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An efficient approach of mechanical pump sealing filter system using PLC

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ABSTRACT

To develop the quality of paper production the water source must be pure and filtered, to modify the filter system settings automatic processing of filter must be included. The model is constructed based on the database of operating parameter and water quality. The structure and the parameters of the neural networks for engineering control are obtained through the optimization algorithm and this model is applied to the PLC environment. Results show that the backwash model can predict the contaminants settled on the filter rapidly and effectively.

INTRODUTION

In day to day life, water is the main source for the industrial and domestic appliances. But now a days water is getting polluted because of industrial wastes, sewage wastes, plastics, domestic wastes, etc., Water pollution is increasing day by day because of draining the contaminated substances into the water areas, such as river, lakes, ponds, etc.,

The production of paper is totally depend on the water source. The volume of the paper is thin and fine, so the usage of water must be dust free. Hence we have to filter the water used in the production of paper. The mechanical pump is used to take water from the river and it is given to the filter source then the outlet of the filter gives the purified water by collecting contaminated particles such as metal pieces, dusts, fine particles, etc., inside the filter and allows the purified water out.

The pump is a device that moves fluids by mechanical action. Pumps operate by some mechanism and consume energy to perform mechanical work moving the fluid. Pumps operate via many energy sources including manual operation, electricity, engines or wind power. Mechanical pumps serves in a wide range of applications such as pumping water from the river, dam and reservoir in paper industry.

The mechanical seal is used, when a pump operates, the liquid could leak out of the pump between the rotating shaft and the stationary pump casing. Since the shaft rotates, preventing this leakage can be difficult. So the shaft is sealed with the carbon-ceramic. Whenever a rotating shaft moves the fluid, mechanical seals plays a key role in sealing process includes fluids in, keeping contaminants out or both.

In a particular interval the system is maintained by back-flushing the filter because the dust particles are filled on the slotted tube filter elements of the back-flushing filter. For this back-flushing process Hydac filter is used.

The Hydac filter is a self cleaning system for extracting particles from low viscosity fluids. Its robust construction and automatic back-flushing capability make a major contribution to operational reliability and reduce operating and maintenance costs. Automatic cleaning starts as soon as the elements become contaminated. The flow of filtrate is not interrupted during the back-flushing procedure. The fluid to be filter flows through the slotted tube passing from the inside to the outside.

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LITERATURE SURVEY

A Systematic Approach to Develop PLC Program for Automation of a Backwash Water Treatment Plant Programmable logic controllers (PLCs) are type of process control computers, which are small but relatively inexpensive, environmentally hardened, and easy to program, operate, maintain and repair. The process control computers primarily control devices such as motors, solenoids, pumps, valves, lights and heaters etc. These computers, which number in millions, are the control elements in the virtually all modern factory operations. The programmability of PLC allows for fast and easy changes in relay ladder logic to meet the changing needs of the process or driven equipment without the need for expensive and time consuming rewiring. In this paper a target to develop, simulate and implement PLC software for automation of a water treatment plant is achieved. The algorithm developed in this paper may be used to develop PLC based software for any control process.

= **PLC & SCADA based automation of Filter House, a section of Water Treatment Plant**

Water Pump House (CWPH). Water Treatment Plant Section Involves: 1. Turbidity Measurement and Alum Dosing. 2. PH Measurement and Lime Dosing 3. Clarifloculator for Clarifying the Alum dosed and Lime dosed Raw Water 4. Filter House for further filtering the Clarified Water. 5. Chlorination This paper describes how automation of Filter House (section 4 of Water Treatment Plant) is done for this project using PLC & SCADA.

