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Basic Analysis of Waste Water treatment Management System

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Abstract

Water is an essential component for life, it is considered as one of the biggest natural resource on earth, but nowadays this resource is being polluted. When wastes from residential, commercial& industrial processes are sinked into a water source this contaminated water is called waste water. For reusing this waste water there is a need to treat away all the infect ants from the waste water .the treatment process involves increasing the efficiency level of water i.e., automating the control system for operation development, improving management level and high efficiency process in water treatment system. Sometimes the Drainage pipe used for sewage disposal are polluted to a large extend, unfortunately there may be a loss of human while cleaning the blockage in drainage pipes, so there is a need to automate this process to prevent such accidents. Another process in a water treatment plant is packaging the purified water and distributing it for further use all these processes is being automated using the PLC and Scada Designing.

Keywords: Waste, Water, Treatment, Management, System, SCADA, PLC, Automation, Sewage disposal.

1. Introduction

Our project work gives a brief description of Automation systems and its controlling. The word Automation is a amalgamation of two words "auto"(means: self)and "mation"(means: motion),so Automation is the delegation of human control to technical equipments or field equipments to increase the productivity, reliability, safety conditions during working condition, reducing cost etc.Hence, we can say that automation has changed the whole scenario of industries all over the world. Introduction of automation system in Waste water management system have increased the efficiency of the plants and also helped in reducing the errors caused by humans. Thus helped to improve the reliability of the system. Another benefit of automation is that it also saves labor therefore increasing the precision, accuracy and efficiency. The system uses various programmed robots to perform activities in an industry. Various sensors, controllers, indicators, valves are used in the process. Programmable logic controllers are used to control various instruments used. It uses control systems, such as computers or robots and information technologies are used for handling different process machineries in an industry to replace human being, fault occurring anywhere in the system is easily and efficiently displayed on the screen. The fault can be cleared using the computer itself.

Water is one of the most common substances on earth, and one of the most vital; it's a tremendously valuable resource, yet one we squander and pollute prodigiously. Water is deceptive. For while it pours freely from the heavens and seems to flow endlessly in rivers, it's a finite resource; we only have what we have. And although there is about 332,500,000 cubic miles of it on earth – only one-hundredth of one percent of the world's water is readily available for human use. Clean drinking water is a basic human need.). Thus need to efficiently manage the available water resources is the most important problem in front of the Indian government. The use of automated systems like SCADA is an effective way to handle the limited water resources. The use of PLC and SCADA increases the water quality and also it is effective for proper distribution of the water over large area. The use of automated systems continuously monitors and controls the water quality thus it gives precise and desired water quality output.

There are basically two types of Automation:

1. Building Automation.
2. Industrial Automation.

1. Building Automation: It is automatic centralized control of a building's heating, air-conditioning, lighting& other system through a building management system or building automation system (BAS).
2. Indusrial Automation: It is the use of control system, such as computer or robot & machineries in an industry to replace a human being.

The objective for improving the quality standards for safe water in a waste water treatment plant is to ensure that the water supplied is free from pathogenic organisms, clean and clear,

- Copacetic and free from undesirable taste and odor. Turbidity of 1 NTU or less should be achieved.
- Disinfection of the water should be done with at least 0.5 mg/liter of free residual chlorine.

2. SCADA System

It is a system which is an assemblage of computer and communications equipment designed to work together that allows an operator to monitor and control processes that are distributed among various remote sites and provide the necessary data to control processes. SCADA is usually implemented on manufacturing processes, (continuous and discrete manufacturing), treatment processes, (water and wastewater treatment), and distribution systems, (gas, oil and water pipelines). SCADA systems also perform monitoring, data logging, alarming and diagnostic functions so that large, complicated process systems can be operated in a safe manner. The SCADA system controls the sequencing and speed of pumps, and maintains run-time logs for maintenance scheduling. Thus the use of SCADA system for the water supply systems will be a most preeminent solution for the problems in water treatment and distribution systems. The SCADA system has got the following benefits:

Superior control and monitoring of the plant, with ease of access,

(i) Reductions in energy consumption through more efficient usage and shifting of loads to off-peak hours,
(ii) Increased accuracy due to automated controls and online data analysis of parameters,
(iii) Reductions in maintenance and operation efforts and costs, and
(iv) Increases in effective capacity through optimization of processes.

