Industrial Applications using Wastewater Treatment using PLC

[1]C. Sakthivel [2]R. Guruprasath [3]K. Selvakumar [4]R. Pradeep [5]R. Rajasekaran
[1,2,3,4,5]Assistant Professor
[1,2,3,4,5]Department of Electrical & Electronics Engineering
[1]JCT College of Engineering and Technology, Coimbatore, Tamilnadu, India [2]Srikrishna college of Engineering and Technology [3]SRM ,University Chennai ,Tamilnadu , India [4,5]SNS College of Technology, Coimbatore, India

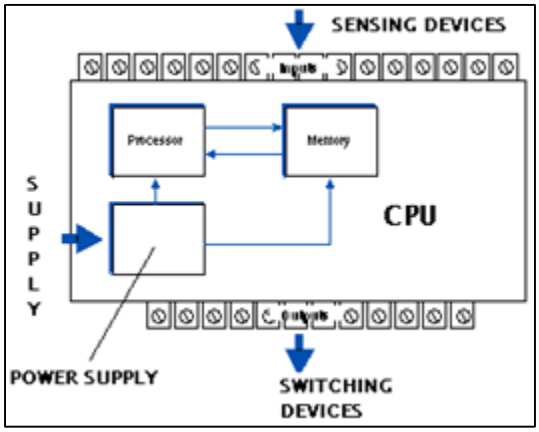
Abstract

Many industries have a need to treat water to obtain very high quality water for demanding purposes. Industrial wastewater treatment covers the mechanisms and processes used to treat waters that have been contaminated in some way by commercial activities prior to its release into the environment or its re-use. This is most commonly done by manually controlled devices. With the development in technology, this process can be automated. In this paper, we have described the automated industrial wastewater treatment process using PLC technology. This process involves treatment in two phases namely, primary and secondary stages. Here the steps are made automatic using sensors and timers of a PLC. The wastewater is first primarily treated where solid wastes settle down and lighter debris and grease rise to the surface to form a crust. In the primary stage, the working is based on the principle that when the water level drops enough so that the Low Level float switch is off (down), the PLC will open the valve to let more water in. Once the water level raises enough so that the High Level switch is on (up), the PLC will shut the inlet to stop the water from overflowing. The secondary stage involves biological treatment using the same principle. This treatment gives a new dimension for the automation of such manual processes.

Keyword- A Programmable Logic Controller (PLC), Suspended Film Systems, Primary Treatment Methods

I. INTRODUCTION

Wastewater is any water that has been adversely affected in quality by anthropogenic influence. It comprises liquid waste discharged by residences, commercial properties, industry, and/or agriculture and can encompass a wide range of potential contaminants and concentrations.



There are numerous processes that can be used to clean up waste waters depending on the type and concentration of the water. Here we use PLC technology for the automated working in the cleaning of the contaminated water.

