WATER POLLUTION CONTROL SYSTEMS THROUGH RENEWABLE POWER FOR LAKES, PONDS AND STPs

Gandhi Jayesh R. * and Jha S. N.
Department of Physics, Sardar Patel University, Vallabh Vidyanagar, Gujarat (INDIA)

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ABSTRACT
We have designed and developed hybrid wind power (mechanical) aerator system interfaced with Solar Photovoltaic powered aerator system for lakes, ponds for shrimp and fish hatcheries and Sewage Treatment Plants (STPs). Wind power aerator is the device harnessing the wind power through three blades which are connected to eccentric shaft and the shaft is connected to bellows which suck the air through non return valve and deliver the pressurize air through non return valve to the diffuser through pipes suspended in the basin of lake or pond. To maintain the DO level throughout the day for lakes ponds and STPs, Solar Photovoltaic powered aerator output is synchronized with wind powered aerator. Water Suspended diffuser is attached with copper / silver electrodes for ionization to control the algae growth, pathogenic bacteria and virus to control BOD. The onsite observations and results are discussed in detail.

Key Words: FRP blades, Bellows, Float, Valves, Metal ionization, Dual hybrid, BOD

INTRODUCTION

Renewable power aerator
This is country’s first hybrid wind power mechanical aerator system interfaced with Solar Photovoltaic powered aerator system. Mechanical wind mill has diaphragm air pump which is connected to blades through shaft, as wind blows blades drive the air pump and when air is pressurized it diffuses in water simultaneously the powered generated from solar-panel is stored in battery and then the usage is programmed for running electric aerator as per the need, diffuser is common for both the air sources and it is connected through long air pipe through non-return valve for aeration of Lakes, Sewage Treatment Plant (STP), shrimp and fish hatcheries pond. Every year, lots of fish and other aquatic life gets killed in lakes due to lack of oxygen especially in summer and monsoon and many times fountains and water boats are used which consumes heavy electricity and diesel which it self pollutes river. Even municipal corporations are dumping waste and sewage water in local lakes which creates bad odors, mosquitos and damages aquatic life, all this can be avoided which brings diseases in town and this can be avoided using wind solar aerator. One of such system is installed in Goya Talav, Anand, India. Minimum bathing bench mark of DO is 5mg/lit similarly for aquatic life minimum bench mark is 4mg/lit this is applicable for Shrimp and fish farmers. Shrimp farmers are using lakhs of rupees for diesel and electricity and diesel is banned by the forest department, even government is not allowing storage and commercial usage of diesel. By using the renewable energy source all this problems can be avoided and farmers can enjoy pay back on investment in approximately three years, which is the shortest period among all other type of usage of renewable power in different sector.

AIMS AND OBJECTIVES
This project is contribution of Swarnim Gujarat to our Nation for resolving a STP operating expense and cost affective (Three year pay back) renewable power solution for shrimp and fish farmers. This wind/solar hybrid aerator system is the innovation for keeping lakes and ponds of town clean and healthy economically.

MATERIAL AND METHODS

Pollution control
Today, copper is recognized as one of the best algaecide killers known to man. Oxides and sulfates of copper are used for pesticides,
algaeicides and fungicides. Pool stores worldwide sell copper based algaecide to kill black algae - the toughest of all to kill. Silver has been known as an effective bacteria and virus killer for centuries. Silver sulfate is the standard antibacterial treatment for burns and any type or an open wound and is used to protect the eyes of newborns. Household and industrial carbon filters purify water through the presence of silver particles and thus the accumulation of bacteria is avoided. These days, to prevent the occurrence of odor-causing bacteria in shoes, fine threads of silver are woven into socks. Similarly, the surfaces of fridge interiors are rendered antibacterial simply by the presence of silver ions. Activated carbon filters for drinking water purification and impregnate silver to prevent bacterial build-up. Silver is used as the drinking water purification for half the world's airlines and in over 1,000 passenger ships. Soft drink, beer, liquor, wine and other beverages are rendered pure and more palatable by the addition of silver in over 70 countries. Several studies by major universities have documented the effectiveness of the copper/silver ionization system.

Technical details
A block diagram of hybrid wind power mechanical aerator system interfaced with Solar Photovoltaic powered aerator system for lakes, Sewage Treatment Plant (STP), shrimp and fish hatcheries pond is shown in above Fig. 1.

Fig. 1 : Block diagram of wind-solar hybrid aerator system

All the imported mechanical wind power aerators are having multi blades of metal with limited life and need tripod tower for installation while our designed wind mill aerator has three blades of fiber resin polymer with a life of about 20 years. Our wind mill is erected on a mast which needs less floor space. All other wind mill aerator has manual breaks for high wind speed and you have to monitor for braking, where as our wind mill do not need brakes because it is aerodynamically designed to regulate over speed and cyclonic storms so no need to monitor. Electrical power harnessed from the solar panel is stored in the battery bank through charge controller device. The stored power is delivered to the diaphragm pump through programmable switching timer; normally more aeration is required during night time so the system is programmed to have the intervenient aeration throughout the night. This increase the consistency of water aeration because the aeration through windmill is random and so many times the DO level reaches saturation level and many time it is at low level during day time. The control panel of solar aerator system is shown in Fig. 2.

