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Removal of pre-cuticle using continuous biological aeration process and taking into account hydraulic retention time and organic charge concentration

Masoumeh Sadeghi[1]

Abstract

Introduction: Lack of water resources and environmental problems due to the discharge of wastewater and effluents into the receiving waters, has forced humans to use various solutions to treat wastewater and reuse it. Among the various contaminants, phenol compounds and their derivatives (cuticles) are of particular importance. The aim of this study was to investigate the removal of pre-cuticle using continuous biological aeration process and to consider hydraulic retention time and organic charge concentration. Methods: The present study is an experimental-laboratory study in which the effect of variables of initial concentration of pericticol (5,10,25) mg / l), hydraulic retention time (2,5,8,24 h) and inlet load concentration (100,150,200 mg / L was investigated for pre-cuticle removal in a continuous aeration biological reactor. Results: The results showed that the removal efficiency of pericticle at an input concentration of 25 mg / l, hydraulic retention time 8 hours and at BOD5 input at 150 mg / l in the aeration reactor the highest percentage of results indicate that with increasing BOD input percentage Deletion increases and the percentage of deletion decreases with increasing concentration of the input cuticle. Discussion and Conclusion: The results of this study indicate that the process of biodegradation of continuous aeration can have a good efficiency in removing the pericarp and the results showed that the removal efficiency can be 99%.

