

PLC Based Apartment Waste Water Filtration System

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ABSTRACT

This research paper is an attempt to develop waste water filtration and recycling system. It uses control system such as plc, microcontroller to control machinery and processes to reduce the need of manpower. A Programmable Logic Controller is a digital computer used for automation of electromechanical processes control of different processes used for manufacturing. A PLC is an example of a real time system because output results must be produced in response to input conditions applied within a specific time. The filtration system is used for filter the waste water that collects from apartment. It consist of MGF, ACF, UF filters. After filtration of waste water the filtered water use again for regular use, garden, bathroom, washing vehicles.

Keywords: PLC (Programmable Logic Controller), MGF (Multigrade filter), ACF (Activated carbon filter), UF (Ultra filter), Recycling system, Automation.

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I. INTRODUCTION

Water is basic necessity of life used for many purposes one of which is industrial use. Industries generally take water from rivers or lakes but they have to pay heavy taxes for that. So it's necessary for them to recycle the water to reduce cost and also conserve it.

Now days in Building or Apartment much of water is being wasted. Water is most important necessity of our life. In kitchens and bathrooms much of water is wasted .Currently in a housing complex Water Saver and reusable systems are not developed and implemented.

There are two forms of living waste water treatments. The first is surrounded by municipal waste water treatment plant pipe network. The living waste water flows into municipal waste water pipe network, and treated by the municipal waste water treatment plant. The second is to construct on-site living waste water treatment facilities for the living waste water unable to flow into the municipal pipe network. After treatment, the water reaches standard and is discharged, or it may be further treated to achieve the purpose of intermediate water reuse.

Using living waste water as water source, after appropriate treatment, the water can be used for miscellaneous purpose. Its quality parameters are between drinking water and drainage, being called intermediate water. The corresponding technology is called intermediate water technology. For lack of fresh water resources, and serious municipal water supply shortage areas, the adoption of intermediate water technology not only saves water resources, but also makes waste water harmless. It is a significant way to prevent water pollution. Our country shall strongly promote this new technology and process at present and for a long time in the future.

2. Literature survey

Piyush R.Panditrao [1] et al.They discuss that the water filtration methods observed in nature &used conventionally for domestic purposes can be combined together & automated using PLC to create a reliable & cost -effective system to get clean usable water. In India most of industries dispose waste water or cleaning water into natural fresh resources such as rivers and lakes.When these resources

saturate, the quality of water will degrade and downstream water is no longer usable without expensive treatments.

Frank D.Petruzella [2] They said that the programmable logic controller is defined as a digital electronic device that uses a programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic words to control machines and processes Here it is controlling the input parameters like Level sensor and output parameters like pump, solenoid valves, dc motor and display. The MicroLogix Programmable Controller contains a power supply, input circuits, output circuits, and a processor.

B. Mulman [3] et al.They presents that the PLC is a combination of electrical, electronic and mechanical section where the software used is Ladder Logic language programming. A Programmable Logic Controller is a digital computer used for automation of electromechanical processes, such as control of machinery in factories, control of amusement rides, or control of different processes used for manufacturing. Programs to control machine operation are typically stored in battery-backed or non-volatile memory . A PLC is an example of a real time system because output results must be produced in response to input conditions applied within a delimited time, otherwise that will lead to unintended operations.

Sadegh Vosough [4] et al.They states that the primary task of a PLC is to acquire the input signals and store this data into the memory of the processor and based on the specified program the output devices are activated. Boolean algebra forms the mathematical basis for this operation, which recognizes precisely two defined status of one variable: "0" and "1". Accordingly, an output can only assume these two statuses. For instance, a connected motor could therefore be either switched on or off, i.e. controlled.

3. Methods

Water Saver System:

Now days in Building or Apartment much of Water will be wastages. Water is most important part of our life. In a kitchens and bathrooms much of water is wastage. Currently in a housing complex Water Saver and reusable systems were not developed. This System includes automatic filters. This filter filters waste water to a good quality of Water. This save a lot of Water and system is fully automatic so no need of manpower required running the system. This is one time installation cost and life time service for water saving.