A PLC is a solid state device designed to perform the logic functions previously accomplished by components such as electromechanical relays, switches, mechanical timers/counters etc. For the control and operation of manufacturing process equipments and machinery. Even though the electromechanical relays have served well for generations, often under adverse conditions, the ever increasing sophistications and complexities of modern processing equipments require faster acting, more reliable control functions that electromechanical relays or timing devices cannot offer. Relays have to be hardwired to perform specific function, and when the system requirements change the relay wiring has to be changed or modified. In extreme case, such as in the auto industry, complete control panels has to be changed or replaced since it is not economically feasible to rewire the old panels with each model changeover. The requirement of highly specialized, high speed manufacturing processes created a demand for smaller, faster acting, more reliable, low power consuming,expandable,eliminating much of the hard wiring control devices called PLC's. Richard E,Morley,who was the founder of the Modicon Corporation, invented the first PLC in 1969. PLC's are designed to be operated by plant engineers and maintenance personnel with limited knowledge of computers. Like the computers,PLC also has memory for storing the user program or logic as well as a memory for controlling the operation of a process machine or driven equipment. But unlike the computer, the PLC is Programmed in LADDER LOGIC(A high level, real world, graphic language that is easily understood by engineers). The PLC is also designed to operate in the industrial environment with the wide range of ambient temperature, vibration and humidity and is not usually affected by the electrical noise that is inherent in most industrial locations. Troubleshooting is simplified in most PLCs because they include fault detectors, blown-fuse indicators, input and output status indicators, and written fault information's that can be displayed on the programmer.

3. Architecture of a PLC: A typical PLC can be divided into four components:

1. Processor Unit
2. Power Supply
3. Input /output section
4. Programming device

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The processor is the "**Decision-maker**" or "**Brain**" of the system. The brain is a microprocessor-based system that replaces control relays,counters,timers,sequencers etc. and is designed so that the use can enter the desired program in LADDER LOGIC. The processor then makes all the decisions necessary to carry out the user program based on the status of the inputs and outputs for control of a machine or process. It can also perform arithmetic functions, data manipulations and communication between the local input/output section & remotely located I?O sections.

The power supply is necessary to convert 120 or 240volts AC voltages to the low voltage DC required for the logic circuits of the processor and for internal power required for the I/O modules. The input/output section consists of input modules and output modules(I/O modules). The Number of input and output modules necessary is dictated by the requirements of the equipment that is to be controlled by a PLC.the real world input devices can be push buttons, limit switches, analog sensors, selector switches etc. While the real-world output devices can be hard-wired to coils, solenoid valves, indicator lights, positioning valves etc. plc system generates the functions of relays,timers,counters and so on even though none physically exists.