Keywords: *Activated sludge, Continuous aeration, Biological process, Practical*

[1] Zahedan University of Medical Sciences, Sistan and Baluchestan, Iran

I. Introduction

Discharge of sewage and effluents to receiving waters and resistant and toxic compounds has caused a shortage of water resources and environmental problems and has forced humans to use various solutions to treat wastewater and reuse it. Among the various contaminants, phenol compounds and their derivatives (cuticles) are of special importance (1, 2). The cuticle or pyrocticle 2,1-dihydroxybenzene is a phenolic compound with the molecular formula C6H4 (OH) 2 (3). Phenolic compounds are materials in which one or more hydroxyl groups are attached to a benzene ring. Aromatic hydrocarbons with a production of millions of tons per year are among the 50 compounds that have the largest volume of chemical production, which is widely used in photography, cosmetics, rubber, antioxidant production, chemical compounds, agriculture and industrial wastewater. There are various such as coal conversion, coking, pesticides, insecticides, oil refineries, pulp and paper, plastics, textiles, paints, polymer resins, medicines, wood, etc. (4,5). These compounds are contaminants that have very harmful effects on living organisms even at low concentrations and are widely found in industrial solutions (6). About 20 million kilograms of pericardium are consumed annually in the world (7), which after entering the environment can easily accumulate in soil, surface water and groundwater and cause one of the most important environmental concerns (8). This compound affects the quality of water resources. In humans and other living organisms, exposure to pyrocticol can lead to estrogen degradation, damage to the nervous system and its precursors, eye, skin and respiratory tract irritation, and its metabolite can lead to neurological diseases, DNA damage, and Even death (9). Due to the difficulty of reducing and eliminating it, strict standards have been set for the discharge of phenolics into the environment (7). Pyroctocol is a priority and dangerous pollutant and has been listed in the US Environmental Protection Agency's International Agency for Research on Carcinogenesis (7). Due to these problems, the removal of phenolic compounds from industrial wastewater is an important matter for maintaining public health and the environment and is one of the necessary components in the wastewater treatment systems of these industries. Various methods have been proposed for the removal of phenols and phenolic compounds, including adsorption, chemical oxidation, precipitation, distillation, solvent adsorption, ion exchange, membrane processes, reverse osmosis, electrochemical methods, irradiation, etc. (10). Most of these methods have disadvantages such as high treatment cost, need for additional treatment, formation of hazardous by-products, low efficiency and applicability for limited concentrations of contaminants (11). At present, scientific attention is focused on the use of biological methods as an environmentally friendly alternative to the removal of emerging contaminants (11,12). Among the mentioned methods, the biological system is used more than other methods due to its greater compatibility with the environment and is considered safer from an environmental point of view (13). For example, in the process of adsorption of pollutants, they are absorbed unchanged and temporarily on the adsorbent and may release pollutants back into the environment under the influence of various factors. Another advantage of these systems over chemical methods is that they usually do not use any chemicals that are harmful to the environment (14). Among the methods of biodegradation, we can mention the process of suspended growth and adhesion growth, which in the process of suspended growth (such as activated sludge oxidation stream process, have lagoons, and in the attached growth process (such as drip filter and rotating biological reactor) microorganisms in the reactor. Some ineffective fillers adhere and remain (15). Activated sludge process is a process of biological treatment of aerobic suspended growth and uses active microorganisms that are suspended in the reactor to decompose and stabilize dissolved organic matter and colloidal and suspended particles of wastewater (16). Activated sludge contains autotrophic and heterotrophic nitrifying bacteria and nitrobacteria that perform the process of ammonia adsorption well (17). Extensive aeration is one of the most common methods of treatment with activated sludge in the world and is widely used to treat wastewater and effluents of communities. The wide aeration activated sludge process is similar to the conventional piston flow process, except that the extensive aeration process in the endogenous (self-destructive) respiration phase utilizes a bacterial growth curve that requires less organic loading and longer aeration time than other sludge process methods. It is active, so the cost of electricity consumption increases (18). Wastewater treatment plants with activated sludge method are involved in the problem of floor and balcony kink in treatment, which disrupts the operation and management of the wastewater treatment plant. Bulking is caused by the overgrowth of filamentous microorganisms, which interferes with the deposition of activated sludge clots and poor solids density, thereby reducing the efficiency of biological treatment (19), but in the extensive aeration system the reason for eliminating the initial settling unit is long aeration time. (Cell retention time). Among activated sludge systems, the highest BOD removal efficiency of 90 to 98% is related to the extensive aeration process. In activated sludge with extensive aeration, the hydraulic retention time is about 18 to 36 hours. Due to the long retention time, the F / M ratio in this method is lower than other activated sludge methods and as a result a large number of microorganisms in the aeration pond due to lack Nutrients are destroyed and some microorganisms are used to synthesize and grow new microorganisms (20), so the volume of sludge produced in this process is less than other activated sludge processes. In addition, the sludge obtained by this method is stable and dehydrates well. In this process, the sludge age is 20 to 30 days and aeration is performed by surface mechanical aeration or diffusion system (21, 22). The most important factors affecting the efficiency of the biological wastewater treatment process are the appropriate selection of design, operation and maintenance parameters (23, 24). In a study by Gonzalez et al., (2001) The results showed that phenol degradation by conventional activated sludge and isolated bacteria was more than 90% efficient (25). Therefore, due to the presence of phenolic compounds in the wastewater of these industries and having toxic effects, the use of efficient treatment system to protect the environment in this regard is necessary and inevitable. Evaluation of the efficiency of percutaneous removal in biological process using extensive aeration. In a study conducted by Mal et al. In 2017 on the biological removal of selenite and ammonium using activated sludge in a sequence classification reactor, the results showed that SBR can remove both selenite and ammonium through biorodoxification and nitrogen desorption, respectively. Eliminate partial denitrification and thus treat selenium and ammonium contaminated waste (26) Also in another study conducted by Hydra et al. In 2016 entitled Biological treatment of tanning wastewater using activated sludge process, the results of this study showed that efficiencies above 90% and 80% for BOD5 and COD, respectively. Sequence can be achieved if ASP operates in the MLVSS range of 3500 mg / L with an aeration time of 12 hours (27) Also in a study by Flas et al. In 2012 entitled Elimination of five acidic drugs ibuprofen, ketoprofen, naproxen, diclofenac and clofibric acid using activated sludge from five urban activated sludge treatment processes with different sludge ages and nitrification capacities, through Batch experiments were performed.

Increasing the age of aerobic sludge from 1 to 3 and 7 was very important for the removal of naproxen and ketoprofen and a significant amount of it increased in the sludge for 7 days or more, which shows that the removal of biodegradable drugs in urban activated sludge processes is highly It depends on the community of heterotrophic bacteria (28).

