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Water Purification with Bottle Filling System

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Abstract— The process of water purification is vital in many manufacturing and process industries. Besides this, numerous household water purifiers are now easily commercially available. The industrial water purification is different from the household water purification from the fact that, at industrial level water is not only purified but also it is implemented for further application or as a final product in which the purified water is filled into bottles. The project partially simulates the basic water purification project in food and juice industries. The bottling process to be carried out in this project is a basic conventional bottling process. Thus the project not only covers the water purification process but also its application, in this case bottling. The entire process is being controlled through a PLC. The language to be used for programming will be ladder logic. The project thus provides a great opportunity to implement various control loops studied earlier and control them with one of the most comprehensive and widely used controller - PLC.

Index Term—***Automation, Water Purification, Reverse Osmosis, PLC, Bottle Filling.***

I. INTRODUCTION

The process of water purification is vital in many manufacturing and process industries. The project not only covers the water purification process but also its application, in this case bottling. The entire process is being controlled through a PLC. Water treatment describes those industrial-scale processes used to make water more acceptable for a desired end-use. These can include use for drinking, industry, medical and many other uses. Such processes may be contrasted with small-scale water sterilization practiced by campers and other people in wilderness areas. The goal of all water treatment process is to remove existing contaminants in the water, or reduce the concentration of such contaminants so the water becomes fit for its desired end-use. One such use is returning water that has been used back into the natural environment without adverse ecological impact. The processes involved in treating water for drinking purpose may be solids separation using physical processes such as settling and filtration, and chemical processes such as disinfection and coagulation. Biological processes are employed in the treatment of wastewater and these processes may include, for example, aerated lagoons, activated sludge or slow sand filters. The water to be treated is feed to RO system for purification then followed by bottle filling process. Our motto is to minimize the water loss with the help of our system while water purification, for this purpose most efficient Ph transmitter is designed using signal conditioning circuitry. The waste water from RO system is checked for neutral Ph and further addition of acid or base is done with respect to corresponding reading. Well designed Ph transmitter and accurate controllers will help to accomplish most accurate water treatment.

The entire controlling action is taken using the PLC. This process will helps to eliminate out the problem of water loss that takes place during purification by treating waste water and most efficient bottle filling work with rapidity, as the rate of bottle filling will be high.

II. WATER TREATMENT METHODS

A. Boiling

Boiling is one of the oldest methods known for purifying water. It can be used under most circumstances, even in emergency situations, with no special equipment needed. The heat will kill off any harmful bacteria. For this method to be effective, it's recommended that the water be allowed to boil for at least three minutes.

B.Distillation

Distilling water is another common purification method. It requires the use of a distilling tank. Water is placed in the bottom of the tank, where it is heated to its boiling point. The heat creates steam, which is collected in a separate portion of the tank, where it eventually condenses into liquid water again, without impurities. The water is then placed into a storage container until it is needed.

Reverse Osmosis

Reverse osmosis is a purification process that requires special equipment. The system consists of a two-part tank that is separated by a membrane. Untreated water enters the tank on one side and is forced through the membrane. The membrane allows clean water to filter through while holding back contaminants. The treated water enters the second half of the tank and then is collected and stored for consumption.

Ultraviolet Light

In this method, water is placed in a clear container and then subjected to ultraviolet light, which destroys harmful organisms in the water. One of the drawbacks to this method is the power required to generate UV light. If insufficient UV light is applied to the water, it may not kill the organisms. The process depends on numerous factors, including the amount of water being purified, the initial condition of the water, and the size and intensity of the light

III. PROJECT HARDWARE

A.PLC (Programmable Logic Controller):

The PLC (programmable logic controller) Micro logic 1000 controls the parameters and devices that are automated. The PLC is programmed in ladder logic and provides logic control in a step-wise fashion. PLCs are rugged and inexpensive, and offer many options for interfacing with process equipment.

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This flexibility allows the PLC to control all the processes within the plant, as well as to provide data to external systems via analog signals or serial strings. The PLC itself, however, is not suited to memory intensive requirements such as data logging or sophisticated operator-interface functions. Our standard systems have PLC controls with alarms and full sensors compliments. Full automatic controls are available including data monitoring, storage and analysis as are network interfaces. A typical system will have a holding tank with level controls feeding the reverse osmosis pump and a reverse osmosis water storage tank with level controls and duplex pumps for shop water pressurization. All this is monitored and controlled by the PLC. Gages and instrumentation include high pressure gages on the reverse osmosis pump output and concentrate output, pressure switches on the reverse osmosis feed and output (monitored by the PLC), and flow monitors (sight gages on smaller systems, electronic on larger ones) on the concentrate, permeate and recycle stream. Even the cleaning cycle can be automated on larger systems with automatic valves to isolate selected banks so down time is minimized.
Analog signals in a current form (4-20 mA) are especially popular, because they are more impervious to noise than voltage ones and can conveniently provide a power source for low demand instruments. Another advantage is that using 4 mA to represent zero for whatever is being measured allows the system to differentiate a faulty instrument from one that is simply reading zero.

B. *pH sensors*

In The Process World, Ph Is An Important Parameter To Be Measured And Controlled. The Ph of a Solution Indicates How Acidic or Basic (alkaline) it is. The pH term translates the values of the hydrogen ion concentration - which ordinarily ranges between about 1 and 10 x -14 gram-equivalents per litre - into numbers between 0 and 14.

