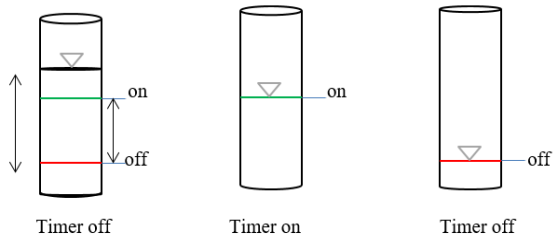

Fig.2 Digital Percolation Design

The experiment was carried out in a location to be used as a recharge area by making 6 holes with a diameter of 10 - 30 cm or a

cube with a side of 10 - 30 cm as deep as 60 cm with a distance between holes 100 cm as shown in the figure 3.

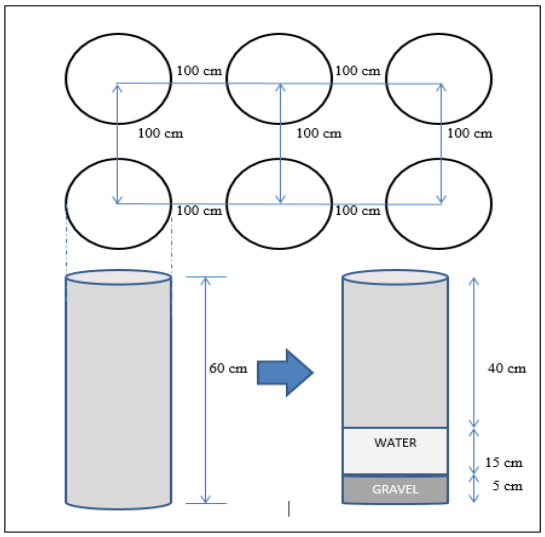

Fig.3 Top View Design

The decrease of water in the test hole after 12 - 24 hours of water baiting remains, then the water level is increased to 15 cm above the surface of the gravel and then calculated the time required to absorb water 1 inch up to the last experiment, since the last result is used as reference Determination of the amount of absorption rate.

Benefits of percolation research of digital meters as soil catchers can be used to measure soil absorption values in the field. In addition to measuring soil recharge rates it also makes it easier for construction workers to determine the value of soil recharge to be constructed. This soil recharge value is used as one of the decisions to establish a building.

RESULT

The water level circuit design uses infrared and Photodiode modules that use standard infrared protocols and a voltage requirement of 3.3 V. Photodioda is an easy-to-use SPP (Serial Port Protocol) module for serial wireless communications converting serial port to Bluetooth. Infrared uses bluetooth modulation V2.0 + EDR (Enchanced Data Rate) 3 Mbps by utilizing radio wave frequency 2,4 GHz.

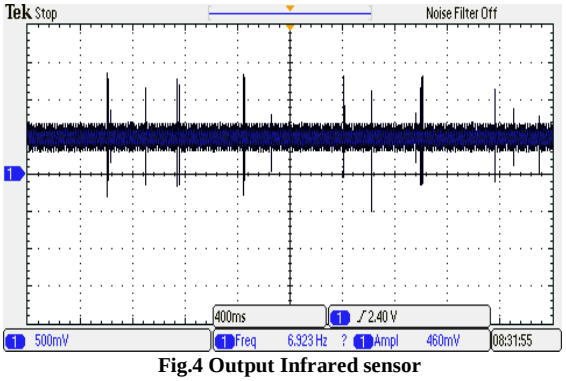

Fig.4 Output Infrared sensor

The signal conditioning circuit is output after the capacitor. The output signal after the capacitor is at the ground point, because the signal has passed the high pass filter circuit and passed through the capacitor. The function of the high pass filter circuit is to pass the frequency above the cut off frequency (0.7 Hz) and suppress the amplitude of the frequency below the cut off. The function of the capacitor is to hold DC signals (DC blocking), so that the DC voltage that appears along with the censorship results can be suppressed. Output that comes out of the sensor still can not be determined results of infrared censorship, it needs to be strengthened in order to be legible.