II. Methods

This study is experimental and laboratory. The study population consists of synthetic solutions containing different concentrations of cuticles. Inclusion criteria for synthetic samples contain contaminant concentrations of cuticle. Sampling is done after the experiments and the number of samples according to the variable under study and finding the optimal point will be according to the table below.

Given that the range of pre-cuticle in 5 concentrations is 5,10,25 mg / l and 4 is limited hydraulic retention time 2,5,8,24, (hours) and load range up to 100,150,200 (mg / l) in terms of Is BOD and the number of tests is 60.

Table 1. test variables

Variable name	Test range	Number of tests
Catechol concentration	5,10,25, mg per liter	5
Hydraulic retention time	2, 5, 8, 24, (hours)	4
Biological oxygen demand	100,150,200 (mg per liter)	3
Total		60

The data collection tool is collected through direct reading with the relevant spectrophotometer and according to the percentage of deletion, the efficiency of the process will be evaluated. The method of this research is to first make specific concentrations of cuticle and draw a standard diagram.

Experiments will be used continuously using a glass column with a width and width of 0.4 m and a height of 0.3 m. The hydraulic retention time will be adjusted according to the specificity. The desired substrate is filled with nutrients (manganese chloride, copper sulfate, sodium oxide, sodium molybdate, zinc sulfate, cobalt chloride, acetate, ammonium chloride, manganese sulfate, calcium chloride, hydrogen, potassium phosphate, activated hydrogen oxide, hydrogen peroxide, hydrogen sulfide, hydrogen peroxide, hydrogen sulfide, hydrogen sulfide Zahedan sewage house will be provided and ventilation will be continuous.

The oxygen concentration of the solution will be monitored regularly. 0 The minimum amount of O2 will be maintained at about 3 mg / l. Nutrient recirculation will be permanent. The specified will be returned to the aeration tank through the control valve. After 3 weeks of controlling the formation of pre-cut biofilm with the specified concentration during the expressed hydraulic retention time, the output pre-cuticle will be measured. In this study, the effect of pre-cuticle concentration factors (5,10,25, mg / l) on hydraulic retention time (2,5,8,24, (h)) will be investigated. The elements will be under constant conditions, the set temperature will be 35 degrees.

III. Findings

In order to investigate the elimination of pericardial depletion in continuous aeration reactor, suspended growth and biodegradation, parameters of pericardial output concentration, hydraulic timing (HRT), inlet load, MLSS, MLVSS, DO, pH were measured in the reactors.

Determination of perictal removal in terms of Biological oxygen demand (BOD5) in biodegradation using continuous aeration reactor

Examination of Figure 1 shows that in the hydraulic stand time of 2 hours with increasing the input BOD from 100 to 150 mg / l, the removal percentage increased from 99.13 to 99.47. 84/80 has decreased. And in the hydraulic time of 5 hours with increasing the input load from 100 to 150 mg / l, the percentage of perictal removal has increased from 88.21 to 99.48. In the input equal to 200 mg / l, the percentage of pericardial removal decreased by 81.02 and in the hydraulic retention time of 8 hours, with increasing BOD, the inlet from 100 to 150 mg / l pericardial removal increased from 92.26 to 99.38% and in BOD Equivalent to 200 mg / l, the percentage of pericardial removal decreased to 58.80%. During the hydraulic retention time of 24 hours, with increasing the input BOD load from 100 to 150 mg / l, the percentage of pericardial removal increased from 92.26 to 99.58 and at the inlet equal to 200 mg / l, in pericardial removal to 86.84% Dropped.

