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Advanced Method For Sewage Water Treatment

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Abstract **-** Sewage is waste water carrying wastes removed from residences, institutions, and commercial and industrial establishments, together with such groundwater, surface water, and storm water as may be present. It is more than 99.9% pure water and is characterized by its volume or rate of flow its physical condition, its chemical constituents, and the bacteriological organisms that it contains.

Increasing volumes of domestic, hospital and industrial wastewater are being produced in cities around the world. Cities in developing countries lack resources to treat wastewater before disposal. Even where expensive wastewater treatment plants are installed, only a small percentage of the total wastewater volume is treated before discharge resulting in rivers, lakes and aquifers becoming severely contaminated. So there is great need to treat waste water.

We can treat such water by various methods. The contaminants in wastewater are removed by physical, chemical, and biological means. The individual methods usually are classified as physical unit operations, chemical unit processes, and biological unit processes, Although these operations and processes occur in a variety of combinations in treatment systems, it has been found advantageous to study their scientific basis separately because the principles involved do not change.

We can achieve desire results with the help of PLC. Using PLC we want to develop an automated continuous process system for treating the waste water. Though the process seems to be simple but degree of automation is higher for proper operation of a system. In this paper we are discussing how we are going to develop this system, what is the basic theme of this system and how our ideas will be applicable to the theme. We have designed a control system particularly a batch process.

1. INTRODUCTION

1.1 Sewage: It is essentially the water supply of the community after it has been fouled by a variety of uses. From the standpoint of sources of generation, waste water may be defined as a combination of the liquid (or water) carrying wastes removed from residences, institutions, and commercial and industrial establishments, together with such groundwater, surface water, and storm water as may be present. Sewage is water-carried wastes, in either solution or suspension that is intended to flow away from a community. Also known as waste water flows, sewage is the used water supply of the community. It is more than 99.9% pure water and is characterized by its volume or rate of flow its physical condition, its chemical constituents, and the bacteriological organisms that it contains. Depending on their origin, waste water can be classed as sanitary, commercial, industrial, agricultural or surface runoff.

1.2 Need of sewage water treatment:

Increasing volumes of domestic, hospital and industrial wastewater are being produced in cities around the world. Cities in developing countries lack resources to treat wastewater before disposal. Institutional support and legislation for pollution control is weak. Even where expensive wastewater treatment plants are installed, only a small percentage of the total wastewater volume is treated before discharge resulting in rivers, lakes and aquifers becoming severely contaminated. Only 4000 of 17,600 MLD waste water generated in India is treated. Approximately 30,000 MLD of pollutants enter India's rivers, 10,000 million liters from industrial units alone.

According to the Central Pollution Control Board (CPCB), 16,000 MLD of wastewater is generated from class 1 cities (population > 100,000), and 1600 MLD from class 2 cities (population 50,000 - 100,000). Of the 45,000 km length of Indian rivers, 6,000 km have a bio-oxygen demand (BOD) above 3mg/l (milligrams per liters), making the water unfit for drinking. Wastewater treatment involves breakdown of complex organic compounds in the wastewater into simpler compounds that are stable and nuisance-free, either physico-chemically and/or by using micro-organisms (biological treatment).

1.3 Unit Operations in Sewage Treatment

The contaminants in wastewater are removed by physical, chemical, and biological means.

1.3.PhysicalOperations: Among the first treatment methods used were physical unit operations, in which physical forces are applied to remove contaminants. Today, they still form the basis of most process flow systems for wastewater treatment. Some of the basic physical operations are given below: Screening, Comminuting, Flow equalization, Sedimentation etc.

1.5.2 Chemical Operations: Treatment methods in which the removal or conversion of contaminants is brought about by the additions of chemicals or by other chemical reactions are known as chemical unit processes. Precipitation and adsorption are the most common examples used in wastewater treatment. In Chemical precipitation, treatment is accomplished by producing a chemical precipitate that will settle..

1.5.3BiologicalOperations:

Treatment methods in which the removal of contaminants is brought about by biological activity are known as biological unit processes. Biological treatment is used primarily to remove the biodegradable organic substances (colloidal or dissolved) in wastewater. Basically, these substances are converted into gases that can escape to the atmosphere and into biological cell tissue that can be removed by settling. Biological treatment is also used to remove nutrients (nitrogen and phosphorus) in wastewater.