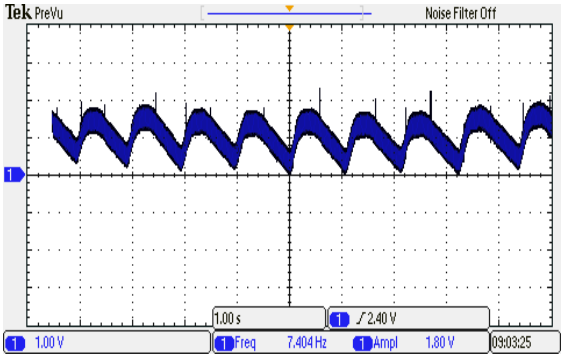

Fig.5 Amplified Output Infrared

Notch Filter circuit module is a filter that has characteristics will hold the signal with a frequency corresponding to the cut off frequency of the circuit and will pass signal with frequency outside the cut off frequency of the filter circuit either below or above the cut off frequency of the filter circuit

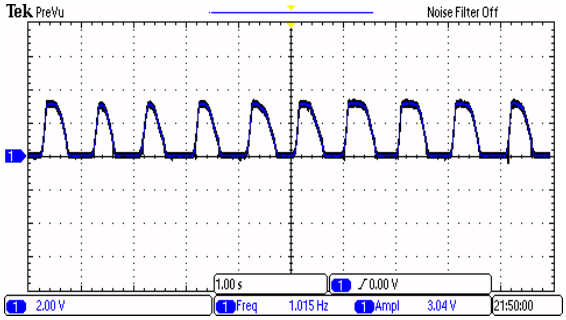

Fig.6 Notch Filter Output

Software design Serial data transmission. Serial data transmission is used to see if the data transmission speed capability can match the connected hardware. This affects the results of sending data serially. Software design for data transmission is as follows

```
Void setup(){
Serial.begin(9600);
}
Void loop(){
Serial.print("A");
Serial.print(sensors.getTempCByIndex(0));
Serial.print("B");
Serial.print(Sensors);
Serial.print("C");
delay(500);}
```

To use the serial communication function it must initialize first that the default serial starts with baudrate 9600 on the Rx / PD0 and Tx / PD1 pins by adding the script; Serial.begin (9600); To transmit data is used function Serial.print () / transmit data on pin Tx / PD1 microcontroller to Rx Bluetooth and to receive data using Serial.read () / receive data from Tx bluetooth pin to Rx / PD0 microcontroller. With the amplitude still difficult to comparator then the signal is reinforced to be more sensitive.

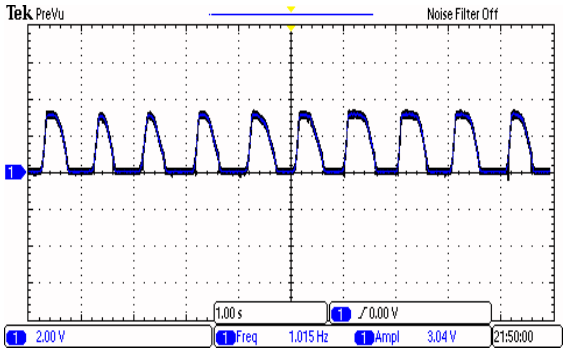

Fig.6 FFT Soleus Muscle in 3 Cm heel

Data Reception software design Creating a connection path with Input Stream to insert or store data in byte data. Input Stream function of entering the received byte data through bluetooth. Mm Input Stream as a variable that will later to accommodate data from tmp In. The connection path using the bluetooth device is declared with the Bluetooth Socket function. TmpIn (Input Stream tmp In = null) is a variable from Input Stream to set the path of tehubungnya sensor device to receive byte data. TmpIn (tmpIn = socket. get Input Stream ()) will be used as a temporary device to get / hold the byte data that has been entered on Input Stream.

If there is already data or value, then the data in tmp In will be stored on mm In Stream variable that has been specified above (mm In Stream = tmp In) to be processed in processing convert data byte into data string for data can be displayed

```
public void run() {
byte[] buffer = new byte[256];
int bytes;
while (true) {
try {
bytes = mmInStream.read(buffer);
String readMessage = new String(buffer, 0, bytes);
bluetoothIn.obtainMessage(handlerState, bytes, -1,
readMessage).sendToTarget();
} catch (IOException e) {

break;} }}
```

DISCUSSION

Analysis percolation meter research uses two water level sensors that are level sensors to initiate calculations and level sensors for stopping water levels. The Water Level Sensor starts this calculation which will then read the initial time value of the existing water level. Excess use of infrared water level sensor and Photo dioda is a small form with a high level of accuracy. Additional circuit using SMD chips. These chips are selected because they have several advantages such as the form of a small chip, lightweight, low power.