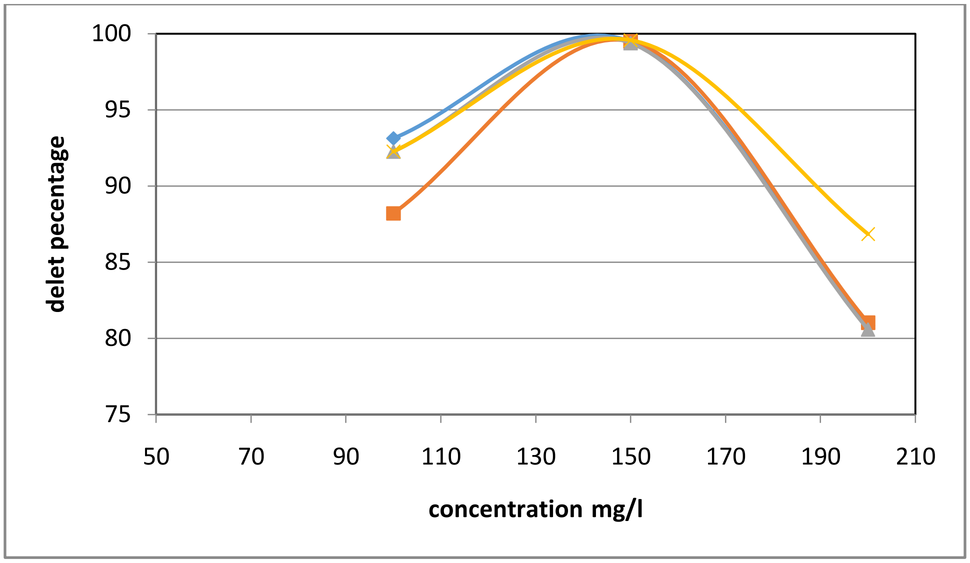

Figure 1. Effect of different organic loads (input BOD) on the removal of pre-cuticle at different hydraulic retention times in a continuous aeration reactor (initial concentration of pre-cuticle 5 mg / l)

Examination of Figure 2 shows that at a concentration of 10 during the hydraulic time of 2 hours with increasing the input BOD from 100 to 150 mg / l, the percentage of pericardial removal increased from 99.36 to 99.73. In the input BOD equal to 200 mg / l, the percentage of pericardial removal has decreased by 82.88. The input BOD of 200 mg / l decreased the pericardial removal percentage to 84.13. With a residence time of 8 hours, with increasing the input BOD from 100 to 150 mg / l, the percentage of pericardial removal decreased from 99.98 to 99.71. In BOD inpute 200 mg / l, the removal percentage has decreased to 84.13. In BOD equal to 200 mg / l, the percentage of pericardial deletion decreased by 91.54.

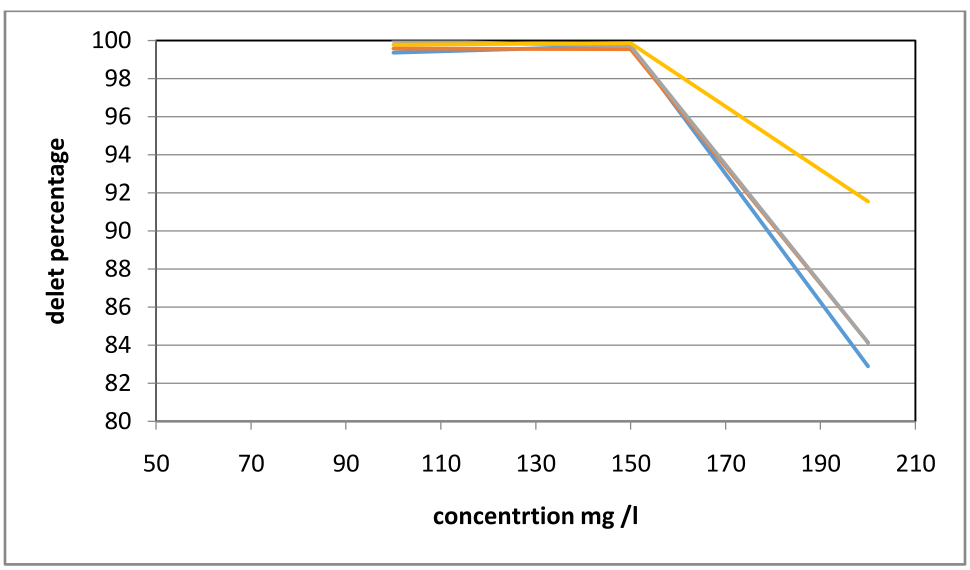

Figure 2. Effect of different organic loads (input BOD) on the removal of pre-cuticle at different hydraulic retention times in a continuous aeration reactor (initial concentration of pre-cuticle 10 mg / l)

