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FULL LENGTH ARTICLE

Studies on Nutrient removal using Polypropylene Fibre (PPF) in Moving Bed Bio reactor (MBBR)

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ABSTRACT
MBBR (Moving Bed Bioreactor) is used for nutrient removal from synthetic wastewater and Actual Wastewater (i.e Kesare Wastewater) consisting of sequence of operation which includes-fill, anaerobic, aerobic, settle and decant phases. The steps in the react cycle are adjusted to provide anaerobic and aerobic phases in certain sequence with variations in duration of time to achieve maximum percent removal of COD, ammonia-nitrogen, nitrate-nitrogen and phosphorous. Polyproplyene Fibre (PPF) with 20% dilution was used as media in MBBR.MBBR with Polyproplyene Fibre (PPF) of 20% volume had removal efficiency of 100%, 95.51%, 96.62% and 97.48% for COD, Phosphate, Nitrate and Ammonia Nitrogenfor synthetic Wastewaterand 98.46%, 96.85%, 96.85% and 82.41% for COD, Phosphate, Ammonia Nitrogen and Nitrate for Actual Wastewater respectively (i.e Kesare Wastewater).
Keywords*: Moving Bed Bioreactor, Polyproplyene Fibre (PPF)*

INTRODUCTION

The MBBR was developed in Norway at the Norwegian University of Science and Technology in co-operation with a Norwegian company Kaldnes Miljoteknologi (now Anox Kaldnes AS). The Moving Bed Biofilm Reactor (MBBR) is a highly effective biological treatment process that was developed on the basis of conventional activated sludge process and bio-filter process. It is a completely mixed and continuously operated Biofilm reactor, where the biomass is grown on small carrier elements that have a little lighter density than water and are kept in movement along with a water stream inside the reactor. This media is designed with a maximum ratio of surface area to weight, and serves as a 'bio-carrier' to which microorganisms attach and form communities. The movement inside a reactor can be caused by aeration in an aerobic reactor and by a mechanical stirrer in an anaerobic or anoxic reactor.

Experimental Setup

Reactors was used with media with Polypropylene Fibre (PPF) of 20% volume was filled with total volume of 5L. The working volume of MBBR was 4L, the influent used was the synthetic wastewater representing the characteristics domestic wastewater. Cow dung was used as seed culture for MBBR. The COD, ammonium nitrogen and phosphorous concentration in synthetic Wastewater was 400 mg/L, 32 mg/L and 12.5 mg/L respectively. Before starting the reactor, it was filled with the synthetic wastewater, inoculated with cow dung was operated continuously with aeration and mixing for several days to obtain a dense culture. Aeration was provided by using compressor connected to diffuser stones. At end of each cycle, the mixed liquor suspended solids were allowed to settle for 30 min and 50% of treated wastewater was removed for analysis.

RESULTS AND DISCUSSION

Performance of MBBR using Synthetic Wastewater with Polyproplyene Fibre (PPF) of 20% Volume

Figure 1 and 2 shows the variation of COD and phosphorous for the entire study period for polypropylene fibre of 20% volume. The influent COD concentration and phosphorous maintained was 540mg/L and 14.28 mg/L respectively. On the day 1, the COD uptake in the anaerobic phase was 412.8 mg/L and corresponding phosphorous release observed was 12.11mg/l. On the day 36, the COD concentration

during anaerobic phase was6.4mg/l and corresponding phosphorous release was 8.86mg/l and in subsequent the COD concentration during aerobic phase was 3.2mg/l and phosphorous release was 4.66mg/l. In MBBR since the substrate is consumed within the biofilm, the rate of COD uptake was high, and this is because MBBR had another portion of biomass provided by the attached growth. COD got reduced to 16 mg/l within 20 days of startup of the reactor.MBBR with Polyproplyene Fibre (PPF) of 20% volume had removal efficiency of 100%, 95.51%, 96.62% and 97.48% for COD, Phosphate, Nitrate and Ammonia Nitrogen respectively for synthetic Wastewater. Figure 3and 4 shows variation of ammonia nitrogen and nitrate nitrogen at the end of anaerobic and aerobic phases Denitrification process was efficient after 30 days and concentration of Nitrate nitrogen was below 4 mg/l.

