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# APPLICATION OF GREEN TECHNOLOGY IN AQUACULTURE WASTEWATER TREATMENT: A CONCEPTUAL APPROACH

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**Abstract:** Aquaculture wastewater is generally treated by using settlement ponds to remove particulate and dissolved nutrients throughout the world in all the land-based aquaculture systems. The fresh, marine and brackish water settlement ponds generally reduce total suspended solids by 60%, but their efficiency is still contradictory. Therefore, functional improvements in wastewater effluent treatment systems are required to provide efficient treatment of aquaculture wastewater. Furthermore, environmental regulation of discharge from intensive culture systems in India is increasing, providing the impetus to upgrade rudimentary single step settlement pond systems. The application and prospects of potassium ferrate in the aquaculture were emphatically discussed. Therefore, in the present study potassium ferrate based environment friendly multifunction water treatment approach for aquaculture wastewater treatement has been presented.
**Keywords:** Aquaculture, Waste water treatment, potassium ferrate, green technology

## Introduction

Water resources are decreasing day by day and under tremendous stress throughout the world. Therefore, effective treatment of aquaculture wastewater is a major problem now a days. Ferrate is considered to be a "green "chemical for use in water treatment [1]. Wastewater treatment using Ferrate does not produce any toxic byproducts. The end product of ferrate oxidation is relatively benign ferric sludge and oxidized forms of water contaminants. According to Global Water Intelligence, "The water sector is facing greater challenges than ever before: population growth, climate change, increased water scarcity, tougher environmental regulation, and dwindling public finances. Only one thing stands between success and failure: water technology."

Wastewater treatments are generally physical processes, including popularly fluidized sand and mechanical filters. Biological treatment of wastewater includes; submerged biofilters, trickling biofilters, rotating biological contactors, rotating drum filters, moving bed bioreactors and fluidized bed reactors are employed in the oxidation of organic matter and

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nitrification. The disadvantages of these treatment methods are that they produce sludge, much energy intensive and depend on frequent maintenance. Therefore, there is a need to implement technically feasible and economically justifiable technology to treat aquaculture wastewater.

**Necessity for the Technology**

Increasing trend of world population has summoned up food insecurity along with threats on environment due to water scarcity and pollution. Developing countries like; India needs the technology which economical in operation and socially acceptable. Presently, aquaculture is growing rapidly and provides 47% (51 million tons) of the global human fish consumption [2]. In order to keep up with population growth and increasing per capita fish consumption, aquaculture output is set to increase by a further 60%–100% over the next 20–30 years. More than 40% of the world population lives not more than 100 km away from the coastlines, putting high pressure on the coastal ecosystems.

The pollutants generated by aquaculture are mainly nitrogen and phosphorus and causing serious environmental problems. Therefore, treating these pollutants is very much essential for successful aquaculture. Therefore, it is important in aquaculture using water reuse systems due to the toxicity of ammonia and nitrite and the chance of hypertrophication of the environment by nitrate [3]. Moreover, the superior performance of ferrate (VI) as an oxidant/ disinfectant and coagulant in water and wastewater treatment has been reported [4-19].Therefore, ferrate based treatment for aquaculture wastewater treatment will be a mile stone in terms of economics, technical feasibility and social acceptability.

**The Approach**

Potassium ferrate is the chemical compound with the formula $K_2FeO_4$. This purple salt is paramagnetic, and is a rare example of an iron (VI) compound. In most of its compounds, iron has the oxidation state +2 or +3 ($Fe^{2+}$or $Fe^{3+}$). Reflecting its high oxidation state, $FeO_4^{2-}$ is a powerful oxidizing agent.$K_2FeO_4$ has attracted interest for applications in "green chemistry" because the by-products of its use, iron oxides, are environmentally innocuous. Potassium ferrate (VI), as a strong and environmentally friendly oxidant, has been used as a dual-function chemical reagent for water and wastewater treatment [5]. It possesses many functions, such as coagulation, oxidation, and purification [8].

**Advantages**

The ferrate treatment system has certain advantages such as precipitation of phosphorus, removes heavy metals, kills spores, bacteria,viruses and protozoa, produces no aquatic

toxicity, deactivates residual drugs & pesticides, reduces organic load in the water body which reduces biochemical oxygen demand, and removes color & odors.

The final product of $Fe(OH)_3$ or $Fe(OH)_6$ is non toxic and environmentally acceptable and can be easily filtered or settled without creating any toxicity to the surroundings. Moreover, there are certain challenges associated with the use of ferrate treatment strategy which are also discussed.

**Challenges**

The challenges associated with the use of the proposed technology includes, Fe (VI) solutions are generally unstable; It decomposed by reduction to Fe(III) rapidly at room temperature. The instability may be retarded but not stopped at very low temperature. Therefore, without refrigeration the Fe (VI) solutions can not be practically stored for the further use [5].

Solid ferrate (VI) salts are stable, but they are expensive in operation and use as they require multiple purifications and long synthesis time. Therefore, it is very difficult to use it in industry due to long operational time and cost of operation. This problem can be minimized to generate ferrate in situ and apply the generated ferrate (VI) directly for wastewater treatment.

**Need for adaptability of technology**

Conventional aquaculture wastewater treatment technologies like; recirculatory aquaculture systems are high energy intensive and are thus not desirable in the present scenario of climate change and energy conservation. Aquaculture waste stabilizing ponds offer a low cost method for collecting and treating the waste in developing countries like; India. These ponds offer excellent results when operated in Ideal conditions [20]. But creating ideal environment is still questionable and it leads to economics. Now a days, potassium ferrate in water treatment in the application of more mature, which is used to improve the culture of potassium ferrate with water reference and guidance. Potassium ferrate is to be treated as a stronger oxidant than chlorine oxidation performance, sterilization, pre-oxidation of algae, removal of ammonia oxidation and coagulation has demonstrated a satisfactory performance, and potassium ferrate itself and its in the application process does not produce carcinogenic, teratogenic, mutagenic by-products, with a high degree of security. Therefore, ferrate in the field of aquaculture has a very good scope and broad application prospects and is the ideal choice for replacement of chlorine oxidants [21]. But, ferrate treatment in the field of aquaculture has not been given much attention, and very few research work has been carried out in aquaculture wastewater treatment. Therefore, there is a lot of scope for this technology

in the field of aquaculture and will definitely play an important role for sustatainable development in aquaculture wastewater treatment.

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