Examination of Figure 3 shows that in the hydraulic stand time of 2 hours with increasing the input BOD from 100 to 150 mg / l, the percentage of pericardial removal increased from 99.91 to 99.95. And in BOD equal to 200 mg / l , The percentage of removal has decreased to 96.49. And with a residence time of 5 hours, with increasing the BOD of input from 100 to 150 mg / l, the percentage of removal of pre-cuticle has decreased from 99.78 to 99.49. In BOD equal to 200 mg / l, the percentage of pericardial removal has increased to 99.78%. And in the hydraulic retention time of 8 hours, with increasing the input BOD from 100 to 150 mg / l, the percentage of pericardial removal has increased from 99.66 to 99 / Increased by 99%. In the input BOD equal to 200 mg / l, the percentage of pericardial removal is reduced by 97.21. / 98 has decreased. In BOD, the input equal to 200 mg / l has increased 99.37% of the pericardial removal percentage.

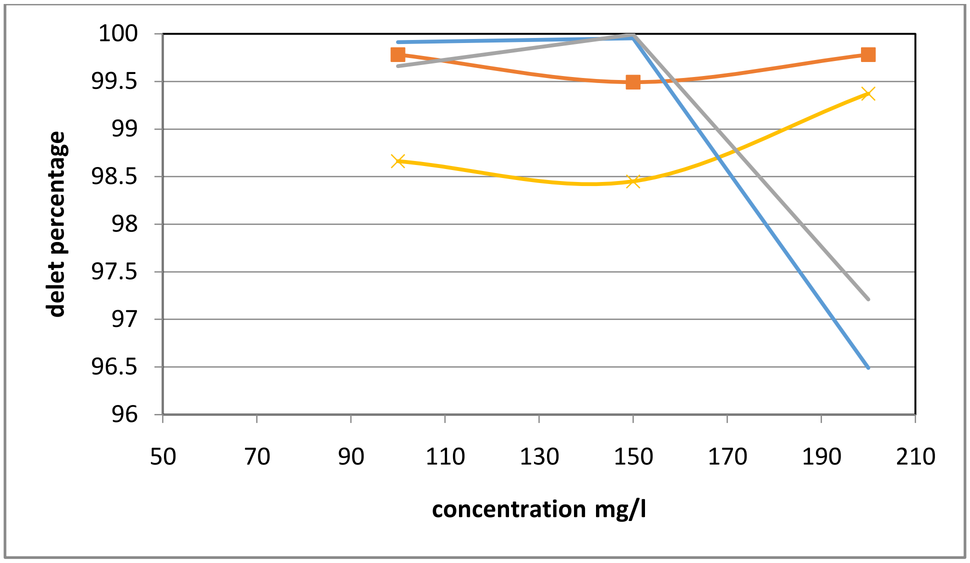

Figure 3. Effect of different organic loads (input BOD) on the removal of pre-cuticle at different hydraulic retention times in a continuous aeration reactor (initial concentration of pre-cuticle 25 mg / l)

Determination of different concentrations in the removal of pre-cuticle at different load inlet to BOD in the reactor in a continuous aeration reactor

Examination of Figure 6 shows that in the initial BOD equal to 100 mg per liter with increasing concentration from 5 to 10% removal of the pericarp increased from 93.13 to 99.36. In BOD 150 mg / l with increasing concentration of 5 to 10 mg / l the removal percentage has increased from 99.47 to 99.73. Also in the initial BOD equal to 200 mg / l with increasing concentration from 5 to 10 mg / l increased from 80.84 to 82.88% Also the diagram shows that in BOD 100 mg / l and concentration 10 mg / l The highest percentage of deletion (99.98%) has been done