C. pH transmitter:

It is simplified Two-wire Hook-up assembly for transmitting signal to the PLC controllers .It has calibration adjustment Capability and also Converts/Transmits Measured Values to a Standard 4-20 mA Output. The transmitter designed by us can accept most types of Sensors.

D. Solenoid valve:

It is an electromechanical valve for use with liquid or gas. 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. We are using it for controlling purpose at various stages.

E. Limit switch

A mechanical limit switch interlocks a mechanical motion or position with an electrical circuit. A good starting point for limit-switch selection is contact arrangement.

The most common limit switch is the single-pole contact block with one NO and one NC set of contacts; however, limit switches are available with up to four poles.

F. Tds meter:

It test for total dissolved solids in water. TDS Meter - Tester. The Only Way to Know If Your Reverse Osmosis RO Membrane Is Performing Correctly - Tests for TDS - Total Dissolved Solids. A Must For All RO System Owners. Compare Incoming Feed Water To Treated Water - Replace Membrane If Less Than 80% of TDS Is Being Removed - Total dissolved solids (TDS) are the total weight of all solids (minerals, salts or metals) that are dissolved in a given volume of water expressed in milligrams per liter (mg/L), or in parts per million (PPM).

G. Conductivity sensor/meter:

The common laboratory conductivity meters employ a potentiometric method and four electrodes. Often, the electrodes are cylindrical and arranged concentrically [citation needed]. The electrodes are usually made of platinum metal. An alternating current is applied to the outer pair of electrodes.

H. Conveyor system:

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries

I. Filters:

A series of filters will be used for water treatment process.it will contain carbon, sedimental,sodium,RO filters. The entire assembly of these filters will be connected together for water efficient purification.

IV. PROJECT WORKING

A. Principle:

Osmosis
Normal Flow from Low to High

Reverse Osmosis
Flow Reversed by application of pressure to high

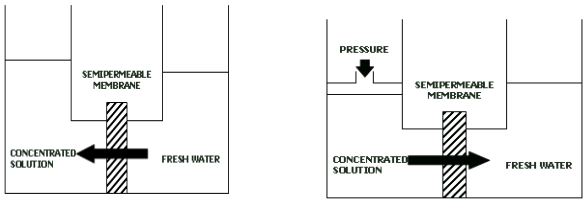

Fig1.Reverse Osmosis System

Low to high concentration

High to Low concentration

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High to Low concentration Reverse Osmosis is a process where water is demineralised using a semi permeable membrane at high pressure. Reverse osmosis is osmosis in reverse. So, what is osmosis? Osmosis is most commonly observed in plants. If you don't water your plants they wilt. A plant cell is a semi permeable (water flows through the membrane but salts don't) membrane with the living stuff on the inside in a salt solution. Water is drawn into the cell from the outside because pure water will move across a semi permeable membrane to dilute the higher concentration of salt on the inside. This is how water is drawn in from the ground when you water your plants. If you salt your plants (over fertilize or spill some salt on the grass), the plant will wilt because the salt concentration on the outside of the cell is higher than the inside and water then moves across the membrane from the inside to the outside. To reverse this process, you must overcome the osmotic pressure equilibrium across the membrane because the flow is naturally from dilute to concentrate. We want more pure water so we must increase the salt content in the cell (concentrate side of the membrane). To do this we increase the pressure on the salty side of the membrane and force the water across. The amount of pressure is determined by the salt concentration. As we force water out, the salt concentration increases requiring even greater pressure to get more pure water.

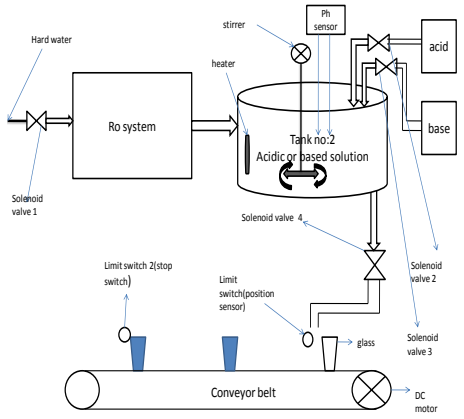

Fig2. Basic Block Diagram of Water Treatment Plant

Reverse osmosis (RO) is a membrane separation process in which feed water flows along the membrane surface under pressure. Purified water permeates the membrane and is collected, while the concentrated water, containing dissolved and undissolved material that does not flow through the membrane, is discharged to the drain. As starting the process, waste water moves from solenoid valve for particular time delay. Then that sufficient amount of water send to the reverse osmosis process, in this process prefilteration occurs for removing impurities and Carbon to remove chlorine. Reverse osmosis systems remove salts, microorganisms and many high molecular weight organics. System capacity depends on the water temperature, total dissolved .then this pure water feed to the tank where Ph test takes place. as depending on the value of Ph whether the water is acidic/based the two solenoid valve connected to the tank get activated. As if water is acidic then solenoid valve 2 get activated and water send to waste i.e no use, and if water is normal then it received through solenoid valve 3 and feed to bottle filling system. Where two limit switches acts as a position sensor get activated as per the position of bottle and bottle get filled.

V. CONCLUSION

From the result using this system it was found that water impurities are discarded through reverse osmosis system and then with the help of ph circuitry acidity and base condition can be checked further with use of plc we brought the water level near the neutral state.

VI. ACKNOWLEDGMENT

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