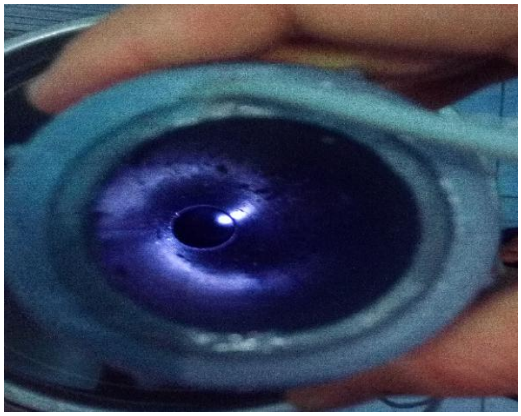

Fig.7 Top View Percolation Digital

The stopwatch is used as a standard Gold on the water reduction from the top-level sensor to the lower-level sensor on the digital meter percolation system. The data will be compared between the data received in the module display with the data transmitted to the microcontroller. At the same time data is also viewed using Stopwatch.

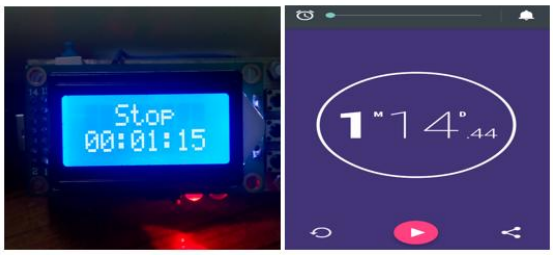

Fig.8 Data Time Compare With Stopwatch

Testing data delivery time (ON) at different levels of recharge levels conducted at a height of 1 inch level, 3 inch and 5 inch, the researchers put the initial sensor at the top. Then the timing results compared to using stopwatch as gold standard. The results of time data transmission can be seen in the table 1.

Table.1 Set Data Time On Condition

Test Data ON	Level 5 inch	Level 3 inch	Level 1 inch
Stop watch (GS)	50	50	50
Data Time On	50	50	49
True Positif	50	50	49
False Negatif	0	0	1
False Positif	0	0	0
Sensitivitas (%)	100	100	98

From the results of table 1 it appears that the sensitivity at Level 5 inch is worth 100%, then after the level is lowered to 3 inch the sensitivity value remains 100%. At the water level lowered to 1 inch the sensitivity value drops to 98%.

Table.2 Set Data Time Off Condition

Test Data Off	Level 5 inch	Level 3 inch	Level 1 inch
Stop watch (GS)	50	50	50
Data Time On	49	48	46
True Positif	49	48	46
False Negatif	1	1	3
False Positif	0	1	1
Sensitivitas (%)	98	96	92

Table 2 shows that the sensitivity of lower level sensor at 5 inch level is 98%, then after the distance is lowered to 3 inch the sensitivity value decreases to 96%. At a distance lowered to 1 inch the sensitivity value drops to 92%.

CONCLUSION

Design Digital Percolation Meter has been tested began to recharge using water-level sensor infrared-photodiode to detect any changes in water level in the recharge tube. Performance is reviewed by looking at the ability of a digital meter percolation system to be able to start calculating the time sent to the microcontroller system appropriately. The sensitivity is indicated by the ability of the program to display the data start time recharge and its changes because of the decrease of water level in the recharge tube. The program averages 99% that the on time data can be sent and received by the digital percolation system well. The average program is 95.4% that the off time data can be sent and received by the digital percolation system well.

RECOMMENDATION

The soil percolation test is still the most practical way to obtain a quantitative indication of the hydraulic conductivity of the subsoil. As such, it will remain a significant aspect of overall site and soil assessment practices into the foreseeable future. Thus, the ability to perform a percolation test in a manner that provides accurate and repeatable results is of paramount importance for any person engaged in the practice of evaluating soils

and sites for future construction or development.

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