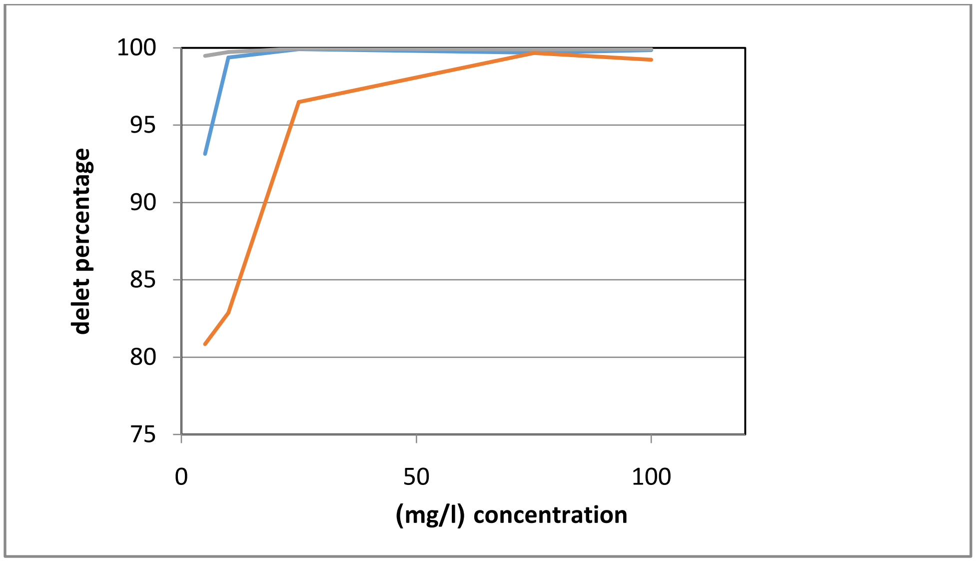

Figure 4. Effect of different concentrations on pericardial removal at different load inlet to BOD in the reactor in a continuous aeration reactor with suspended growth (during hydraulic retention time 2 hours)

Examination of Figure 8 shows that during hydraulic retention 8 in the input BOD equal to 100 mg / l with increasing initial concentration from 5 to 10 mg / l, the removal percentage increased from 92.26 to 99.98% removal efficiency and in the BOD equal to 150 mg / l with Increasing the concentration from 5 to 10 mg / l, the removal percentage increased from 99.35 to 99.71 and in the initial BOD equal to 200 mg / l with increasing the concentration from 5 to 10 mg / l, the removal efficiency increased from 80.58 to 84.13%. The diagram also shows that at a residence time of 8 hours, the highest removal efficiency occurred at a concentration of 100 mg / l and BOD 150 mg / l.

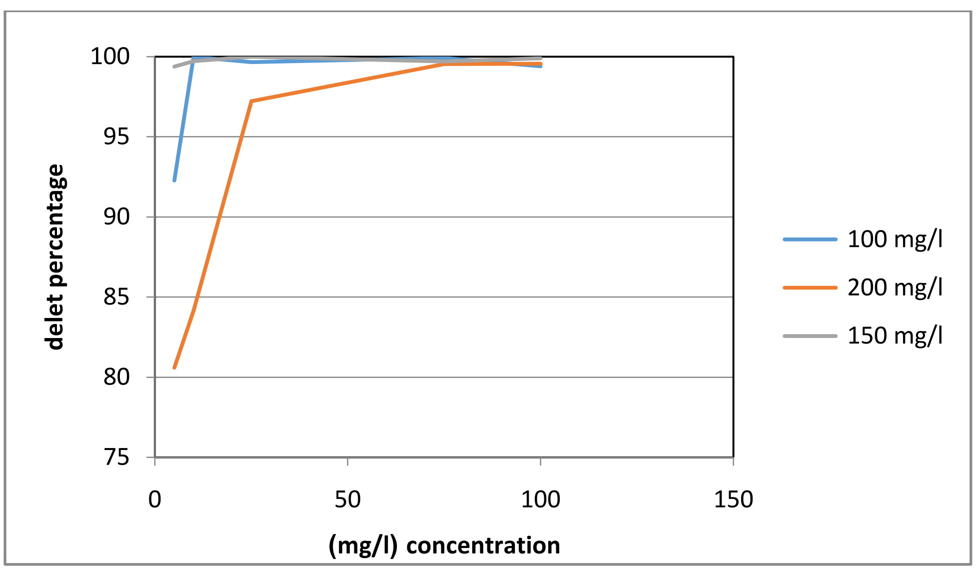

Figure 5. Effect of different concentrations on perictal removal at different inlet load to BOD in the reactor in a continuous aeration reactor suspended growth (during hydraulic retention time 8 hours)