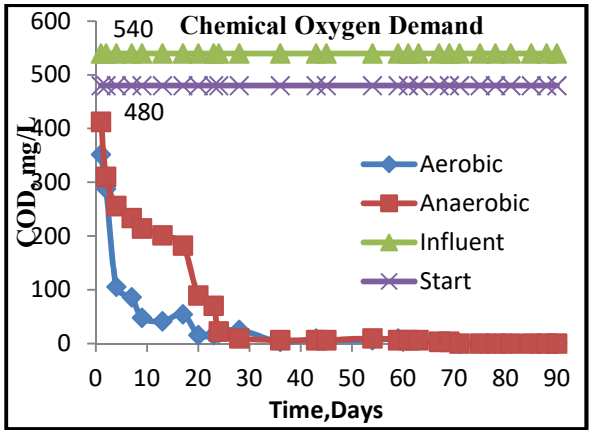

Figure 1

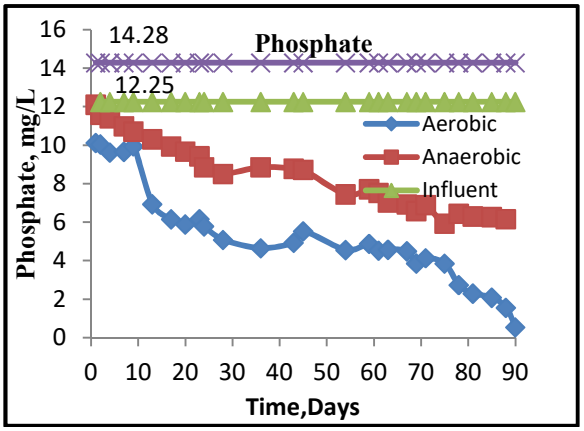

Figure 2

Figure 1 Variation of COD in a cycle of MBBR using Polyproplyene Fibre (PPF) of 20%Volume

Figure 2 Variation of Phosphate in a cycle of MBBR using Polyproplyene Fibre(PPF) of 20%Volume

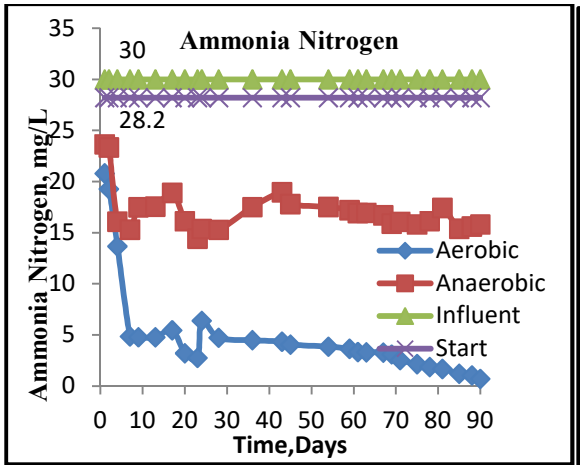

Figure 3

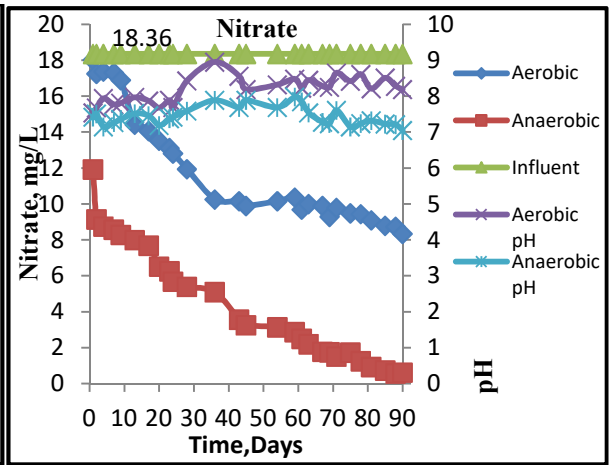

Figure 4

Figure 3 Variation of Ammonia Nitrogen in a cycle of MBBR using Polyproplyene Fibre (PPF) of 20%Volume

Figure 4 Variation of Nitrate Nitrogen in a cycle of MBBR using Polyuproplyene Fibre (PPF) of 20%Volume

3.2 Track Studies of MBBR using Polyproplyene Fibre (PPF) of 20% Volume

Track studies were conducted using Polyproplyene fibre of 20% Volume. Figure 5, 6 and 7 shows variation of COD, pH and ammonia nitrogen.