2. LITERATURE SURVEY

Before the late 1800s, the general means of disposing human excrement was the outdoor privy while the major proportion of the population used to go for open defecation. Sewage treatment systems were introduced in cities after Louis Pasteur and other scientists showed that sewage born bacteria were responsible for many infectious diseases. The Early attempts, in the 900s, at treating sewage usually consisted of acquiring large farms and spreading the sewage over the land, where it decayed under the action of micro-organisms. It was soon found that the land became 'sick'. Later attempts included the discharge of wastewater directly into the water bodies, but it resulted in significant deterioration of the water quality of such bodies. These attempts relied heavily on the self-cleansing capacities of land and water bodies and it was soon realized that nature couldn't act as an indefinite sink.

In general from about 1900 to the early 1970s treatment objectives were concerned with:-

1. The removal of suspended and floatable material from wastewater.
2. The treatment of biodegradable organics (BOD removal).
3. The elimination of disease-causing pathogenic micro-organisms

The CWA requires that municipal wastewater treatment plant discharges meet a minimum of 'secondary treatment'. Over 30 percent of the wastewater treatment facilities today produce cleaner discharges by providing even greater levels of treatment than secondary.

3: HARDWARE DETAILS

3.1 Introduction

In sewage treatment we are using different process. Neutralization process is heart of our project. Here we are using 4 tanks, 8 solenoid switches and 7 level switches which will help to control the flow of treated and untreated water. For Neutralization process we are using one acid and base tank whose flow will be control with the help of fine valve.-Sewage treatment is a continuous process based on PLC. It includes four process which are given below in brief:-

3.1.1 Screening: As per P&I diagram, reservoir tank is the source of sewage. So with the help of pump, sewage fluid is pumped into tank 1. Tank1 is provided with LH1 (Level High) & LL1 (Level Low) switches. As soon as high level is reached, LH1 is switched off through controller. After some delay, SV1 (Solenoid Valve) is opened through which the sewage water from tank 1 is allowed to flow in tank2. Here we are using iron net which is use to eliminate small solid particles, plastics, covers etc. from sewage water. In this process water is allow to stay for some time.

3.1.2Sedimentation

As soon as sufficient water from tank 1 is taken in the tank 2 i.e. up to LH2 SV1 will close. Here we are using stirrer which is operating on motor. This stirrer is moving very slowly at the top of the water in order to collect all the floating solids which is not removed in screening process. Here it slows down and the suspended solids gradually sink to the bottom. This mass of solids is called primary sludge. Various methods have been devised to remove primary sludge from the tanks. As water remains in the tank for some time sludge get settle down at the bottom of the tank. After some time SV4 get open and settled sludge is taken to the drain. After a certain delay SV3 get open and Water goes into Tank3.

3.1.3 Chlorination:

Water from tank comes into tank 3 through SV2. In tank 3, we treat this water by alum and chlorine water. As we can see in the diagram there are two small tanks above the tank3 which contain alum and chlorine, get controlled by SV3 and SV4. As water enters into tank 4 according to the value of the pH of the water, particular amount of alum and chlorine get added into tank. Alum helps to settle the sludge at bottom so water gets clean and chlorine is used as purifying agent which kills the bacteria in the water. As soon as alum and chlorine starts adding stirrer in tank starts rotating. Stirrer is used in order to mix the mixture properly. Stirrer rotates till SV4 is close. Once the SV4 get open Stirrer stops rotating. After certain amount of delay SV5 gets opened and water from tank 3 is transfer into tank 4. As water moves sludge into tank 3 is removed by the manually operated tank. Tank 3 is also provided with limit switches which controls the limit of the tank.

3.1.4 Neutralization:

Separate tank (tank 4) is used to carry out neutralization which is also provided with LH4 & LL4 switches to carry necessary conditions .This is very important process for sewage water . First of all pH of the sewage water is measured with the help of signal conditioning of pH meter and then transmitted to PLC controller so that it can give further control to adjust the pH of sewage water by addition of acid (through SV6) or base (through SV67) to the water coming from tank 2 .While addition of acid or base the stirrer provided in this tank is continuously operated with duty cycle of 5sec .Here as soon as acid or base starts adding in the tank stirrer starts rotating. As level reaches at LL4 stirrer stops rotating. Tolerance Band of 6 to 8 pH is considered as neutral for these process.