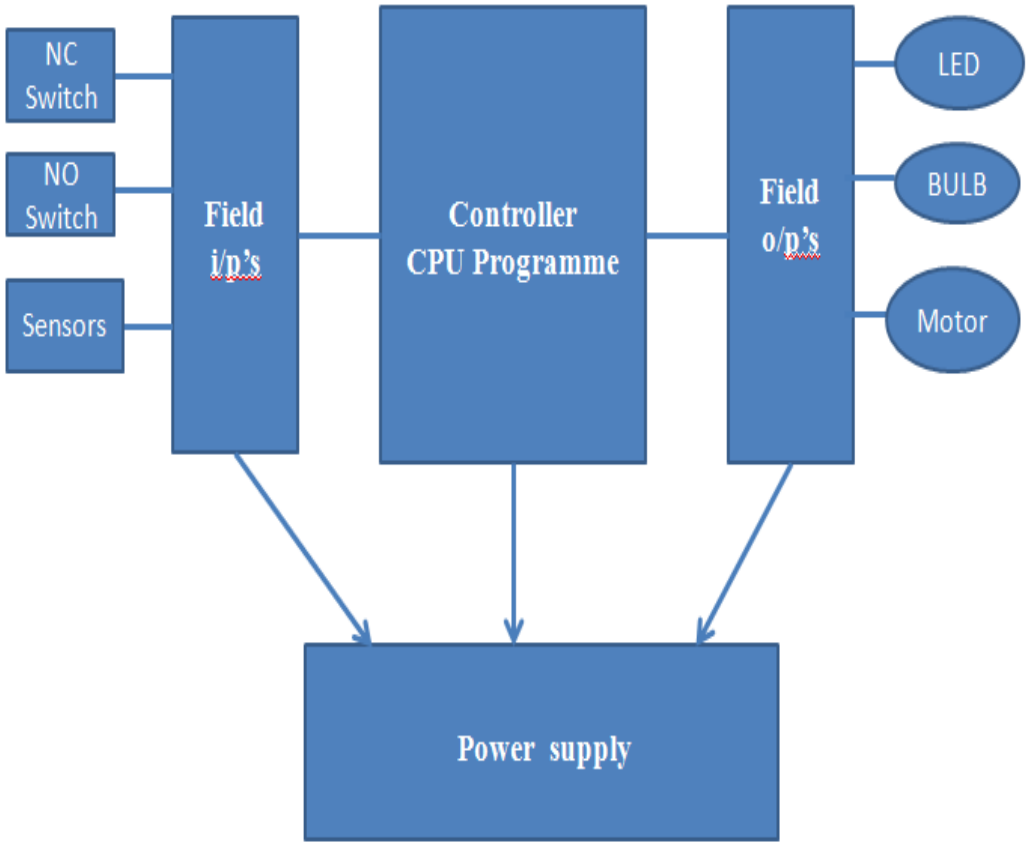

Figure 1: Architecture of PLC

4. SCADA(Supervisory Control and Data Acquisition)

SCADA is mainly use for monitoring function, which is separately designed from PLC which is used for controlling functions .SCADA is applied to WWTMS (Waste Water Treatment Management system) for monitoring and controlling processes that are distributed among various remote sites gives big advantage in terms of control and effective working and also provide the necessary data to control the processes. The automated water treatment and distribution systems will be an effective tool against the water quality and distribution problems. The water purification system needs to be

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efficiently managed and the available water resources must be effectively consumed in India. Use of SCADA system for WTP gives the efficient way to operate it economically and effectively.