Examination of Figure 9 shows that during hydraulic retention time of 24 hours in BOD 100 with increasing concentration from 5 to 10 mg / l, removal efficiency increased from 92.26 to 99.78%. Inlet BOD equal to 150 mg / l with Increasing the concentration from 5 to 10 mg / l removal efficiency increased from 99.58 to 99.85 and in the input BOD equal to 200 mg / l removal efficiency increased by increasing the concentration from 5 to 10 mg / l from 86.84 to 54 / 99 has increased The results show that in 24 hours in BOD 150 and concentration of 100 mg / l we had the highest removal.

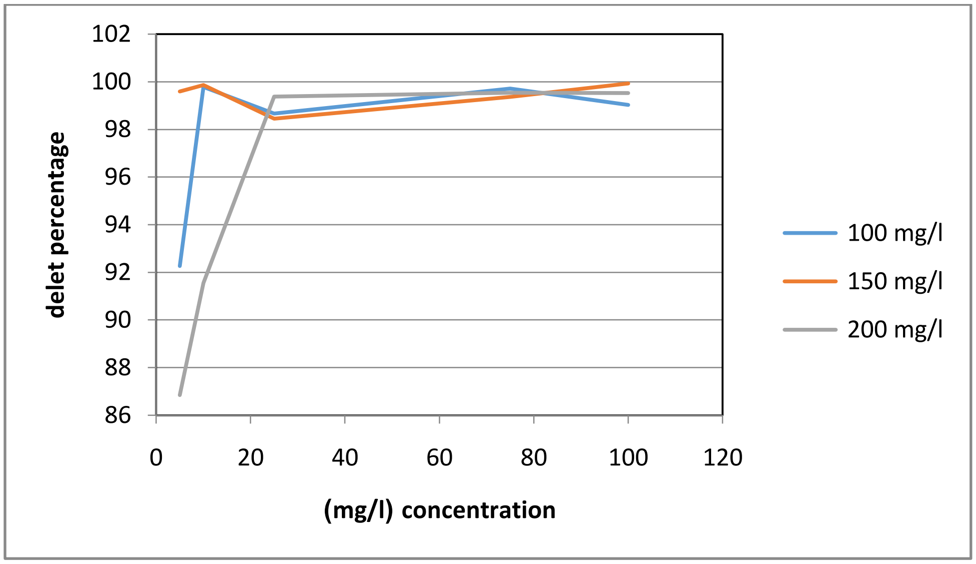

Figure 6. The effect of different concentrations on the removal of pre-cuticle at different load inlet to BOD in the reactor in a continuous aeration reactor suspended growth (during hydraulic retention time 24 hours)

IV. Conclusion discussion

Extensive aeration method is one of the most common sludge treatment methods in the field, which is widely used for wastewater treatment and effluents of small communities. The process of active aerated sludge is similar to the conventional piston flow process. The difference is that the extensive aeration process in the endogenous self-destructive respiration phase utilizes a bacterial growth curve that requires less organic loading and longer aeration time. Due to the longer aeration period compared to other methods of activated sludge process, the cost of electricity consumption increases. One of the most important problems of operation and operation in different systems of activated sludge is the production of floor and sludge volume as a result of reducing the efficiency of wastewater treatment plant. About 40 activated sludge treatment plants in the world face floor and balking problems.

Effect of Hydraulic Retention Time (HRT) on the Performance of Continuous Growth Suspended Aeration Reactor in Pericardial Removal.