3.1.5 Treated Water:

After neutralizing the process fluid the neutralized fluid is transferred to another tank (tank 4) through which it can be used as per domestic applications .Tank 4 which consist of neutralized or treated water is provided with LH4 & LL4 to avoid excess flow of liquid from tank 3.As soon as LH 4 is reached the whole processed is stopped whatever may be the level in tank 3 for safety conditions .SV7 is used for drain out of treated water as per the requirements.

The whole process is controlled through PLC & all SV & level switches are operated through controller.

4. **Software Details:**

4.1 Introduction: Control engineering has evolved over time. In the past humans were the main methods for controlling a system. More recently electricity has been used for control and early electrical control was based on relays. These relays allow power to be switched on and off without a mechanical switch. It is common to use relays to make simple logical control decisions. The development of low cost computer has brought the most recent revolution, the Programmable Logic Controller (PLC). The advent of the PLC began in the 1970s, and has become the most common choice for manufacturing controls. PLCs have been gaining popularity on the factory floor and will probably remain predominant for some time to come. Most of this is because of the advantages they offer. In our system the PLC program is going to control the valve i.e. is amount of acid or base is to be add into treated water. It also controls the positions of all the levels of the different tanks in the process. This will help to control the system smoothly.

4.2 Basic Elements of PLC

PLC mainly consists of a CPU, memory areas and appropriate circuits to receive input/output data. We actually consider the PLC to be a box full hundreds and thousands of relays, counters, timers and data storage locations. They don't physically exist but rather they are simulated and can be considered as software counters, timers, etc. Each components of PLC has specific function.

Languages in PLC

1. Ladder Diagram
2. Functional Block Diagram
3. Structural text
4. Instruction List
5. Sequential functional chart

Of the above five languages we are using the ladder diagram for our programming. A brief description of Ladder diagram is as follows:

Ladder Diagram

The **ladder diagram** has and continues to be the traditional way of representing electrical sequences of operations. These diagrams represent the interconnection of field devices in such a way that the activation, or turning ON, of one device will turn ON another device according to a predetermined sequence

of events. Figure 1-15 illustrates a simple electrical ladder diagram.

4.3 Specification of PLC

(Delta's dvp-10sx11rPLC)

4.3.1 Introduction

- 10I/O points: 4DI+2DO+2AI+2AO
- 2 channel 12 bit analog volt/ current input
- 2 channel 12 bit analog volt/ current output
- Built in 2-digit 7 segment display, corresponding to internal register directly to display PLC station

4.3.2 Function Specification

- Control Method: Stored program, cyclic scan system
- I/O processing method: Continuous processing method
- Execution speed: Basic commands, Application Commands(10~hundred us)
- Program language: Command+ ladder logic+ SFC
- Program capacity: 7920 steps
- Programming port: COM1:RS232,COM2:RS485(Master/slave)
- Built-in RTC

4.3.3 Electrical Specifications

- Power supply voltage: 240V DC
- Fuse: 2A/250V AC
- Power consumption: 5W
- Insulation resistance: <5Mohm at 500v DC(between all I/Os and earth)
- Environment: Operation: 0`-55`C, 50-90% humidity, pollution degree 2: storage: -25 to 75`C (temp), 5-95 humidity: D/A output operation: 0-50`C
- Vibration/Shock Resistance: Standard: ICE1131-2,ICE68-2-6(test FC)/ICE1131-2 and ICE68-2-27(test EA)
- Weight(g):158

4.3.5 I/O Configuration

- Includes expansion module DVP16SP11R
- 12DI/DC24V/5mA Sink or Source
- 2AI: -20~20mA range (-1000~+1000)
- 10DO: 1.5A/1point
- 2AO: -20~20mA range(-2000~+2000).