4.1. SCADA System Architecture

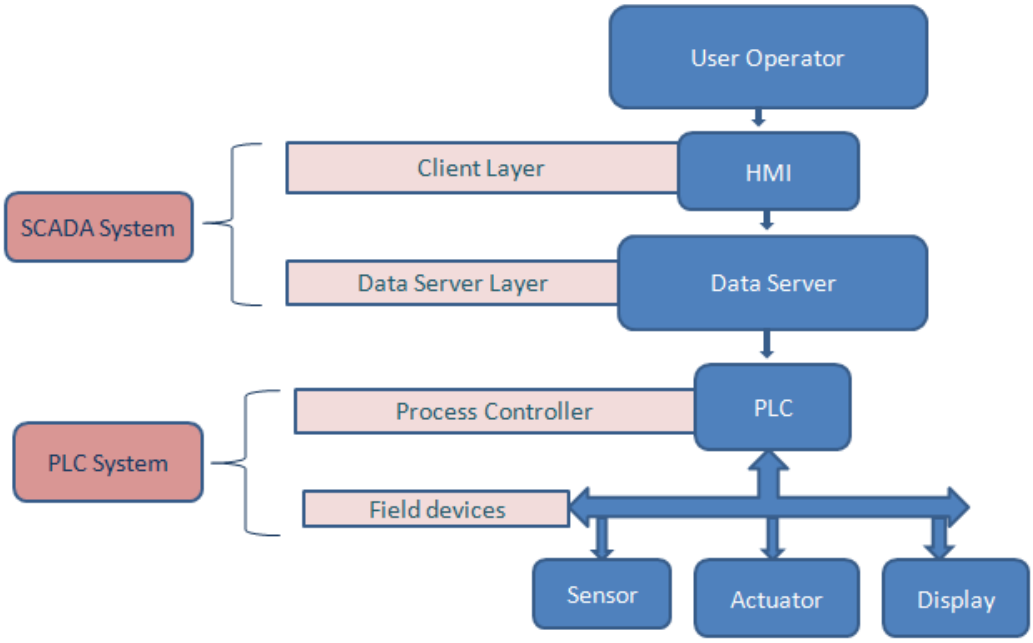

Figure 2: Architecture of SCADA system

4.2. Flow Chart Design of the SCADA System of Waste Water treatment Plant

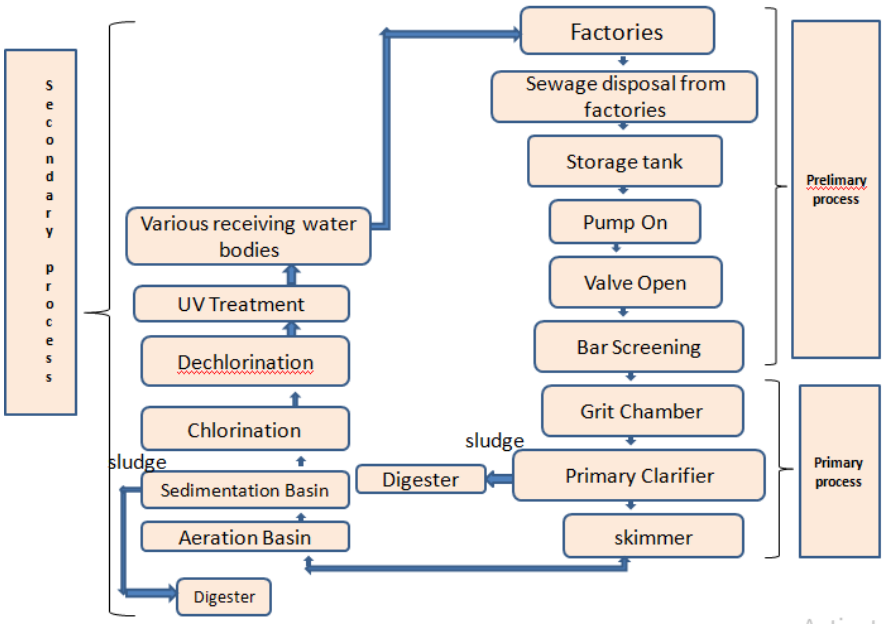

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Figure 3: Flow Chart Design of the SCADA System of Waste Water treatment Plant

5. SCADA System Implementation Of Waste Water Treatment Plant

5.1. Waste Water Treatment Management System

The First process in treatment of waste water is **Bar Screen** .In this Stage raw sewage (influent) is made to pass through Bar Screens. Bar Screens are the metal rods immersed in the incoming flow to separate large objects such as sticks and rags from the water. These objects are removed first because removing these large objects protects pumps and other rotating mechanism. The next process is that after the liquid passes through Bar screen, it enters the large Settling tank known as **Grit Chamber.** The influent flow is slowed down so any heavy solid (such as sand and gravel) that remains settle to the bottom of the basin. The solids that fall to the bottom of the basin are removed from the treatment plant .After processing being done at the grit chamber ,from the grit chamber the liquid is pumped to the another basin called das Primary classifier . Classifier are basically a circular sedimentation basin which allow for the slowing of the waste water so that the heavier organics fall to the bottom .Classifiers are used throughout the waste water treatment process both during primary and secondary treatment ,to let solid and large particles fall out of the waste water .In primary Treatment ,a mechanical process,i.e,the process known as **SKIMMER** .In this process it slowly skims the top of the water to remove the fats ,oils ,and greases that floats to the top of the Skimmer. The Fats, oils and Greases that are removed off the top are the diverted to the Digester. The Solids that fall to the bottom of the basin are removed for further treatment. Depending on the facilities, these solids could be moved to a digester, to a sludge press or to a drying bed .After the fats, oil, and greases have been scrapped off from the top and the organics have settled down the remaining water flows over weirs, moving to the next step in the WWTP.

Weirs collect remaining small particle, skums, greases, floating fats and helps oxygenate the water to help the biological process. Now the treatment process moves further to use biological processes which are referred to as secondary treatment .Since most of the solids have been removed in the primary treatment the waste water is then made to flow on to an **Aeration Basin**. Here air is added to aeration basin to create an environment for benevolent microorganism to grow and continue treating the remaining pollutants in the waste water. These microorganisms continue to consume and treat away the remaining dissolved organic materials in the water .These bugs get their name from the fact that they are so small that you need a microscope to see them. The processes of microbes eating waste products begin in the sewer pipes along the way to the plant .However aeration basin provide the perfect environment for maximum consumption of the organic waste.

The process of using microbes to consume waste in this oxygen rich environment is referred as **Activated Sluge**.

Activated Sludge look like a dared muddy area .it is rich with active(live)microbes; bacteria and protozoan's .The bacteria and protozoan's require oxygen to live and reproduce just like other living organism .The Aeration Basin gives them extra oxygen so that they can grow and consume waste. The food chain is a continuous cycle .in Aeration Basin, the microbes, the "workforce "of a waste water plant, digest and breakdown materials and then die out when their life cycle ends .Since new waste water, carrying new organic materials is added all the time the cycle continues and new microbes are born .When the microbes die their dead bodies stick together in clumps. After leaving the aeration basin the water goes to a **Secondary Clarifier** or **Sedimentation Basin.** A portion of sludge is then sent to the **Digester.** Sluge can be sent to large, heated and enclosed tank called digester. Here, more bacteria break down take place. Reducing volume, orders and getting rid of organisms that can cause diseases .The environment in Digester is Anaerobic (Completely free of dissolved oxygen).The by products are methane gas, ammonia and hydrogen supplied.