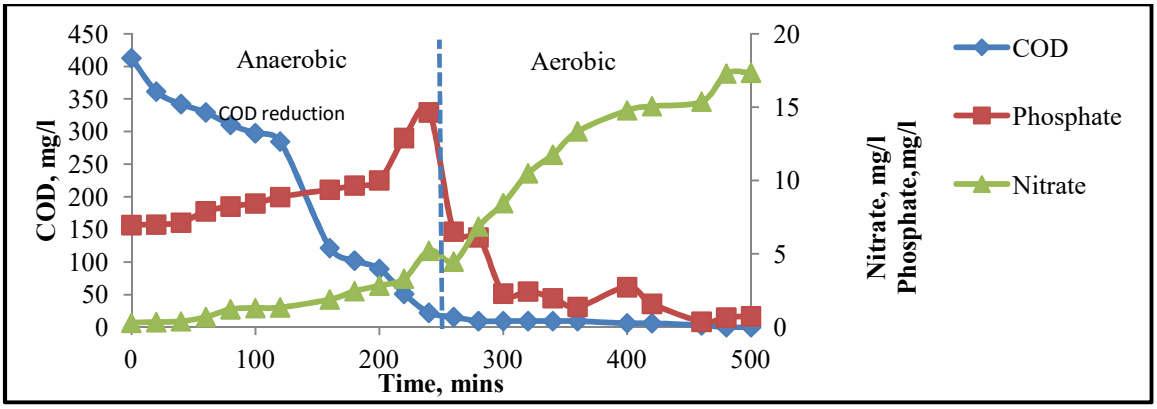

Figure 5 Variation of COD, Nitrate and Phosphate with Polyproplyene Fibre (PPF) of 20% Volume

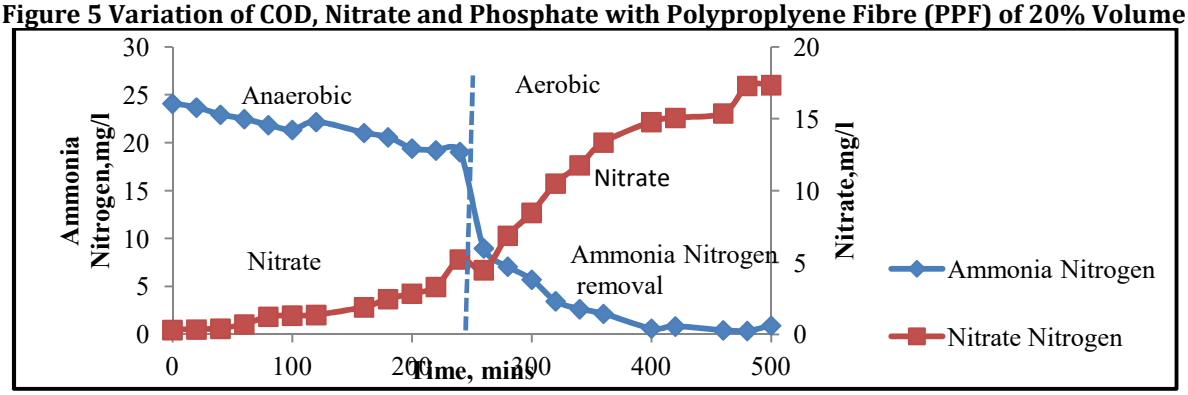

Figure 6 Variation of Ammonia Nitrogen and Nitrate Polyproplyene Fibre (PPF) of 20% Volume