= **Ceramic Water Filter for Point-Of-Use Water Treatment**

This paper describes the design of a ceramic water filter factory in Mashamba Village, Limpopo province, South Africa. In rural settings, water contamination occurs mainly at the point-of-use (POU), or household level and water purification in Limpopo province is still a huge challenge. Locally manufactured ceramic water filters have been proven to significantly improve the microbiological quality of water when used as a POU water-treatment technology. Ceramic water filters have been shown to remove up to 99.9% of pathogens. Students from the University of Venda (Univen) and University of Virginia (UVa) have embarked on a collaboration to implement and construct a socially and financially sustainable ceramic filter factory (CFF) which will manufacture ceramic filters for household-level water treatment. The factory was successfully completed in August 2011 at the site of Mukondeni Co-operative Community Based Pottery Project (CCBPP) in Mashamba Village. This CFF is designed to operate under the leadership of the CCBPP. The factory operations system is low cost efficient and technical knowledge is required. Laboratory testing of filters is targeted to be conducted by Univen and UVa students on a regular basis. Water purification technologies on POU in household is highly context-dependent, and further research on the training and management on production of ceramic filters is essential.

Automatic Filtering of Starch in a Paper Manufacturing Industries using Distributed Control System

Paper is a thin material mainly used for the purpose for writing , printing , drawing, packaging etc., It is produced by pressing together the moist fibers, typically cellulose pulp derived from wood, rags or grasses and drying them into flexible sheets. Starch coating process is the most final step carried out in the paper manufacturing process. Starch coating process mainly gives two characteristics such as softness to the surface of the paper and also the paper thickness. So, starch coating is very important in thickness determination. The amount of starch coated on the either sides of a paper determines the thickness of the paper which is measured in terms of GSM (Grams per Square Meter). Tapioca is a rich source of starch and therefore tapioca is crushed to get starch. When coating on the partially made paper, starch should be of pure liquid form and should not contain any solid particles, even if tiny. In order to filter the solid particles, simple mesh filters are used. These mesh filters filter the solid particles in the liquid starch continuously. It has to be cleaned periodically for better filtering. At present filtering system, these filters are cleaned manually by removing one out of three in certain intervals of time. This causes lag in the coating process and thus resulting in loss of production. The proposed system is to increase the number of filters and flush

these filters using Distributed Control System. It is used to control the opening and closing of control valves in order to flush the filters. This system results in continuous constant starch coating on the paper which subsequently yields a higher paper manufacturing rate.

EXISTING SYSTEM

Paper presents fabrication and experimentally investigates the working of Mechanical Pump Sealing Filter System (Hydac Water Filter System) along with its purification which had used to prevent the over heating of the Mechanical Pump and for the production of Paper in Industry. Mechanical Pump Sealing Filter System consists of Pump .associated with the Shaft, Sealing, Bearings and the Carbon brush. This Pump is mainly used to transfer the water from one place to another.

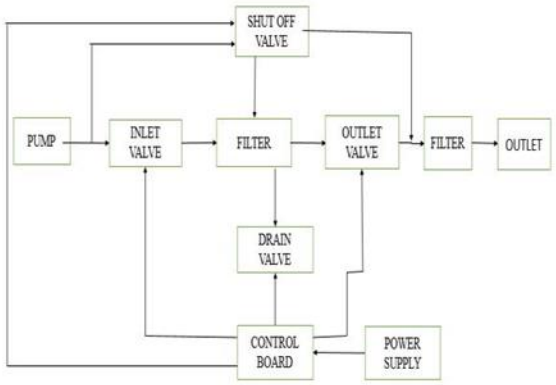


FIG.1 Block diagram of existing system

Water requirement and consumption are more in the Paper Industries, so the Pump continuously in working state. Because of this heat production is more. To reduce the heat, cooling water is circulated throughout the process into the sealing.

This cooling water must be free from fine particles, sands and dust. If the water is contaminated it damages the shaft and the brush. So the water should be filtered. In Industry, the Hydac Filter is used to filter the water. Hydac Filter system has automatic Back-Flushing process. This means it automatically cleans the dust particles settled in the filter. To control the all process, the control board circuit and the programs are used. According to the program the water filtered and given to the Pump Sealing to reduce the heating.