Automatic Building Water Saver Operation:

This system consist of measuring instruments, level switches, pressure switches, flow transmitter This measuring instruments data processed and controlled in PLC system. In this System collect a waste Water form a kitchen and bathroom on a building, and this collected water will be stored in a sump tank .sump tank connected to a pump. This pump controlled by checking levels in sump water and feed water to a conveyer solid waste filter. In this process a system separate solid part in water. This separated Water collected in tank. On this tank pump is installed for water feeding to a next automated filter system. This pump is

interlocked on a level switches. This pump feed Water to a MGF, ACF, and UF Filters. This filters, filter water up to a reusable quality and this product water is used.

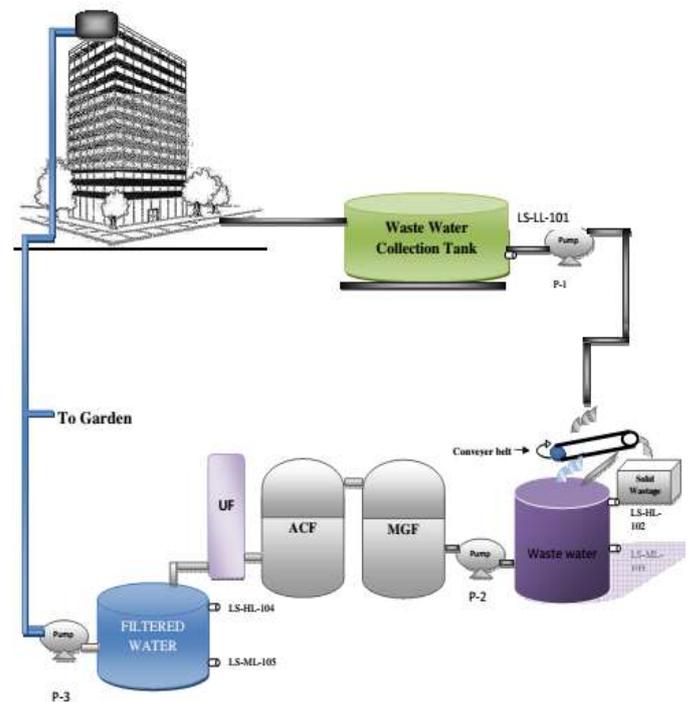


Figure 3.1: Layout of project

For developing this project there are mainly four systems are used:

a) Waste water collection System:

In a Building total wastage Water from a kitchen, bathrooms are collected in Waste Water tank. This collected water is feed to a conveyer system by using a pump. This pump is controlled by checking a level of a waste water tank. When waste water tank level goes to a low, at that time feed pump will be OFF. It checks continuous level of a tank and control a pump.

a) Automatic Conveyer System:

In a conveyer belt, waste water feed is input of a conveyer filter belt. It is used to separate water and a solid wastage. Solid wastage is collected in a solid waste bucket and this solid waste is pressed and dried in dryer. Also used as fertilizer to gardens.

c) Waste water filtration system:

Conveyer through separated water is stored in a waste water tank. This water feed to an automatic multi grade filtration system by using a pump-2. This pump is interlocked with level switches of a waste water tank. It check an all levels and ON/OFF a pump-2. Product of first MGF filter is feed to a next filtration system as carbon filter. Total filtration is performed on waste water. This stage includes a multigrade filter, activated carbon filter and ultra-filtration as shown in block diagram. All above process is controlled by PLC system automatically .So no need of manpower is required.

d) Filtered water distribution system:

This filtered water is collected on a filtered water tank. Pump-3 is used for a feeding a water to reuse cycle and to a garden, bathrooms & washing vehicles. This pump-3 is interlocked on 2 level switches.

PROGRAMMABLE LOGIC CONTROLLER:



Figure 3.2: Delta PLC

PLC is a special form of microprocessor- based controller. It includes a programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic. In order to control machines and processes, PLC is designed to be operated by engineers even by a limited knowledge of computers and computing languages. It has a great advantage of changing the PLC Ladder Diagram after it had been built or worked, which gives the facility of using the same PLC unit for controlling different systems after erasing it each time.

a) Multigrade filter (MGF):

A latest concept in the water treatment technology, a Multi Grade Filter consists of vertical or horizontal pressure sand filters that contain multiple layers of coarse and fine sand (pebbles and gravels) in a fixed proportion. It is a kind of a deep filter bed with adequate pore dimensions for retaining both large and small suspended solids and undissolved impurities like dust particles. As compared to conventional sand water filter, this multigrade filtration system works on higher specific flow rates.