Hydraulic retention time is one of the important parameters of the operation of biological systems, which while providing the appropriate contact time between the active microbial mass and the refined organic matter, prevents the leaching of the active cell mass. Overall, the results of this study showed that the highest percentage of pericardial deletion in a continuous aeration reactor with an initial concentration of pericandicle of 25 mg / L; In BOD 150 and the hydraulic retention time was 8 hours, which is 99.99% removal rate. In less than 8 hours of contact time, the removal efficiency of this contaminant is reduced. Farzadkia et al. (2008) stated that with decreasing hydraulic retention time, MLSS concentration also decreases, which reduces the number of decomposing microorganisms and reduces removal efficiency. Also, reducing hydraulic retention time reduces the amount of contact between contaminants and microorganisms. This leads to a portion of the input pollutant leaving the aeration reactor undecomposed (29). Li et al. (2015) in relation to the biological removal of organic pollutants showed that by increasing the hydraulic load in aerobic biological processes and Anaerobic reduction efficiency is reduced (30) Another study showed that the maximum removal in 8 hours at a concentration of 30 mg / l will be 90% (31) Effect of input pre-cuticle concentration on the efficiency of suspended aeration continuous aeration reactor in removal of pre-cuticle. The results of this study showed that in general, with increasing the concentration of inlet precuticle from 5 to 25 mg / l at all times of hydraulic retention (2, 5, 8 and 24 hours) and at organic inlet loads (100, 150 and 200 mg / l), the removal efficiency increased. But the best removal efficiency occurred at a concentration of 25 mg / l in 8 hours and an organic load of 150 mg / l. In BOD150 mg / l and hydraulic retention time of 8 hours, with increasing the concentration of inlet periculum from 5 to 25 mg / l, the removal efficiency increased from 99.38 to 99.99%.

Ali Ahmad Aghapour et al. (2013) stated that if the input concentration increased from 630 to 960 mg / l then to 1295 and finally to 1560 mg / l, the percentage of cuticle removal was 91%, 93% and 91%. ٪Is reduced. Also, the steady state time for the input-periculture concentration is 630, 960, 1295 and 1560 mg / l 20, 10 and 30 days. When the concentration of the input pericardium changes to a higher level, SCR performance initially decreases but then improves after a few days and reaches stability. The sudden decrease in COD efficacy and removal of the pericardium with increasing pericardial concentration may be due to inhibition of the cuticle in the process of microbial metabolism. The higher the intake, the higher the inhibitory effect of the cuticle, resulting in a greater rate of degradation and consequently a longer recovery period (32).

Nakhli et al. (2014) also showed that increasing the phenol input concentration from 1000 to 1200 mg / l reduces phenol removal from 97.6% to 94%, respectively. The rate of COD reduction compared to phenol at input concentrations of 1000 and 1200 mg / l was less than 93% and 85.1%, respectively. At low phenol concentrations, no effect is observed on the impurities of metabolic activity such as specific growth rate, respiration rate, synthesis rate, etc., but with increasing phenol concentration, biological parameters will increase due to the metabolism of microorganisms. Further increase in concentration does not increase biological parameters. Further increase in phenol concentration eventually reduces physiological parameters and inhibits substrate use (33). In a study conducted by Mostafapour et al. Mg / L has reduced the efficiency so that increasing the dye concentration can affect the metabolism of bacteria at a certain dye concentration can stop growth due to toxicity (34).

Effect of Input Organic Load (BOD) on the Performance of Suspended Growth Continuous Aeration Reactor in Removing Pre-Cuticle The results of the study show that by increasing the BOD from 100 to 200 mg / L at low concentrations of pollutants (5,10,25 mg / L) Removal efficiency is reduced. In general, it can be said that the removal of pericardium at all different input concentrations (5, 10, 25 mg / l) and hydraulic retention times (2, 5, 8, 24 hours); BOD150 mg / l had the highest efficiency.

The study of JafarzadehL et al. To investigate the effect of biofilm on activated sludge process showed that the rate of COD removal at 0.29 kg kg COD / m3.h loading was equal to 98.86% and with increasing this loading 0.43 kg COD / m3.h decreased to 64% but In conventional activated sludge, system performance was completely disrupted by this loading. (35).

Suggestions

Use this process to remove other phenolic contaminants

Identification of phenol-degrading aerobic bacteria in this process

Examine the results of this test at other concentrations such as 75 and 100 mg / l and compare with other concentrations

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