



Kitchen Wastewater Treatment Using an Aerobic Process

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ABSTRACT

Water is one of the vital natural resources. Without the availability of water, there is no life on the earth. An increase in the developmentalism generation of wastewater increased rapidly and some countries presently facing problems of water scarcity. Therefore reuse of that wastewater is essential for today's lifestyle. Wastewater treatment has gained importance worldwide so the application of appropriate wastewater treatment technologies that are effective, low cost, and simple to operate is a key component in any strategy aimed at increasing the coverage of wastewater treatment. Grey water is wastewater from urban areas including kitchens that require proper treatment of wastewater before using it for irrigation purposes. According to a study, 80-90% of kitchen wastewater can be recycled using different processes.

Keywords: Last Mile Delivery, India, Logistics, E-Commerce, Customer Satisfaction

1. Introduction

There are two types of processes for wastewater treatment. First is anaerobic and another one aerobic. Here in this project, we are going to use an aerobic treatment to recycle wastewater. Also, we are measuring the quality of water at different stages and that data is seen on the Blynk app. Depending on the quality of water we can use this water for Gardening, Car washing, Flushing, etc. This project consists of various sensors such as the pH sensor, turbidity sensor, level sensor which are interfaced with Node MCU through Arduino.

In our project, we are using solenoid valves for controlling the flow of the water from one tank to another. Hence the treatment of waste material is so important to reuse that water for various sectors like car washing, gardening, and flushing, etc. In our house, there are liters of wastewater going to direct drainage and can't be usable. So that wastewater is needed to be recycled and reused. Wastewater will be processed indifferent treatment and when it passes from various treatments we are checking the quality of that water using a pH sensor, turbidity sensor, and output of the sensors will be sent to the node MCU with the help of Arduino and show on blynk app in a real-time basis.

2. Review of Literature:

In wastewater treatment, two primary types of processes are aerobic and anaerobic. The most common wastewater treatment and reuse system currently in many locations is the aerated wastewater treatment system. According to study aerobic and anaerobic wastewater treatment help prevent waterborne diseases and improve the biological water quality, which is necessary for a population's overall health. One key difference between aerobic and anaerobic wastewater treatment is the process in which the treatment mechanisms work. In the aerobic process, the air is circulated during treatment to cause bacteria that break down waste within the wastewater. Electricity also is used throughout the process. In some systems may use a pre-treatment process that reduces solids that aerobic bacteria may have difficulty compressing. The Aerobic process Bacteria in sewage treatment feed on the water, which is mixed with air. The Bacteria reproduce several times and continue to attack the waste, with some waste settling on the bottom of the water as sludge. This sludge may be pumped out of the system software that the system is not clogged. A disinfectant may be used at the final stage, possibly along with a filtering process and water quality during anaerobic wastewater treatment uses anaerobic bacteria that change organic matter into organisms that contain large quantities of methane gas and carbon dioxide. Income Systems, sometimes this process is used as a pre-treatment for aerobic wastewater treatment.

- I. pH sensor-It is an electromechanical device that basically measures the quality of water- based on hydrogen-ion activity in water. The alkaline solution ha

- II. Turbidity sensor - The turbidity sensor is used to measure the contamination present in water with the help of light. Light scattered by the suspended particles in the water and reflects back. There are NTU i.e. Nephelometric Turbidity units which can determine the water contamination.

According to the Bureau of Indian Standards (BIS), specifications for water (BIS-10500- 1991) are:

pH value : 6.5 to 8.5 Turbidity: 1 NTU (Ideally)

5 NTU (max)

- III. Ultrasonic Sensor -As the name indicates ultrasonic or level sensors measure distance by using ultrasonic waves. The sensor transmits ultrasonic waves and receives the wave reflected from the target. An ultrasonic sensor measures the distance to the target by measuring the time between the emission and reception.

3. Working

This section explains the complete block diagram of the proposed system. The overall block diagram of the system is shown in the above fig. This system consists of primary storage and settling tank, a charcoal and sand filter tank, alum process tank for the recycling procedure. For continuous measurement of different types of concentrations in the water, we placed different sensors such as a pH sensor, turbidity sensor. These sensors are connected to the Node MCU controller. It receives the sensor values from the Arduino controller and displays them on the Blynk app. There are solenoid valves for controlling the flow of water for a certain time between the main storage tank and the primary settling tank concerning the concentration of the particles in the final usable water tank the water will be used for the different applications.

