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AERATION METHOD FOR WASTEWATER TREATMENT

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Abstract-Water is vital for sustaining all forms of life on earth. Treatment of domestic wastewater before its disposal into the environment was not given much importance until the recent past. This was due to increased contamination rates of surface and ground water sources. Domestic wastewater treatment is becoming even more critical due to diminishing water resources and resulting water scarcity especially during summer in many parts of the country. Aeration is one of the methods which help in the removal of various contaminants present in domestic wastewater. During the past decade, pond aeration systems have been developed which will sustain large quantities of fish and invertebrate biomass. Dissolved Oxygen (DO) is considered to be among the most important water quality parameters in fish culture. Fishponds in aquaculture farms are usually located in remote areas where grid lines are at far distance. Aeration of ponds is required to prevent mortality and to intensify production, especially when feeding is practical, and in warm regions. To increase pond production it is necessary to control dissolved oxygen. Artificial intelligence (AI) techniques are becoming useful as alternate approaches to conventional techniques or as components of integrated systems. They have been used to solve complicated practical problems in various areas and are becoming more and more popular nowadays. This project presents a new design of diffused aeration system using fuel cell as a power source. Also fuzzy logic control Technique (FLC) is used for controlling the speed of air flow rate from the blower to air piping connected to the pond by adjusting blower speed. matlab simulink results show high performance of fuzzy logic control (FLC).

Keywords-Aeration, Dissolved Oxygen, Irrigation, wastewater

1. INTRODUCTION

Wastewater is the liquid end product or by product of municipal, domestic or an industrial activity. The term "wastewater" however implies that it is a waste product to be discarded in an environmentally sound manner. The world's available freshwater is about 3 percent of that of total water supply. Only 20 percent of this amount is available for use in drinking water supplies. The remainder of the world is salt water, which is costly to desalinate for drinking water purposes. Consequently, the water we use for drinking, washing, bathing etc. ultimately ends up back in the stream, river. Aeration brings water and air in close contact by exposing drops or thin sheets of water to the air or by introducing small bubbles of air (the smaller the bubble, the better) and letting them rise through the water. The scrubbing process caused by the turbulence of aeration physically removes dissolved gases from solution and allows them to escape into the surrounding air. Aeration also helps remove dissolved metals through oxidation, the chemical combination of oxygen from the air with certain undesirable metals in the water. Once oxidized, these chemicals fall out of solution and become particles in the water and can be removed by filtration or flotation. The efficiency of aeration depends on the amount of surface contact between air and water, which is controlled primarily by the size of the water drop or air bubble. Oxygen is added to water through aeration and can increase the palpability of water by removing the flat taste. The amount of oxygen the water can hold depends primarily on the temperature of the water. (The colder the water, the more oxygen the water can hold). Water that contains excessive amounts of oxygen can become very corrosive. Excessive oxygen can also cause problems in the treatment plant i.e. air binding of filters. Domestic wastewater treatment is also becoming even more critical due to diminishing water resources and resulting water scarcity especially during summer. Aeration is one of the methods which help in the removal of various contaminants present in domestic wastewater. The characteristics of wastewater having pH, Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Oil, phosphorus and nitrogen (about 6% of the BOD level) at a range of value which is harmful to human and environment was found to be the major polluting sources. The process of aeration was found to be an effective method in reducing these contaminants

A. Definition of Aeration:-

"Aeration is the process by which the area of contact between water and air is increased either by natural methods or by mechanical devices". In other words it is the method of increasing the oxygen saturation of the water.

B. Methods Of Aeration:-

A) Natural methods.
B) Mechanical devices methods

C. Cascade Aeration:-

In this method, the water is made to fall through certain height (1 to 3m) over a series of steps (3 to 10) with a fall of about 0.15 to 0.3 m in each step. The structure so formed is known as a free fall Aerator. The simplest type of a free fall aerator is known as a Cascade Aerator. Such aerators are widely used as water features. They will take large quantities of water in a comparatively small area at low head, are simple to be kept clean and can be made of robust and durable materials with a long life. The plates can be made of cast iron, or of RCC, or timber, or even of glass. The aerator should preferably be installed in open air. However, for protection against air pollution, freezing and algal growth, it can be installed in a small house having plenty of louvered air inlets. The cascade aerators are efficient in raising dissolved oxygen content of water, but not for CO2 removal, which is removed only in the range of 60 to 70%. Weirs and waterfalls of any kind are, of course, cascade aerator. Where a stream passes over an artificial or naturally occurring obstacle, a large contribution occurs to the self purification of the river water, due to increase in DO, which accelerates the process of decomposition of organic matter.

In a cascade aerator, usually, the rate of flow may vary between 20 to 100 m^3/h per m length of weir. To allow entrained air to mix in the water, each receiving basin should have a pool of water of depth 0.3 to 0.5 m. Weirs with serrated edges perform better, as they help to break water flow into separate jets. If the water is allowed to cling to the steps, especially at low discharge rates, the efficiency is reduced. The space requirement is typically of the order of 0.5 m^2 per $1m^3/h$ water treated. The oxygen transfer efficiency should be as 2.5 kg O2 / kWh.

A cascade aerator consists of a series of steps that the water flows over. In all cascade aerators, aeration is accomplished in the splash zones. The aeration action is similar to a flowing stream. Splash areas are created by placing blocks across the incline. They are the oldest and most common type of aerators.

D. Operating Considerations:-

Aeration raises the dissolved oxygen content of the water. If too much oxygen is injected into the water, the water becomes supersaturated. Aerators fall into two categories. They either introduce air to water, or water to air. The water-in-air method is designed to produce small drops of water that fall through the air. The air-in-water method creates small bubbles of air that are injected into the water stream. All aerators are designed to create a greater amount of contact between air and water to enhance the transfer of gases and increase oxidation.

