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Design of Automatic Chlorinator For Elevated Storage Reservoir

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Abstract *- In rural areas of India where there is no water treatment plant present for the treatment of drinking water, the drinking water is just directly chlorinated as a safety measure. The untreated water is directly pumped to the Elevated Storage Reservoir (ESR) and the water is chlorinated by adding bleaching powder in the ESR. To add the bleaching powder in the ESR a man has to climb up on the ESR and then put the bleaching powder from the top. An automatic chlorinator is a piece of equipment that automatically dispenses chlorine into the inlet pipe. Rather than putting the bleaching powder directly into ESR you would place it into your automatic chlorinator and allow it to dispense at your set rate. In this paper the design of an automatic chlorinator is shown with tested model results to minimize the manual effort for chlorination.*

Key Words*: Drinking water, Chlorination, Bleaching Powder, ESR , Automatic chlorinator.*

1. INTRODUCTION

As piped water delivery systems spread during the 19th century, treated water storage gained significance. The need to safeguard water sources from contamination and deterioration as well as the increasingly sophisticated operation of supply systems has motivated its subsequent development. Storage for treated water may be offered within the treatment facility or further downstream; it may be housed in elevated tanks or at ground level. In Rural areas of India convectional water treatment plants are not present, people usually take water directly from river or groundwater which can contain a wide array of viruses or bacteria. So to prevent health hazards from this water it has to be disinfected. Disinfection is carried out by using chlorine in the form of Bleaching powder or Sodium Hypochlorite. The water is pumped to elevated storage reservoirs (ESR) located in villages and then supplied to households from ESR. Before releasing the water from the ESR bleaching powder is added in the ESR for the disinfection purpose. To add the bleaching powder in the ESR a man has to climb up on the ESR carrying bag of bleaching powder and the put the bleaching powder from the top. To minimize this manual effort we can you an inline automatic chlorinator and attach it to the inlet pipe of ESR, so the chlorine is added in the inlet pipe carrying water in the ESR and get mixed automatically with sufficient contact time for the chlorine to react.

2. DESIGN OF AUTOMATIC CHLORINATOR

Design of Automatic chlorinator is simple and cost-effective. It is easy to install. Flow switch, Chemical Dosing pump, non-return valve and 40 liters tank was used to design an automatic chlorinator.

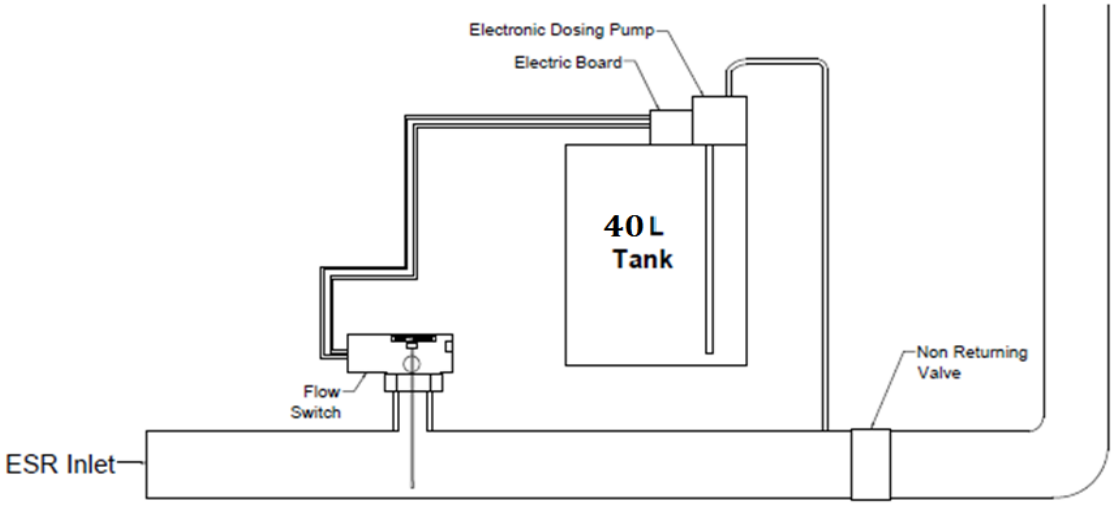

Fig – 1: Design of Automatic Chlorinator

2.1 Working

When the water starts flowing in the inlet pipe of the ESR, the flow switch detects it and act as a switch to close the circuit of the power supply of the dosing pump. As the circuit closes the dosing pump starts. The dosing pump suck the chlorine from the 50L tank and starts injecting the chlorine in the inlet pipe carrying water in the ESR. We can set the required dose of chlorine on the dosing pump. To prevent damage to dosing pump from the back flow from the ESR a non-return valve is installed just after the joint of dosing pump outlet pipe and the inlet pipe of ESR.

2.2 Estimation of Rate of Chlorine

There are different sizes of ESR present based on the requirement of the village. A 40,000 liters capacity of ESR was considered for the calculation of rate of chlorine required. Chlorine dosage of 5 mg/l was considered for the design purpose. Bleaching powder containing 33% concentration of chlorine is considered.