The primary storage and settling tank has a partition that acts as a trap to solid food particles and oil molecules before the wastewater flows to the next charcoal and sand filter tank. Oil in primary storage and settling tank that allows wastewater to slow down long enough to let the

oil float to the top. When the primary storage tank gets full the outlet valve for floating oil gets open and it will remain open until a certain level occurs or below the outlet valve. As soon as the first upper-level valve gets turned off the bottom level second valve will get on and water will flow from the primary storage tank to the charcoal /sand filter. Then water will flow to the alum process which is the first filter for the further process but the alum process valve which will add alum in the tank is open only if the alum process tank gets full. In this system, we are using charcoal and sand filters and alum processes to disinfect water. Depending on the pre- decided pH and turbidity values water will be used for different applications. This project focuses on the development of a system for the treatment of kitchen wastewater for reuse.

Filtration is going to be done using mechanical or physical operation which is used for the separation of solids from fluids by intervening a medium through which only the fluid can pass.

- Primary Treatment: In this stage, raw sewage is screened to remove hard food particles. The primary treatment section where the water is stored in a large tank called a pre-settling tank which helps to settle sludge at the bottom and the oil rises to the surface. The sludge is scooped out of the tank from below the outlet and oil is also removed by removing some upper-level water
- Secondary Treatment: Clarified water is filtered through charcoal and sand filters to remove any remaining suspended impurities. A dual media filter consists of a layer of anthracite above a layer of fine sand. The upper layer of coal traps most of the massive floc, and the finer sand grains in the lower layer trap smaller impurities.
- Tertiary Treatment: Finally for purifying and disinfecting water more alum process is used. This tertiary treated water is then pumped into a dedicated set of storage tanks from where it is used for car washing and gardening regarding pH and turbidity of water. After this, if the pH will be between 8 to 9 then the first valve at the final outlet will get open for car washing purposes else if the pH is between 5.5 to 5.7 then the second outlet valve will get open flushing purpose or gardening.

4. Relay mechanism

A relay switch circuit has a coil driven by an NPN transistor. When node MCU will send the signal from the GPIO pin then the voltage will appear at the base of the NPN transistor and the coil of the relay will get energized so normally open connection will get closed and normally closed connection will get open and the transistor act as a closed switch. And cut the 5v supply and get connected to the 12v which is coming from the adapter. When 12v supply gets to the solenoid valve then it will be in ON condition. If the base voltage of the transistor is zero the transistor acts as an open switch and the relay coil will be de-energized and it's coming to the original position and the solenoid valve will be off.

5. Tools used

pH sensor It is an electromechanical device that basically measures the quality of water-based on hydrogen-ion and hydroxyl ion present in solution. The alkaline solution has less hydrogen concentration than the acidic solution. So probes of pH sensor measure pH by measuring the voltage or potential difference of the water which dripped into. There is a standard table to identify what type of water it is from the range of pH mention in that. The pH

value of the solution ranges from 1 to 14. A pH of 7 represents neutral conditions, while pH values greater than 7 indicate basic conditions, and pH values less than 7 indicate acidic conditions. The pH of most natural waters is between 6.0 and 8.5. Because pH calculated as the negative logarithm of the hydrogen ion concentration, one pH unit represents a tenfold difference in hydrogen ion concentration i.e. pH 6 is ten times less acidic than pH 5.

The pH sensor used here measures the difference in electrical potential between a pH electrode and the reference electrode. The change in potential difference among the electrodes defines acidity and alkalinity/basicity of the solution. This kind of pH sensor can be used in various applications ranging from laboratory experimentation to quality control. The pH probe consists of the electrode, glass membrane, and housing. BNC connector is connected to the pH circuit and circuit into any analog input on the microcontroller to read pH value easily.

Turbidity sensor Turbidity is a measure based on the degree to which the water loses its transparency and quality due to the presence of suspended particles in water. Turbidity is considered as an optical property of water and hence optical devices are used for determining turbidity. Turbidity is measured in NTU (Nephelometric turbidity unit). According to the amount of light received or scattered turbidity is measured. When the suspended solid amount increases the water turbidity level increases. The material which causes water to be turbid includes clay, finely divided inorganic and organic matter, soluble colored organic compounds and plankton, and other microscopic organisms. Turbidity sensors are used in river and stream gaging, Effluent measurements in ponds, wastewater, and control instrumentation for settling ponds, sediment research, and various laboratory measurements.

Turbidity probe as made up of plastic covered circuit. Inside the housing, it contains a probe circuit which includes a photo emitting diode and phototransistor which receives the light. It is made waterproof so that the water does not move inside the housing the amount of light received determines the turbidity of water. As the particles in the water increases, the amount of light transmitted decreases, which helps us to measure the amount of turbidity in water.