E. Advantages:-

Plants are easy to operate, as the management of operation is for a maximum of two or three hours per day.Extended aeration processes are often better at handling organic loading and flow fluctuations, as there is a greater detention time for the nutrients to be assimilated by microbes.Systems are odor free, can be installed in most locations, have a relatively small footprint, and can be landscaped to match the surrounding area.Extended aeration systems have a relatively low sludge yield due to long sludge ages, can be designed to provide nitrification, and do not require a primary clarifier.

F. Disadvantages:-

Extended aeration plants do not achieve denitrification or phosphorus removal without additional unit processes.Flexibility is limited to adapt to changing effluent requirements resulting from regulatory changes.longer aeration period and hence requires more energy.Skilled personnel are required for the operation and control.

2. OBJECTIVE

The main objective is to produce a supply water that is chemically and bacteriological safe for human consumption. In this project, the construction of cascade aerator for effective treatment of water has been done.

3.LITERATURE SURVEY

R.Divya [1], Generally water can be treated in treatment plants for removing harmful substances present in it. The treatment process includes pretreatment, aeration, coagulation, flocculation, sedimentation, filtration, fluoridation, conditioning and disinfection. In our project we concentrate on aeration process using cascade aerators. The cascade aerators are efficient in raising dissolved oxygen content of water, CO2 removal and a large contribution occurs to the self-purification of water due to increase in DO, which accelerates the process of decomposition of organic matter. The working stress method approach of design has been used and recommendations of IS 456-2000, IS 875(Part III), IS 1893 (Part I):2002 and SP-16 have been adhered too. Here we analysis and design a Cascade Aerator for Mettur water treatment plant having a height of 21.6m using Staad Pro v8i and Auto Cad 2010 respectively. The elements of the aerator such as top and bottom ring beams, slab, column, plinth beams, footing & foundation are to be designed.M25 and Fe415 have been used to design all the components of the aerator. The typical analysis of a cascade aerator has been performed on the basis of quantity of water intake.

Dana Andreya Bondrea [2], The study aimed at evaluating the OC for different aeration systems. In the studied conditions, the highest aeration efficiency was the one of the disc membrane difussers, so using this system provides a much air flow requirement when compared to the other systems, hence the lower power consumption.

Bianca-Ștefania ZĂBAVĂ [3],In wastewater treatment, for certain specific treatments, the processes of transfer in/of water of gaseous components are important. Among these, the most representative treatment, widely used in practice is the introduction of gaseous oxygen in the effluent, in order to remove organic impurities under the action of a biomass of aerobic bacteria. The oxygen comes most often from the atmosphere, and in this case the process is called water aeration. To protect the environment, and especially the emissary, the soil and the air, the process of wastewater treatment should provide favorable conditions for further use of treated water in domestic, industrial or agricultural activities. Untreated wastewater discharged into rivers has a devastating impact.

U.O. Enwereuzoh [4], Preparation of algae (Dunaliela Salina) biomass in ammonia (NH4+) and nitrate (NO3-) growth media for biofuel production was investigated, with special attention on the elimination of inhibitory oxygen that adversely affects algae growth. A novel aeration method based on high and efficient transfer of carbon dioxide (CO2) required to stabilize the CO2 of the algae growth medium in a short time was adopted for the elimination of the inhibitory oxygen. The novel aeration method was found to increase the algae growth rate in the growth media investigated as suggested by increases in pH and decreases in dissolved oxygen concentration. However, algae grown in ammonia medium showed 17% higher growth rate than algae grown in nitrate medium. The high mass transfer of CO2 and high energy efficiency make the novel aeration method of algae growth in ammonia medium better suited for high yield of algae biomass for biofuel production.

R.K. Malviya [5], The review is concerned with the transfer of oxygen from air to a wastewater subjected to biological aerobic treatment. Oxygen transfer from gaseous to the liquid phase, is a vital part of a number of wastewater treatment processes, such as activated sludge process which is totally depend on the availability of sufficient quantity of oxygen. This paper is a study of oxygen transfer rate, efficiency, capacity and their kinetics on aeration system. Apart from this the study shows how the sludge retention time and the oxygen uptake rate is depend on the temperature of wastewater of sewage treatment plant. The standard oxygen transfer rate is the decisive factor in the dimensioning of activated sludge process used in STP Plants. It depends on the required oxygen uptake rate by micro-organisms. This review discuss about the dependency of oxygen transfer rate on the temperature of wastewater.

4.CONCLUSION

Aeration systems are key to the success of any biological process. They consume the most energy of any part of an aerobic process and the potential energy savings warrants close attention to design and maintenance details. The recent work at standardization of methodologies (ASCE standards) has taken a lot of the guess work out of the design process. A key aspect of any design is its practicality and workability. One does not want to force the plant operators to operate in a certain way or region because of an inflexible aeration systemAeration was done on sample wastewater at different flow rates of 1.5L/min, 3L/min, and 4L/min. It was found that as flow rates increased the percentage removal of above constituents also increased. Time period of aeration can also be varied in addition to air flow rate. Different time period of aeration such as 24 hrs.48 hrs.72 hrs.were adopted. Percentage removal of different parameters also varied with the change in time period. It was found that as time period of aeration increases, there was more reduction in the parameters. Optimum removal was possible at flow rate of 4L/min for a detention period of 72 hours. BOD, COD, Turbidity were found to be removed by 95.88%, 95.71%, and 37.72% respectively.

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