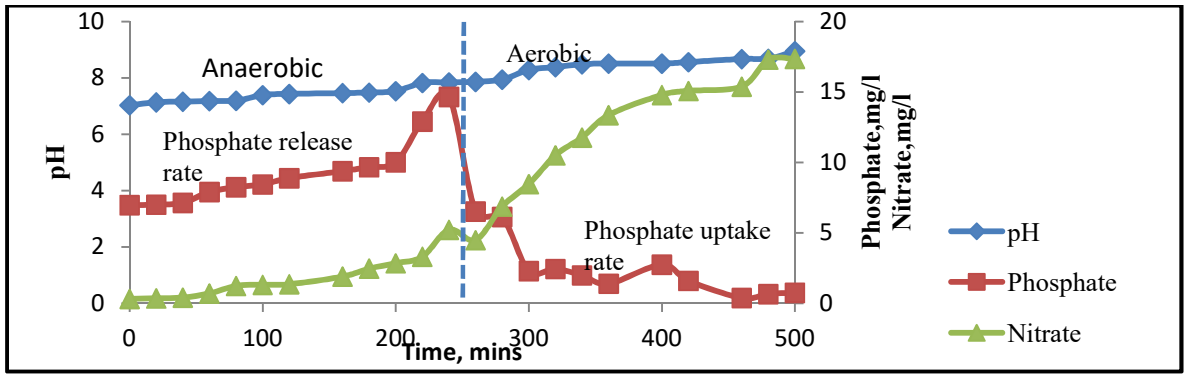

Figure 7 Variation of pH, Phosphate and Nitrate Polyproplyene Fibre (PPF) of20% Volume

Performance of MBBR using Polyproplyene Fibre(PPF) of 20% Volume using Kesare wastewater

Figure 8, 9 shows variation of COD and phosphorous for the entire study period using polypropylene fibre of 20% volume. The influent COD concentration and phosphorous maintained was 416.6 mg/L and 28.27 mg/L respectively. On the day 1, the COD uptake in the anaerobic phase was 416 mg/L and corresponding phosphorous release observed was 24 mg/l. On the day 30, the COD concentration during anaerobic phase was 6.4 mg/l and corresponding phosphorous release observed was 4.96mg/L and in subsequent the COD concentration during aerobic phase was 6.4 mg/L and phosphorous release was 0.86mg/L. Even though the initial fluctuations were seen in the reactor. It got stabilized after 12 days of start up. COD was effectively removed after 22 days. Denitrification process was effectively observed. Nitrate nitrogen was below 2mg/l within 18 days of period.Figure 10 and 11 shows variation of Ammonia nitrogen and nitrate. Hence Polyproplyene Fibre(PPF) of 20% Volume was efficient in removing nutrients from synthetic and actual wastewater.