PROPOSED MODEL

As the proposed method is same as the existing system expect the control board. The small variation is that instead of control board here PLC is used. Because, the PLC program Is simple to execute and trouble shooting is also very easy. There are four valves which are controlled by the Ladder Logic Program. As the filter operates in the service mode, it traps and holds particles in the filter bed. Also, since water's nature is to follow the path of least resistance, after a time it begins to cut channels through the medium. As channels or holes in the media bed form, water begins to flow around rather than through the medium. This process is called “channeling,” and it can reduce the effectiveness of the filter considerably. At a preset time, the control valve initiates a “backwash” to clean the medium of collected particles and to resettle the bed and eliminate channels that have formed. The backwash is accomplished by sending water down the riser tube from which it enters the filter tank at the bottom. The force of the water is such that it actually lifts the media bed, swirling and tossing the granular medium.

Block diagram of the proposed model is illustrated in the fig.2.The filter plays the major role in this system,the amount of water is set to flow through the inlet valve and it is filtered by reverse osmosis and passed to the outlet for the production of paper. The PLC plays the important role in the process,that it shows the identification of water flow and filtering process.The main advantage of using PLC is,

Process run by time period Easy identification of fault. The water flows through the inlet valve is consumed by the filter and it send to outlet valve is the normal operation .As the preset time is involved, the filter operates in the backwash mode. At the time of back washing the inlet and outlet valve has to be closed. The shut off valve and drain valve is opened then the backwashing mode is operated under the preset time.

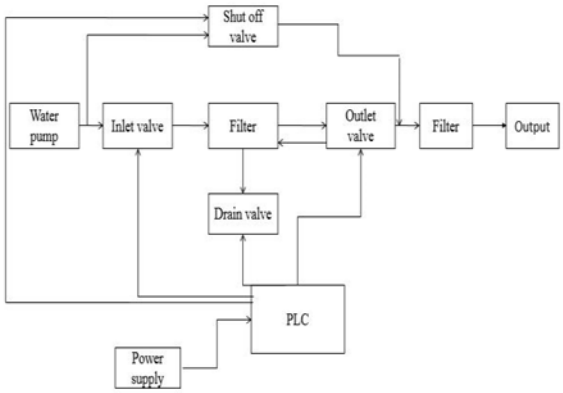


FIG.2 Block diagram of proposed model

Reverse osmosis (RO) is a process that purifies the water used like a partially permeable membrane to remove contaminants. Reverse osmosis can remove any types of solvents, dissolvents and suspended particals as well as biological terms in form of bacteria and germs in normal osmosis process solvents naturally moves from an area of low solute concentration. The driving force for the movement of the solvent is reduction in the free energy of the system. Applying an external pressure to reverse the natural flow of pure solvent,thus is,reverse osmosis.

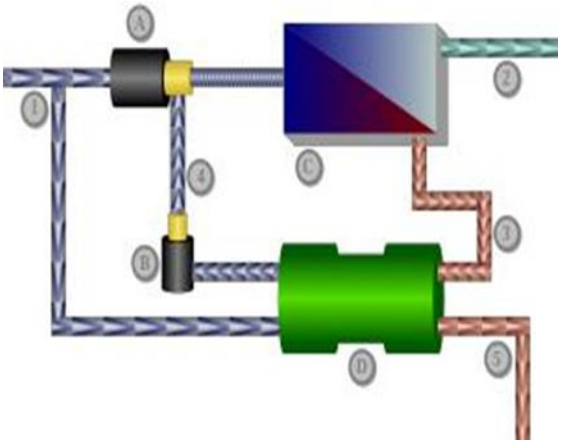


FIG.3 Reverse osmosis

PIC controller is a family of modified microcontrollers made by microchip technology. the name PIC initially refers to “Peripheral Interface Controller”. PIC are popular industrial

developers due to their lower cost, wide availability, large user base. Extensive collection of application notes, free development tools and serial programming capability.

There are three memory blocks in PIC 16f87XA device. The program memory and the data memory have separate buses so that concurrent assess can occur the PIC device have 13 bit program counter capable of addressing an 8K x14 bit program memory space. The performance of the PIC microcontroller is very fast and programming is very easy.it has three types of

- Timer 0:8 bit timer/counter with 8 bit pre-scaler.
- Timer 1:16 bit timer/ counter with pre-scaler Timer 2:8 bit timer/counter with 8 bit pre-scaler, period, register, and post scaler.
- 8 channel analog-to-digital converter with 10 bit each.
- It has synchronous serial port (SSP) with SPI (Master/Slave) and 12C.