The working principle of a multigrade filter is quite straight forward. In a multigrade filter or pressure sand filter, water is passed through multi layers of filter media consisting graded sand, pebbles and gravels layers. The contaminants in the water are captured in the media bed and filtered water passes into the discharge manifold at the bottom of the tanks. The next and last step is backwashing, a process of effectively removal of captured contaminants from the media bed. After back-washing the filter is rinsed with raw water and after the required quality of water is achieved the filter is put back into service.

b) Activated carbon filter (ACF):

Activated carbon filters are generally employed in the process of removing organic compounds and extracting free chlorine from water.

c) Ultra filter (UF):

UF removes dispersed material, suspended solids, and other large molecular weight materials from water which are harmful to human health. UF water purifiers are works without electricity. UF can be used for the removal of particulates and macromolecules from raw water to produce potable water.

DC Motor



Figure 3.3: DC Motor

A DC motor is being controlled by PLC. It will operate the stirrer. A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power.

A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances.

Submersible Pump



Figure 3.4: Submersible Pump

It is device that moves fluids or sometimes slurries, mechanical action. Pump operates by some mechanism and consumes energy to perform mechanical work by moving the fluid. It is a submersible pump which has AC-230V, 50Hz. It is acting as booster which will boost the flow of liquid through it. It is acting as an output parameter for PLC.

Solenoid Valve



Figure 3.5: Solenoid Valve

A solenoid valve or solenoid actuated valve is basically an electrical valve that controls the flow of media either open/closed or diverting my means of an electro magnet or solenoid. The principles are based around a thin copper wire wound around a bobbin or core in such a way that when electrical energy is applied a sufficient magnetic field is generated to provide a lifting force to a ferromagnetic stainless steel armature within the solenoid valve armature assembly which in turn will directly or indirectly change the position of the valve. It is acting as an output parameter for PLC. A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two -port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Level Switches



Figure 3.6: Level Switch

As the float rises or lowers with liquid level, the magnetic field generated from within the float actuates a hermetically sealed, magnetic reed switch mounted within the stem. The stem is made of non-magnetic metals or rugged, engineered plastics. When mounted vertically, this basic design provides a consistent accuracy of $\pm 1/8$ inch. Multi-station float switches use a separate reed switch for each level point being monitored. The installation in the tank can be vertical or horizontal depending on the type of float system used. The level dead band is variable. That is, the level differential between the high and low switching points.

WPL software:

For programming of delta PLC WPL software is used. The widely used language in designing a PLC program The ladder diagram was a diagram language for automation developed in the WWII period, which is the oldest and most widely adopted language in automation. In the initial stage, there were only A (normally open) contact, B (normally closed) contact, output coil, timer and counter...the sort of basic devices on the ladder diagram (see the power panel that is still used today). After the invention of programmable logic controllers (PLC), the devices displayable on the ladder diagram are added with differential contact, latched coil and the application commands which were not in a traditional power panel, for example the addition, subtraction, multiplication and division operations. am is the ladder diagram.

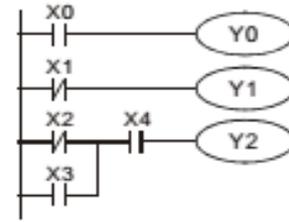


Figure 3.7: PLC ladder diagram

4. Results

In India most of industries, apartment, and cities disqualify waste water or cleaning water into natural fresh resources such as rivers and lakes. To remove solids like graded sand, pebbles and gravels, organic compounds, heavy metals, such as lead and other large molecular weight materials from water which are harmful to human health.

5. Discussion

1. The automation can be implemented in water filtration system ensures to avoid wastage of water and reduce manpower.
2. All the system is controlled by PLC.
3. Solids and liquid separation.
4. By using MGF, ACF and UF filters purification of waste water is done.
5. One time investment for long time.

6. Conclusion

In this paper we presented how water filtration & also recycling can be easily implemented by using PLC. The automation can be implemented in water filtration system ensures to avoid wastage of water and reduces time, manpower and give better quality of water. This system can also be used in housing societies for recycling the waste water. The important is to minimize the water pollution and water wastes.

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