After calculation, we get the rate of the dosing pump as 5LPH rate, and we have to add 0.75 kg of bleaching powder in 40 L water in the 40 L tank of chlorinator, so the chlorinator will inject bleaching powder in liquid form at the rate of 26.041 mg/s.

We can calculate the required setting of dosing pump and rate of chlorination as above for different sizes of ESR and flow rates in the inlet pipe.

3.MODEL

A working model of the automatic chlorinator was made and tested. Water from Mula river, Pune was taken as the source of water on which chlorination was done by using the automatic chlorinator model.

Fig – 2: Automatic Chlorinator Model

3.1 Flow Switch

A flow switch is a tool used to start and stop an electric current in a circuit, just like all other switches. A flow switch is crucial for monitoring and managing the flow rate of process media, such as steam, liquids, and gases, in an industrial system. Flow switches activate actions in multiple machines throughout a system to offer on/off flow control of process media, helping to maintain safe and controlled rates of flow. There are many types of flow switches available on the market today that operate in a variety of different ways, but all flow switches share the property that when the flow rate reaches a switch's set-point, it can either open or close the circuit, which results in an action: whether it's opening or closing the circuit or switching on or off a device**.** Flow switches are either normally open (NO) or normally closed (NC). This is referring to the switch's default setting. A NO switch leaves the circuit open (OFF) until it is otherwise triggered. A NC switch keeps the circuit closed (ON) until it is otherwise triggered. It is offered in the market for between 1500 and 2000 rupees.

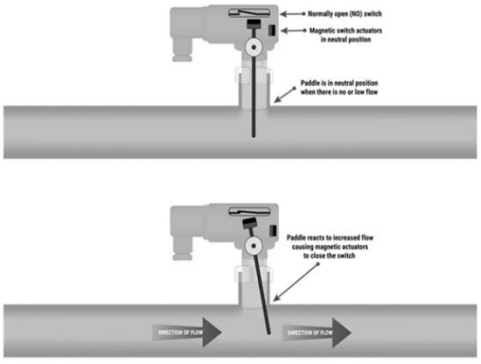

Fig – 3: Working of Paddle type Flow switch

Fig – 4: Flow switch

Fig – 5: Flow switch installed in the model

3.2 Dosing Pump

A positive displacement pump called a dosing pump is used to inject chemicals or other materials into a flow of water, gas, or steam. Small dosing pumps offer an incredibly precise flow rate for optimal control. They serve as the focal point of an integrated dosing system created for the chemical industry's autonomous chemical dispersion. The applications and industries covered by this definition of dosage span from food processing to wastewater treatment. It comes with various range of flow rate. Dosing pump with 0- 6 LPH flow rate range was used in the model. It is electromagnetic operated mechanically acute diaphragm type dosing pump. It is molded with 40% glass filled Polypropylene body and spacer. All other components are of plastics, resistant to chemicals and even components are of plastics, resistant to chemicals. It is driven by solenoid coil and electronic pulsar. Power consumption is less than 75 Watts. It is available in the market with the price range of Rs 4700 to 8000 (6 LPH variant).

Fig – 6: Dosing Pump

Fig – 7: Dosing Pump installed

Fig – 8: Point of Chlorination

3.3 Chlorine Tank

A tank of 40 L capacity was used in the model to store the chlorine.

Fig – 9: Chlorine Tank

3.4 Water tank

Water tank 0f 300 L capacity was used as a source of water in the model to create the flow in the pipe to which automatic chlorinator model is attached. The pipes used are of 40 mm diameter.

Fig – 10: Water Tank (300 L)

3.5 Estimation of Rate of Chlorine for Model

Tank Capacity of 300 liters is taken as the source of water with 15 minutes as time of flow, so we get 0.33 *l/s* of flow in the 40 mm pipe. Considering chlorine dosage as 5 *mg/l,* total chlorine required is 1.5 *g* and bleaching powder required is 4.5 *g* (containing 33% chlorine). Taking 25 liters of in the chlorinator tank and mixing 75 g of bleaching powder to get the required concentration of chlorine. Rate of Dosing pump was set on 6 LPH so that it injects 1.5 liter of water with 4.5 g of bleaching powder in 15 minutes.

4. RESULTS

Water from Mula river, Pune was taken in the 300 liters tank as the source of water. MPN test was conducted to check the presence of bacteria in the water. The MPN test showed 4-2-1 positive samples in 10 ml, 1 ml and 0.1 ml respectively i.e. 26 MPN value which means 26 coliforms per 100 ml of sample. Then the water was passed through the pipe of the model and automatic chlorinator was run to see the working efficiency of automatic chlorinator. The dose of chlorine was calculated as given above in section 3.5. Water from the outlet was collected and tested after giving 1 hr contact time for chlorination. The

MPN test of the chlorinated water gave 0-0-0 positive tubes i.e. 0 MPN value. This shows that the automatic chlorinator worked successfully and can be used to chlorinate water of the ESR.

5. CONCLUSIONS

Inline chlorination system can be used safely used to chlorinate water of the ESR. Using this Automatic chlorinator we can minimize the manual efforts for the chlorination in the ESR. The cost of automatic chlorinator is low thus economical. The ease of process will encourage the chlorination of water and thus leading to healthy life of people.

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