In the final step of the secondary treatment process use of chlorine and another disinfectant is done to kill harmful bacteria from the treated waste water .This process is called **Chlorination**. When chlorine gas or liquid chlorine comes in contact with the treated water for a longer period of time it reduces the number of bacteria to a safe level .After this

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Dechlorination process is followed which means effective removal of chlorine. In order to minimize any toxic effect of the disinfectant on organism leaving in the receiving end .Every waste water treatment plant operates in a different way .Depending upon the consumption type. In our project the treated water is then stored and further packaged for customer use. Because of concerns about high chlorine levels in the discharged water, waste water treatment plant nowadays use ultraviolet light as an alternative to using chemical disinfectant. Ultra violet light is a high-intensity light that disinfects waste water in a more environmentally friendly manner. It is a more expensive process because of consumption of electrical power. The function of the UVlight system is to reduce the number of disease causing organisms such as viruses, bacteria, spores, molds, yeast and algae in the effluent prior to discharging it to the receiving water body.

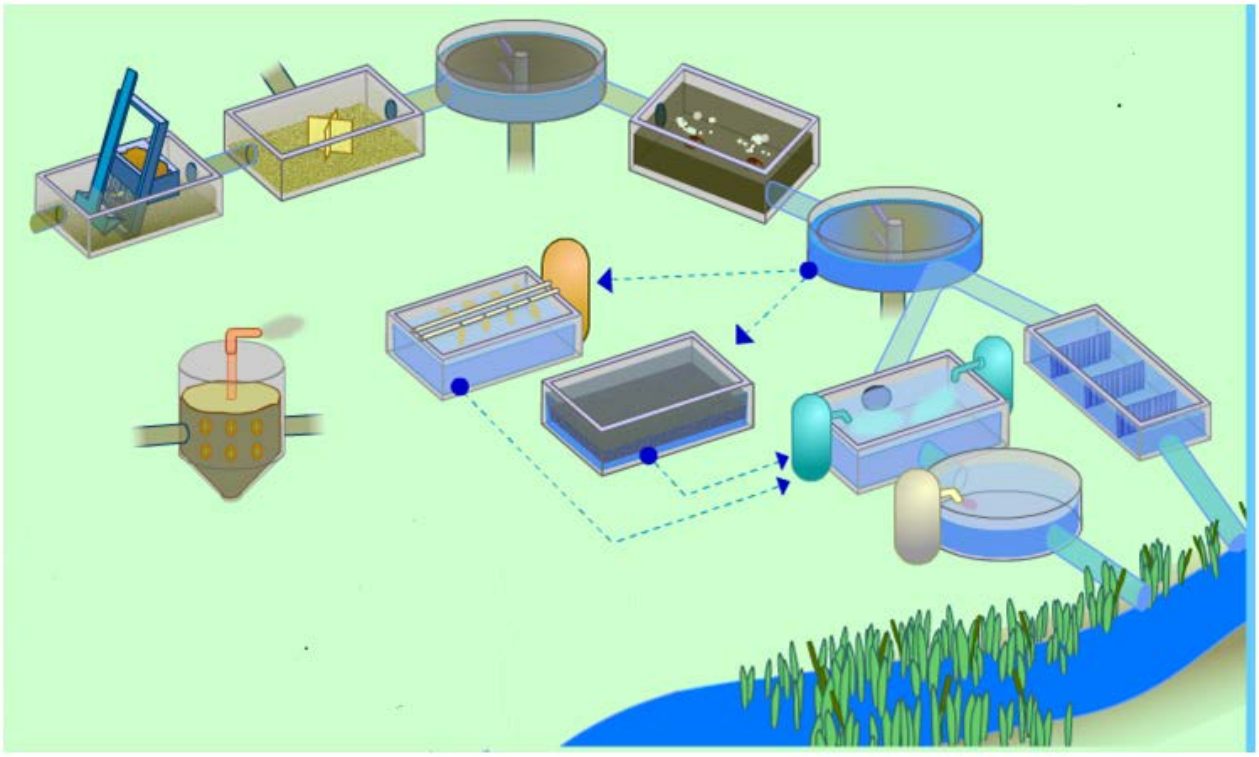

Figure 4: SCADA System Implementation of Waste Water Treatment Plant

Advantage

1. .Automatically monitored and controlled.
2. Require less manpower
3. Feasible
4. Reliable
5. To save precious resource
6. To reduce human error

6. Conclusion

In above proposed method of Waste Water Treatment Management System is a system of treating waste water automatically and since the system is automatically operated it need less man power .Our study on this waste Water management System is basically due to the increasing water pollution which leads to scarcity of the water free from pollutants .So before disposing waste water in river or steams it must be treated before disposing them into the river. Due to the increase in the utilization of water for industrial use and other purposes, the treated water can be used in the industries and can also be utilized for gardening .The treated water can be further treated in a form so that it can be made

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fit for drinking and also for the utilization for the basic needs .Thus by automating the whole process the system can be made reliable, feasible and

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