5. Applications

1. Irrigation
2. Industrial use
3. Recreational uses

.4. Groundwater recharge

5. Potable reuse

6. CONCLUSION

In this paper, we can say that water treatment is not easy as it seems. It has great importance in industries as well as in society. we realize that water treatment processes are very precise and well controlled. Using PLC techniques we can automate the water treatment processes. As we see water is one of the important part of all of us and to use treated water in our daily life is one of the great contribution in saving limited reservoir of water.

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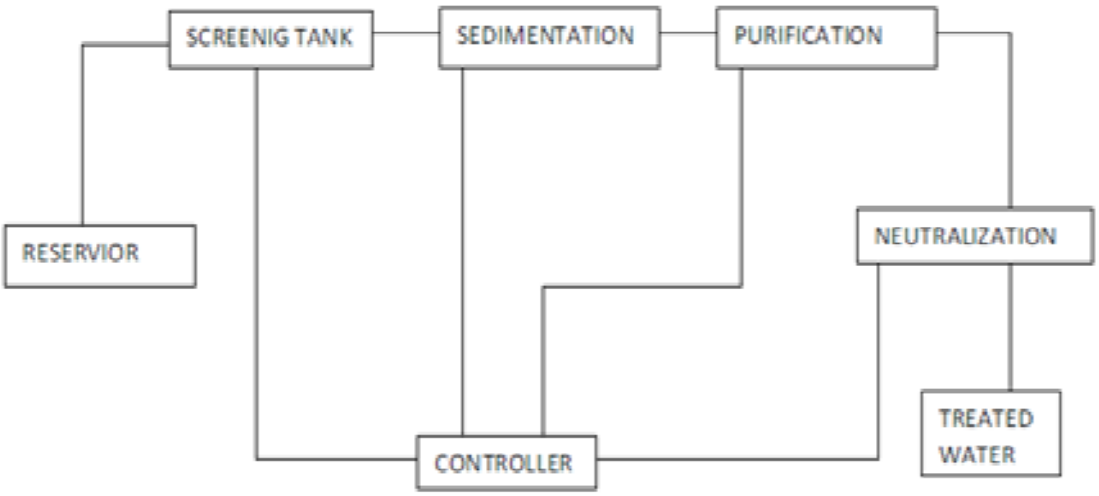
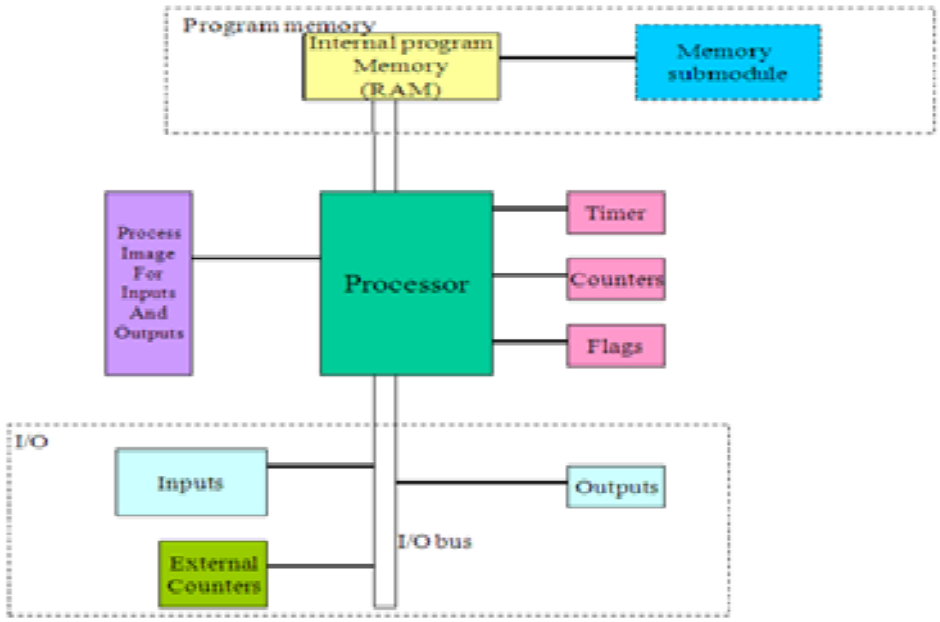


Figure:1 Block diagram of PLC based



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