Node MCU ESP8266 Controller Node MCU ESP8266 is an open-source platform and node MCU development kit /board consist of an ESP8266 Wi-Fi-enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. Node MCU development kit has analog and digital pins on its board available. It supports protocols like UART, SPI, and I2C, etc. It has a single analog input pin available on the kit.

Features of Node MCU are as follows:

- Open-source
- Interactive
- Programmable
- Low cost
- Simple
- Wi-Fi enabled
- USB TTL included
- Plug and play

Solenoid valve

The valve is an electromechanical device in which the solenoids coil which operates electronically with DC 12 volt supply. Electric current is used to generate a magnetic field and thereby coil is energized which regulates the opening of fluid or gas flow in a valve. Depending upon which electric current they used Solenoid valves differ in the characteristics, and also the strength of the magnetic field they generate, or the what type of mechanism they are used to regulate the fluids and the type and characteristics of fluid they control. The Mechanism varies from linear action, and depends on the actuators are they used. Solenoid valves are frequently used to control the flow of liquids or gas. Solenoids offer fast and safe switching, more reliable, low control power, and compact design.

Arduino Nano microcontroller Arduino Nano is a small, compatible, flexible Microcontroller board developed by Arduino.cc uses ATmega328p. It is almost similar to Arduino UNO but quite small in size. It has an operating voltage of 5V. Arduino Nano has 30 Pins. Each of these Digital & Analog Pins has multiple functions but their main function is to be configured as input or output. This pin acts as input pins when they are interfaced with sensors but if we are driving some load then it will act as an output pin. Arduino Nano has a crystal oscillator of frequency 16 MHz This board does not use standard USB for connection with a computer but it comes with Mini USB support. Atmega328controller comes with a flash memory of 32KB and 2KB of memory out of total flash memory is used for a bootloader

Ultrasonic ranging module HC-SR04 Ultrasonic or level sensors measure distance by transmitting ultrasonic waves. The sensor transmits ultrasonic waves and receives the wave reflected from the object. An ultrasonic sensor measures the distance to the object or obstacles by measuring the time between the transmitting waves and receiving waves. The module includes ultrasonic transmitters, receivers, and a control circuit. The basic principle of work: It sends an ultrasonic pulse out at 40 kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated.

6. Blynk app

Blynk is a Platform with IOS and Android apps to control Arduino, Raspberry Pi, node MCU, and the likes over the Internet. Features of Blynk app:

- Similar API & UI for all supported hardware & devices
- Connection to the cloud using: Wi-Fi, Bluetooth and BLE, Ethernet, USB (Serial), GSM
- Set of easy-to-use Widgets
- Direct pin manipulation with no code writing
- Easy to integrate and add new functionality using virtual pins

Blynk App - Allows us to create amazing interfaces for our projects using various widgets we provide.

Blynk Server - Possible the communications between the smartphone and hardware. We can use the Blynk Cloud or run our private blynk server locally. It is open-source, could easily handle thousands of devices.

Blynk Libraries - It can enables communication with the server and process all the incoming and outgoing commands.

7. Application

Building kitchens: Sewage water from buildings kitchens basin water directly goes to drainage so that this system attaches to the kitchen's basin pipe for filtering that water and reuses it for various purposes.

In this way, we reduce the wastage of water in the previous manner which not only helps to reduce the scarcity of water but also will help to prevent the environment.

Hotel canteens: In the canteen also that system can be used for recycling wastewater that goes out from the canteen pipe and reduces the wastage of water.

In schools, offices, colleges' people washed tiffins into the basin where the water goes out from the pipe directly into the sewer without recycling. This system is also attached to the pipe and recycles that water for various purposes.

8. Conclusion

The design of a low-cost reliable system "Kitchen Waste Water Treatment Using Aerobic Process" is presented. Due to increasing urbanization wastewater recycling system will help to reduce the effect of scarcity water in the future. The Proposed System Consist Of a pH sensor, Turbidity, level sensor for checking and continuously monitoring the quality of water at the primary and tertiary stages, and a solenoid valve will control the flow of water. The major advantage of this system is not only monitoring the quality of water but it is recycling the water using charcoal filtration tank and alum processing. This system also shows the real-time data of the quality of water on the Blynk app due to which necessary action will be taken required.

The final application of Recycled water can be used for purposes like gardening, flushing toilets, cleaning cars. This monitoring and Recycling process can be performed in various places like Household kitchens, schools, offices, colleges, Hotels, etc. In the future, we can include biological sensors for better detection of contaminants in water.

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