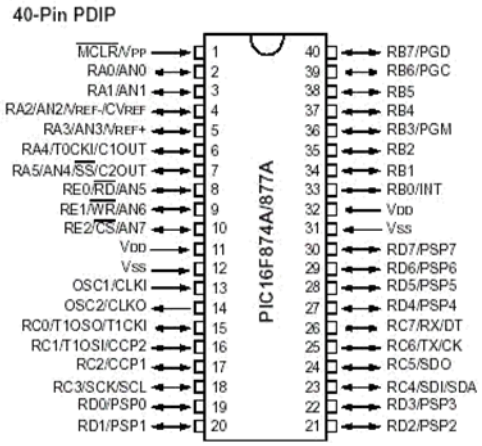


FIG.4 Pin diagram

CIRCUIT DIAGRAM

The 230v AC supply is given as input through the transformer. The step down transformer is used to step down the 230v AC input supply to 12v AC. Here all the components working input is 5v, so Full Bridge Rectifier is used to converter the AC voltage to DC voltage. The Capacitor is used here to reduce the harmonics and filter the 5v DC supply. This 5v DC supply is given to the Voltage Regulator to maintain the constant 5v throughout the process and this is given to the Relay and the PIC. The Regulator input Vi is connected to the capacitor output, the output Vo is connected to the relays and the Gnd is connected to the ground. The Relay acts as a Switch for the closing and opening of the valve. Here Four valves are employed for the process. Input valve, Output valve, Shut off valve and Drain valve. Single Pole Double Through (SPDT) switch is applied as NO (Normally Open) and NC (Normally Closed) connections. Before the power supply, the switch is in NO connection and the valve in closed state.

After the supply given to the circuit, the switch becomes NC connection and the valve in open state. The Valves are separately given supply through the 12v Battery. PIC 16f877a controller has four ports.

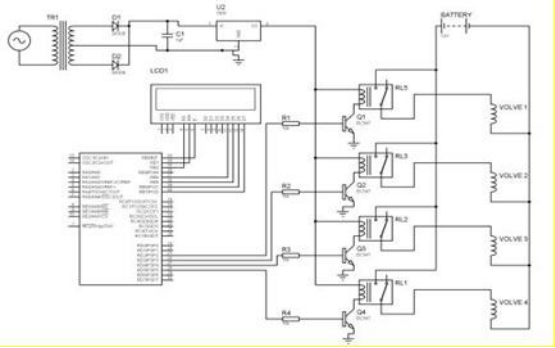


FIG.5 Circuit diagram

Here Port D pins are used to operate the relay because it's a bidirectional input and output port. The Ladder Logic Diagram is used to program the whole process of the circuit. The program is dumped into the PIC to control the process of filtration time and backwash process. The Relays are connected to PIC through the Transistors. Here the Transistors acts as a Drivers because the relays are in coil type, so we cannot directly interface the relays to the PIC because of high voltage rating. The Emitter pin of the Transistor is grounded, Collector pin is connected to the one end of the relay coil and the Base pin is connected to the PIC. The other end of the relay is connected to the voltage regulator to maintain constant voltage level. Again the power supply of the relays are limited through the Resistors.

The LCD display is used here to display the running status of the circuit. As the supply is ON, the PIC energised and the process gets started, According to the program, filtering system operated and the input, output, shut off and drain valve works as per the program. Under normal operation, the input and output valves are ON. The water gets filtered and leave to the sealing. At the Back-Wash operation, the input and output valves gets closed (off), then the shut-off and drain valves gets opened (on).

During this back-wash process, the dust particles deposited in the filter washed off and drained through the drain valve. This whole process is controlled by the PLC program. The ON and OFF state of the valve and the water flow are displayed in the LCD displayed.

SOURCE CODE

The main algorithm for the process is run by the ladder logic program. The PLC program is set to apply for the system.

