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Nitrate and Nitrite Removal from Wastewater-a Review

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Abstract— Removal of organic matter, phosphorus and nitrates can be carried out by various chemical, physical and chemical methods. Nutrients present in water mainly contain phosphates and nitrites. An excessive growth of these compounds in the wastewater can make the reservoir prone to different undesired effects. The aquatic plant can grow rapidly and hinder the oxygen uptake and photosynthesis. The removal of nitrogenous compounds can be carried out by electrochemical, biological and adsorption methods. The current review summarizes research and studies on nitrate and nitrate removal from wastewater.

Keywords—adsorption, ion exchange, treatment, removal, nutrient, biological methods

I. INTRODUCTION

Wastewater treatment includes treatments such as physical, chemical and biological for removal of various impurities from wastewater. The physical treatments removal coarser materials. These includes screening and bar racks. The secondary treatments includes biological treatments such as activated sludge and trickling filters [1,2,3,4]. The organic matter can be removed by various biological and non biological methods [5,6,7,8]. The methods such as adsorption and membrane separation can be used efficiently for removal of organic matter and heavy metals[9,10] The current review presents summary of research and studies for removal of nitrites and nitrates from wastewater.

II. RESEARCH AND STUDIES ON NITRITES AND NITRATE REMOVAL FROM WASTEWATER

Kutty et.al. carried out investigation to enhance the conventional activated-sludge process through a modified, laboratory scale biological reactor [11]. They used the conventional activated-sludge process through a modified, laboratory scale biological reactor. They created a control reactor (SRT = 2 days) operating at conventional aeration, in order to compare the performance. They monitored the performance of the reactor for 10 days continuously until the readings were stabilized. They observed that modified reactor had 60 percent more ammonia removal capacity. Cliford and Liu investigated the removal of nitrate by using Ion Exchange[12]. The combination procedure results in 50 percent reduction of regenerate consumption and 90 percent reduction in the mass of waste salt discharged. They observed that, during recycle reuse experiments, essentially complete (>99 percent) gentrification of spent 0.5 N NaCl brine was achieved in 20 h using a optimum methanol-to-nitrate-nitrogen ratio (R) of 2.2.Electrochemical removal of nitrite was investigated by Saleem et.al. [13]. They studied the effect of important parameters like electrode material and applied current density. They got highest nitrite removal with nickel as compared to stainless steel and other electrode materials. The best pH value they obtained for electrochemical nitrite removal was 5.They also observed that the increase in anode to cathode surface area ration increased the nitrite removal. Maximum 95 percent removal was obtained at the ratio 1.Akpor et.al. carried out investigation on the effect of temperature on nutrient removal from wastewater [14]. They observed that the optimum temperature for phosphate removal was observed at 30°C -40°C. Patil et.al. used chitosan as an adsorbent for removal of nitrate from groundwater [15]. They investigated groundwater status in the area and also studied suitability of water for domestic use. They found that chitosan was very effective adsorbent. The disadvantage of chitosan was that, it imparted turbidity to

water. They also observed that chitosan removed hardness and chlorides and there were significant reductions in nitrate and fluoride concentrations. Dairy wastewater was treated for carbon and nitrogen removal by Gutierrez et.al.[16]. They used sequential batch reactor system for processing a synthetic dairy wastewater. The percentage removal for total nitrogen obtained by them was 90-99 percent. According to them, sludge growth was mainly responsible for nitrogen removal. Yamashita Yamamoto-Ikemoto carried out investigation on nitrogen and phosphorus removal from wastewater treatment plant effluent [17]. They used an anoxic bioreactor packed with wood and iron for bacterial sulphur reduction. They observed that the nitrogen and phosphorus removal in the bioreactor packed with cedar chips and iron continued till 500 days. For aspen wood and iron, it continued for 1200 days. Adonadaga carried out an investigation on nutrient removal efficiency of activated sludge plants [18]. According to them, there is need for modifications to existing activated sludge plants in Ghana to improve their nutrient removal efficiency. Magnaye et.al. carried out an investigation on nitrogen and organic removal efficiency of a lab-scale system using aerobic and an-aerobic reactors[19].They used simulated wastewater with high levels of nitrogen. They compared efficiencies of aerobic and anaerobic reactors for removal of nitrogen and organic matter. According to these studies, aerobic methods were better for nitrogen removal from wastewater. Wang studied electrochemical removal of ammonia with various cathodes and Ti/RuO_2-Pt anode [20]. In this investigation they achieved anodic oxidation of ammonia and cathodic reduction of by-products. They also observed that initial pH in the range of 4 to 9 favours electrochemical treatment. DebRoy et.al. carried out an investigation on isolation of nitrate and phosphate removing bacteria from various environmental sites[21].Hanfi and Azima derived activated carbon from rice straw for removal of nitrites and nitrates[22].According to results obtained by them, the adsorption of nitrate and nitrite ions onto activated carbon was exothermic and non-spontaneous. They observed that the parameters like temperature, pH, adsorbent concentration and carbon dosage affects the rate of adsorption. Sotirakou et.al. used extended aeration for phosphorous and nitrate removal from wastewater[23]. They were able to eliminate ammonia completely from the plant. Wastewater protozoa were used in a laboratory scale batch reactor by Akpor et.al. for nutrient removal from activated sludge mixed liquor[24].They observed that the rate of nutrient removal was dependent on the isolate. Rossi et.al. carried out investigation on biological denitrification for nitrate removal from wastewater[25]. They studied denitrifying performances of the bacterium *Azospira* sp. OGA 24.They observed that OGA 24 can clean water with efficiency up to 90%. Trentepohlia Aurea Microalgae was used for removal of nitrate from wastewater by Al-Balushi et.al.[26].During their investigation, they observed that the removal efficiencies for nitrogen, phosphorous and nitrate from wastewater reached high efficiencies. They also observed that the percent of NO_3- removed using Trentepohlia aurea microalgae was 37% during 30 days.

III. CONCLUSION

The methods such as activated sludge process and ion exchange can be used for removal of nitrites and nitrates.Electrochemical nitrate removal was also effective. Almost 95 percent nitrate removal was obtained by this method by few researchers. The nitrogen and phosphorus removal in the bioreactor packed with cedar chips and iron also showed promise.Adsorption by using waste materials was also tried by some investigators with considerable success.Use of protozoa and microalgae was also reported by few investigators. The use of appropriate method for nitrite and nitrate removal depends on concentration, quantity and quality of wastewater.

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