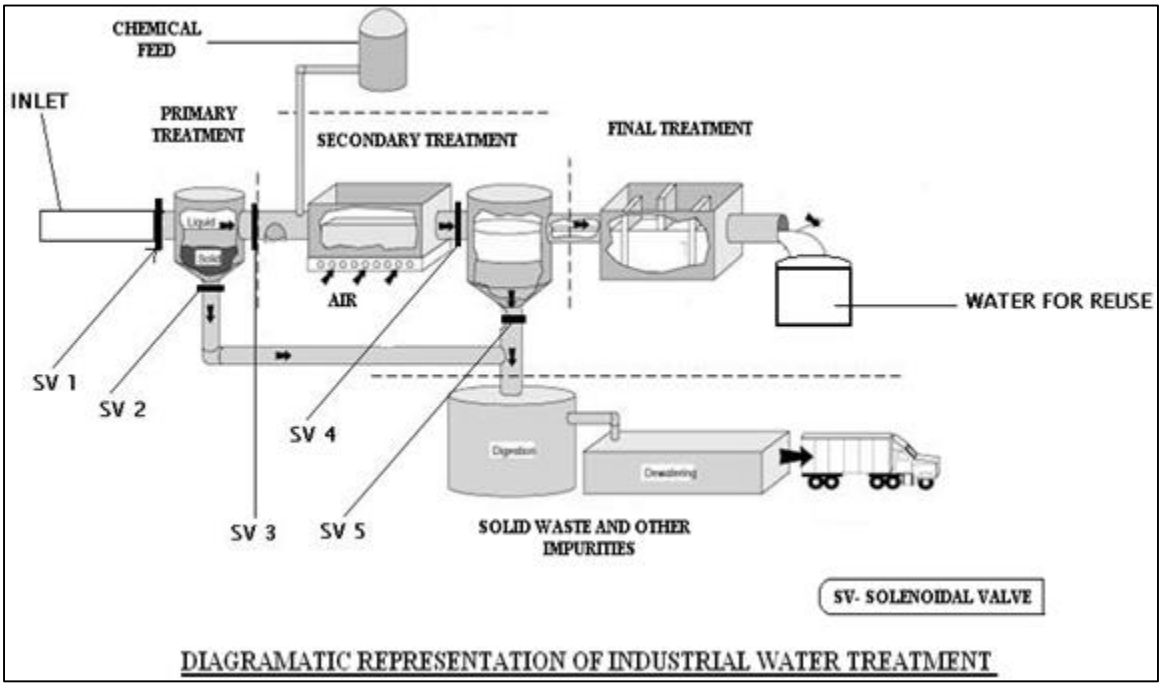
A. Architecture of the PLC

A programmable logic controller (PLC) or programmable controller is the 'work horse' of industrial automation. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programmable logic control is important because all production processes go through a fixed repetitive sequence of operations that involve logic steps and decisions. A PLC is used to control, time and

regulate the sequence. Examples of production processes that are controlled using PLC are batch chemical process, assembly lines and controlling machinery etc. 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 since output results must be produced in response to input conditions within a bounded time, otherwise unintended operation will result. In our system, the input devices used here are industrial process sensors such as switch status sensors, proximity sensors the output devices used are industrial process actuators such as solenoid valves, solenoid switches.

At the basic level, the PLC is programmed in a simple form of assembly code. The logic sequence is programmed into the program memory unit and then it can be executed.

II. PLC WORKING



DIAGRAMATIC REPRESENTATION OF INDUSTRIAL WATER TREATMENT

III. PRIMARY TREATMENT

In primary treatment, the influent sewage water is strained to remove all large objects that are deposited in the sewer system.
In this stage, there are three solenoid valves involved. Solenoid valve1 is provided with a sensor, SV 1 is switched open when it detects the inlet flow. At this interval valves SV 2 and SV3 remain closed. Here PLC has two digital inputs from float valves (Low Level and High Level). When the water level is above the SV1 it closes the contact and passes a signal to the input.

The PLC uses a digital output to close the inlet valve into the tank. The timer is activated. For an 8hr period, all the valves remain closed. This is the sedimentation stage. The large tanks used in this stage are commonly called "primary clarifiers" or "primary sedimentation tanks". The main purpose of the primary clarification stage is to produce both a generally homogeneous liquid capable of being treated biologically and a sludge that can be separately treated or processed.

Primary treatment also typically includes a sand or grit channel or chamber where the velocity of the incoming wastewater is carefully controlled to allow sand grit and stones to settle, while keeping the majority of the suspended organic material in the water column. This equipment is called a detritor or sand catcher. Sand, grit, and stones need to be removed early in the process to avoid damage to valves, the pipes and other equipment in the remaining treatment stages. Now the valve SV3 is switched open, so as to allow flow of the liquid into the pipe adjoining the solenoid valve 3. After all the water flows through SV3, the valve SV2 is timed in the PLC using digital inputs and outputs such that it gets opened after all the water has flowed out. And all the solid materials are removed.

IV. SECONDARY TREATMENT

Secondary treatment is a biological treatment process to remove dissolved organic matter from wastewater. Sewage microorganisms are cultivated and added to the wastewater. The microorganisms absorb organic matter from sewage as their food supply. Three valves are used to accomplish secondary treatment.

A. Fixed Film Systems

The valve S2 is now closed after a period of time where the solid materials are pushed out. Now the primary tank is empty. On the layers of the pipe connecting the valve SV3, microorganisms are applied. The wastewater is spread over the substrate, allowing the wastewater to flow past the film of microorganisms fixed to the substrate. As organic matter and nutrients are absorbed from the wastewater, the film of microorganisms grows and thickens. Trickling filters, rotating biological contactors, and sand filters placed on its way.

B. Suspended Film Systems

The valve SV3 is now closed using timers controlled by the PLC. After the microorganisms have been suspended in the wastewater for several hours, they are settled out as sludge. The sludge is wasted and sent on through SV5 for sludge treatment process.
The valve SV4 is now open and the water now moves into the final stage of treatment.

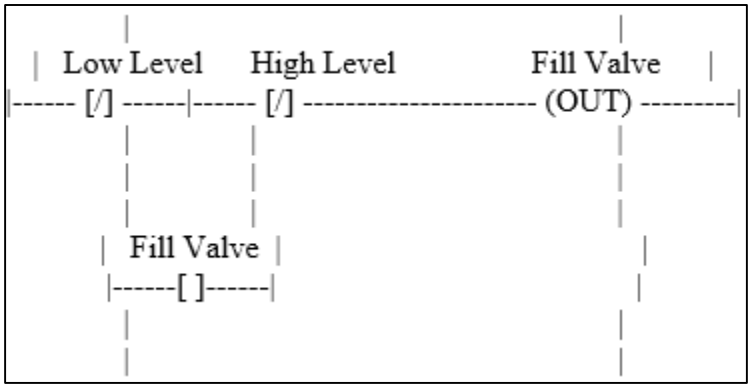
C. Final Treatment

Final treatment focuses on removal of disease-causing organisms from wastewater. Treated wastewater can be disinfected by adding chlorine or by using ultraviolet light. And now the water is free from impurities. This treated water can be used again.