How Windmill Pond Aeration Works

We used floats to suspend diffuser 1.5 meter in lakes above base level so that diffuser can be protected from silt mud. The shrimp and fish farmer are using imported surface aerator attached with diesel engine which is having poor efficiency while our
aeration is under water through diffuser and so the DO efficiency is high, similarly fountain used for lake aeration is also surface aeration and its efficiency is also poor compared to diffuser aeration.

As lake suffer major problem between summer and monsoon the hybrid configuration provides the best performance consistency throughout the whole year.

Wind power aerator is the device harnessing the wind power through three blades which are connected to eccentric shaft and the shaft is connected to bellows which suck the air through non-return valve and deliver the pressurize air through non-return vale to the diffuser through pipes suspended in the basin of lake or pond. For lakes, pond and STPs, aeration at proper time is required to maintain the DO level throughout the day, which can be done by interfacing solar photovoltaic power which charges the batteries for electrical aerator (diffuser type).

**Metal ions for pollution control**

Silver metal and copper metal electrodes were suspended along with air diffuser and power was delivered through electronic control unit through wires attached with floating air delivery pipe to diffuser. For lake the weight of silver electrodes is 2% the weight of copper as copper is ionized 50 times faster the silver. The ion dissolving rate and percentage of copper and silver depends on volume or which water is to be treated like water of lake, STP water, fish or shrimp pond water etc. When copper and silver ions are released into the water, these cationic, surface-active ions are a potent biocide. The disinfection action takes place when the positively charged copper and silver ions form electrostatic bonds negatively charged areas on the microorganism cell walls. These electrostatic bonds create stresses which lead to distorted cell wall permeability, minimizing the normal intake of life sustaining nutrients. Once inside an algae cell, copper and silver attack sulfur containing amino acid residues in the proteins used for photosynthesis (the process of converting light into usable food and energy). As a result, photosynthesis is blocked and lead to cell lysis and death. If the algae cell manages to live, the reproduction process is hampered by the presence of the copper ions and the spread of algae is held in check. Bacteria is killed, rather that suppressed. The greatest benefit of copper/silver ionization is that the ions remain in the water providing a residual protection. They provide long-term, nontoxic purification and prevent against recontamination. Unlike most other types of sanitizers, the copper and silver ions remain in the water until they flocculate or form masses with algae and bacteria and then become large enough to be removed by the filtering equipment. When the "used" copper and silver ions are removed, the microprocessor control box is always producing new copper and silver ions to continuously sanitize the water. Generally the setting of the microprocessor is kept at the same setting, thus a proper amount of copper and silver ions are always in the water. If your test kit shows a copper-ion level too low, simply turn the control knob up a notch. The digital display will show the milliamp charge going to the electrodes. Even if the unit was turned off, the copper and silver ions remain in the water until they flocculate with algae and bacteria, and are removed by the filtering system. This can last several months.

In 1997, in Brooklyn, Massachusetts, USA, a scientific study was undertaken over a period of several months, to document the effectiveness of copper/silver ionization in public swimming facilities. The results indicated that the use of copper/silver ionization, combined with small amounts of chlorine, produces a far faster, longer-lasting and more effective level of disinfection than that seen using the traditional chlorine-only method, due to the incredible (and unexpected) synergetic effect of the ionization process. Using these techniques, public swimming pools can reduce their use of chlorine by up to 80% and achieve a reduction of their output of toxic trihalomethanes by up to 150%.

Although the use of chlorine disinfection still continues in the treatment of swimming pools in Spain and Germany, there exist, in Belgium (St. Vieth and Leuwen) and France, public swimming pools which, for already more than twenty years, have been disinfected solely by copper/silver ionization.
For more than twenty years, the swimming pools of St. Vith have been kept clean and disinfected through the means of copper/silver ionization, without any addition of chlorine and with the full support of local sanitation authorities.

RESULTS AND DISCUSSION

When we checked the state government data of all the rivers and lake health of the year 2009, we found that report of a lake in Anand city (Goya Talav) was very poor, the DO level was 2 mg/l which was well bellow bathing and aquatic bench mark and so we plan to install our first designed and fabricated mechanical wind mill and Solar photovoltaic aerator hybrid system with silver and copper ionizing device. The on sight photographs of the installed system are shown in Fig. 3. This is first of its kind of hybrid system where output of mechanical wind machine and electric power generating photovoltaic aerator device were interfaced, this interfacing was a need of consistent aeration treatment along with silver and copper ionization because the aeration is needed badly in night as DO level always drops in night. Timing of wind power can’t be predicted and so to have the aeration in night we used photovoltaic solar panel to store the power in battery which can be utilized for aeration through electric aerator as per the stored program of time. The water samples after three months of the installation of our system were analysed to measure the DO level, at Depertment of Bio-Science, Sardar Patel University, Vallab Vidyanagar, India. The results after 3 months of installation were that the DO level was reached to 8 miligm/lit. The alga was dropped to about 60%, which can be seen from the photographs of Fig. 3.
CONCLUSION

The renewable powered programmable hybrid system is economical and most effective problem resolving solution for water aeration and water pollution control. Hybrid configuration depends on wind regime and solar radiation of the installed site. Ionization process of copper and silver depend on pollution type and level of impurities in the water which is to be treated.

REFERENCES