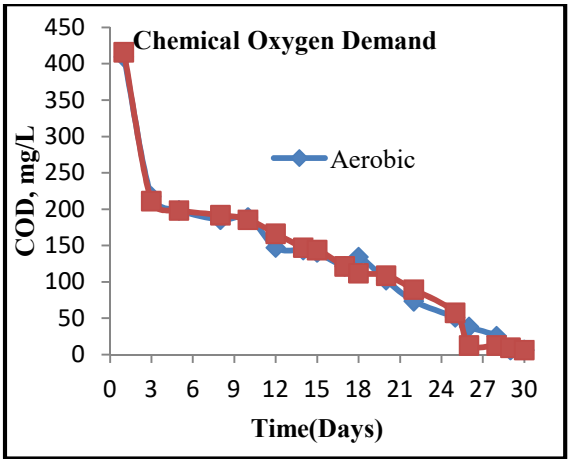

Figure 8

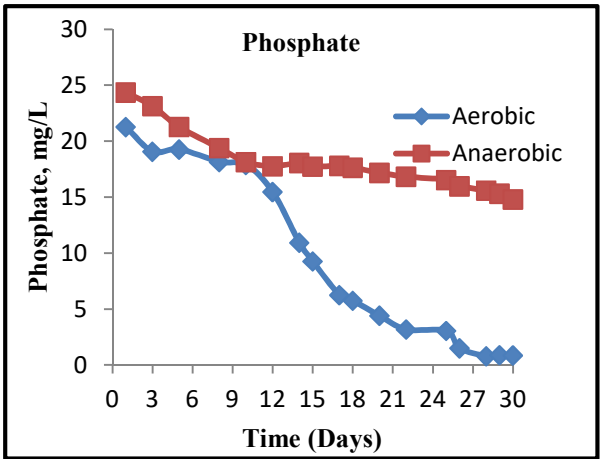

Figure 9

Figure 8 Variation of COD in a cycle of MBBR using Polyproplyene Fibre (PPF)of 20%Volume
Figure 9 Variation of Phosphate in a cycle of MBBR using using Polyproplyene Fibre (PPF) of 20%Volume

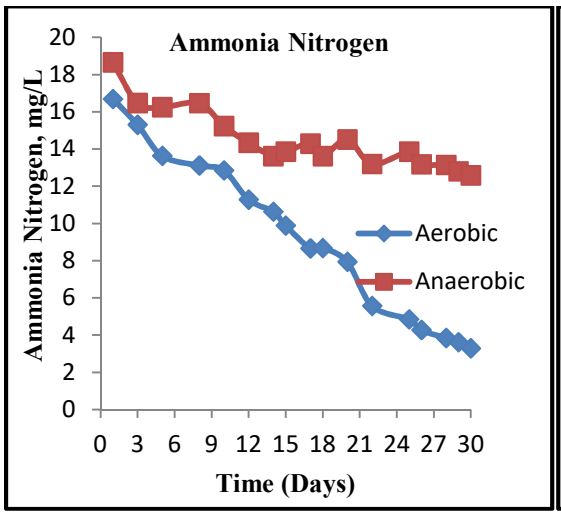

Figure 10

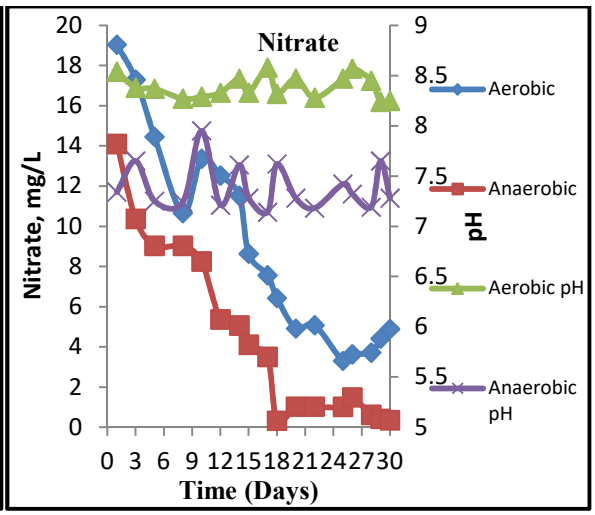

Figure 11

Figure 10 Variation of Ammonia Nitrogen in a cycle of MBBR using Polyproplyene Fibre (PPF) of 20%Volume
Figure 11Variation of Nitrate in a cycle of MBBR using using Polyproplyene Fibre (PPF)of 20%Volume

CONCLUSION

MBBR with Polyproplyene fibre (PPF) of 20% volume showed stable performance for COD with 16mg/l within 23 days.Ammonia nitrogen got reduced to 0.71mg/l for entire study period. For the same volume trial run was carried out using Kesare wastewater;nitrate concentration was below 1 mg/l after 22 days. MBBR with Polyproplyene Fibre (PPF) of 20% volume had removal efficiency of 100%, 95.51%, 96.62% and 97.48% for COD, Phosphate, Nitrate and Ammonia Nitrogen respectively for synthetic Wastewater. MBBR with Polyproplyene Fibre (PPF) of 20% volume had removal efficiency of 98.46%, 96.85%, 96.85% and 82.41% for COD, Phosphate, Ammonia Nitrogen Nitrate respectively for Actual Wastewater (i.e Kesare Wastewater). Hence Polyproplyene fibre (PPF) proved to be efficient media for nutrient removal.

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