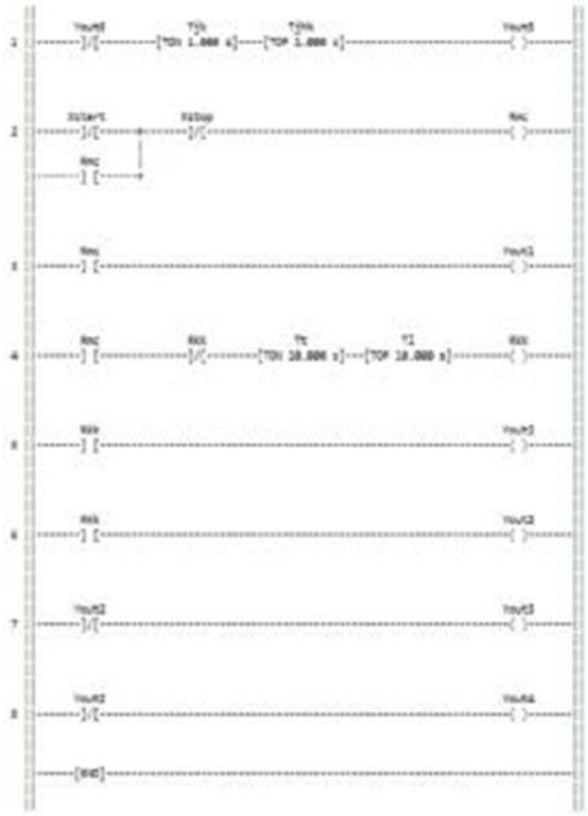


FIG.6 Ladder logic program

I/O ASSIGNMENT:

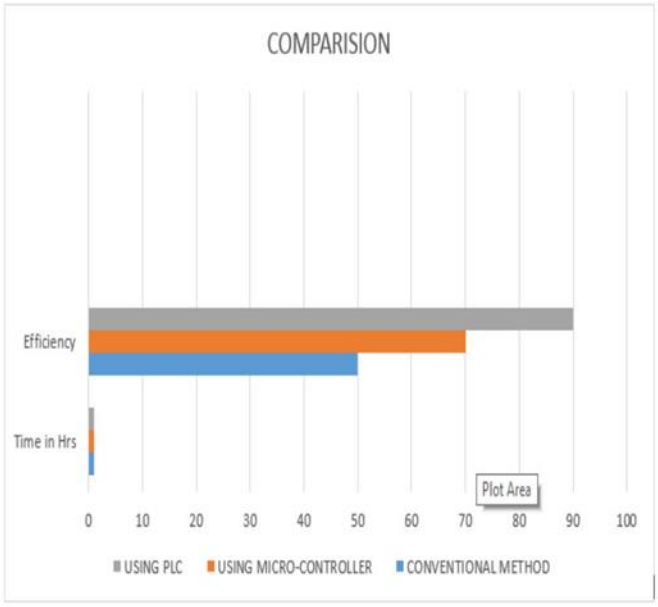
Name	Type	Pin
Xstart	digital in	9
Xstop	digital in	10
Yout1	digital out	17
Yout2	digital out	18
Yout3	digital out	1
Yout4	digital out	2
Yout5	digital out	11
Rkk	int. relay	
Rmc	int. relay	
Tjk	turn-on delay	
Tt	turn-on delay	
Tjhk	turn-off delay	
Tl	turn-off delay	

FIG.7 Parts denoted on the program

The program is executed and the result of the process is proceeded.

RESULT

Thus the output of mechanical pump sealing water filter system is compared with the conventional method and using micro controller. Efficiency of the PLC is shown in FIG.7



A	B	C	D
	CONVENTIONAL METHOD	USING MICRO-CONTROLLER	USING PLC
Time in Hrs	1	1	1
Efficiency	50	70	90

FIG.8 Output of the proposed system

CONCLUSION

In this paper, it simulate water quality are useful tools for predict and optimize the contaminants for the filtration process, the field test is done to verify the feasibility of the model. Improving those tools by applying new modeling techniques, combining the new techniques with conventional ones, constitutes the kind of strategic goal that may lead to better treatment of drinking-water quality. Through the optimization for filter backwashing control, can reduced the operating cost. The delay of the filtration process factors, has the great effect for the prediction and control.

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