D. Action of PLC

The pump and valve inputs to the PLC are binary input signals that actuate the opening or closing of the valves. The sensors are also binary. They tell the PLC whether the switches or valves are open or closed. Here flow meter can also be used to find pipe flow rates. They give pulsed signals.
Here the total number of inputs is 5[solenoid valves]. The total number of outputs is 15[level, flow rate and detectors for 5 valves]. The waste water is collected from the outlet of another system, as needed, and the major work of our system is to manage the water level in each of the Tanks. The working of the valves should be made precise. The proper timers are to be set at the respective valves. The system consists of interrelated valves controlled by the timers of the PLC. Using only physical signals, the PLC is made to work with two digital inputs from float switches (Low Level and High Level). This mechanism is programmed for two consecutively placed valves. When the water level is above the first valve it closes the contact and passes a signal to an input. The PLC uses a digital output to open and close the inlet valve into the tank. When the water level drops enough so that the Low Level float switch is off (down), the PLC will open the valve to let more water in. Once the water level raises enough so that the High Level switch is on (up), the PLC will shut the inlet to stop the water from overflowing. This rung is an example of seal in logic. The output is sealed in until some condition breaks the circuit this process is the working of a single valve. As all the other valves are simultaneously connected, they work in the similar fashion.

V. THE ABOVE LOGIC IS EXPLAINED FOR A SINGLE SOLENOID VALVE. THE SAME IS APPLIED FOR THE ENTIRE SYSTEM



VI. CONCLUSION

The modern technology of automating everything influenced us to work on this process also. The reliability and good maintainability of PLC makes the output of the above process a successful one.

In view of ever changing developments in the engineering field, PLC's are considered to be one of the best options available to the design engineer taking into consideration factors such as cost involved, the less amount of man power required to control the process, reliability factors of the process.

Considering the above factors PLC based automation system to the alternation for practical application will be more effective and will have greater scope for accurate and effective control.

REFERENCES

[1] A. Luque, and A. Martí, "A Metallic Intermediate Band High Efficiency Solar Cell," Progress in Photovoltaics, vol. 9, p. 73-86, (2001).
[2] R.T. Ross, "Efficiency of hot-carrier solar energy converters," Journal of Applied Physics, vol. 53, no. 5,p. 3813-18, (1982).
[3] C.B. Honsberg,"Approaches for Ultra-High Efficiency Solar Cells," Proceedings DOE Solar Program Review, November, 2004.
[4] P. Wurfel, "Thermodynamic limitations to solar energy conversion," Physica E: Low-Dimensional System sand Nanostructures, vol. 14, no. 1, p. 18-26, (2002).
[5] R.D. Schaller, and V.I. Klimov, "High efficiency carrier multiplication in PbSe nanocrystals: implications for no.31, p.7578-7580, (2002).2568 solar energy conversion," Physical Review Letters, vol. 92, no. 18, p. 186601/1-4, (2004).
[6] R.J. Ellingson, M.C. Beard, J.C. Johnson, P. Yu, O.I. Micic, A.J. Nozik, A. Shabaev, and A.L. Efros, "Highly Efficient Multiple Exciton Generation in Colloidal PbSeand PbS Quantum Dots," Nano Letters, vol. 5, no. 5, p. 873 - 878, (2005).
[7] N.J.Ekins-Daukes, C.B.Honsberg, M.Yamaguchi,"Signature of Intermediate Band Materials from Luminescence Measurements," Proceedings of the31st Photovoltaic Specialists Conference, Orlando, 49-54, (2005).
[8] R. Plass, S. Pelet, J. Krueger, M. Gratzel, U. Bach,"Quantum dot sensitization of organic-inorganic hybrid
[9] K. Selvakumar1, c. Sakthivel2, c. S. Boopathi3 and t.venkatesan4 design and implementation of a converter model for hybrid electric vehicle energy storage system in International journal of control theory and applications 2016
[10] C. Sakthivel*, K. Selvakumar** and T. Venkatesan Modified SEPIC Converter with High Static Gain for Renewable Energy Applications in International journal of control theory and applications 2016
[11] c. sakthivel*, k. selvakumar optimal generation scheduling of thermal units with considering start-up and shutdown ramp limits applications in IEEE Explore ,in 2014

