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Study on Treatment efficiency of Rubber Processing Effluent using Pseudomonas Fluorescens

Meenu George
Department of Civil Engineering,
Government Engineering College, Thrissur,
India

Meena John M
Department of Civil Engineering,
Government Engineering College, Thrissur,
India

Abstract:- **Even though rubber processing industry plays a significant role in polluting the water bodies they contributes to a major portion of income in Kerala .Hence it is necessary to reduce the pollution from rubber processing industry. The present study was conducted to develop an ecofriendly process for the treatment of rubber processing industry effluent using Pseudomonas fluorescens. Rubber processing industry consumes a large quantity of water which is disposed as waste water. Economical and bio-friendly approaches are needed to remediate wastewater from rubber processing industry. Hence, a study was conducted with the aim of treating and disposing of rubber processing industry effluent that is rich in BOD, COD, PO_4, NH_4 and solids. The bacterium used in this study is pseudomonas fluroscens which will survive in the rubber processing effluent. The efficiency of both the species in treating the effluent was studied with varying bacterial dosage and contact time. The treatment using pseudomonas sp yielded BOD, COD, TDS, Ammonia and Phosphate removal of 71.21%, 73.31%, 74.31%, 72.16% and 65.14% respectively.**

INTRODUCTION

Among the natural resources, water is considered to be the precious resource hence it is required to be saved and maintained in its quality as well as quantity. An adequate way of conserving water is by recycling the waste water from industries, as they are the major contributors of water pollution. As the waste water from industries consists of large number of pollutants, it becomes difficult to maintain the water quality standards. Each freshwater body has an individual pattern of physical and chemical characteristics which are determined largely by the climatic, geomorphologic and geochemical conditions prevailing in the drainage basin and the underlying aquifer.

RUBBER PROCESSING INDUSTRY

Rubber processing is considered to be one of the major sources of income to our country. Out of five hundred thousand hectares of rubber plantation in India, Kerala state alone has 75.3 per cent. During the processing of rubber, water is used for washing, cleaning and dilution. As per the studies, amount of effluent generated from an average-sized rubber factory producing about 20 metric tons of rubber was estimated as 410,000 litres per day. The present studies reveals that the latex concentrate effluent contained more suspended solids, dissolved solids, total solids (TS) and volatile solids (VS) which resulted in substantial growth of microorganisms resulting in high Biochemical oxygen demand (BOD) and Chemical oxygen demand (COD). Studies show that the amount of solids plays a significant role in the salinity of effluent. High BOD and COD value of the rubber processing effluent indicate that the TS in the effluents are mainly organic, especially fine particles of rubber hydrocarbon, with high oxygen requirements for their oxidation.

THEORETICAL BACKGROUND

Pseudomonas fluorescens is a common Gram-negative, rod-shaped bacterium. It is an obligate aerobe, but certain strains are capable of using nitrate instead of oxygen as a final electron acceptor during cellular respiration. Optimal temperatures for growth of *Pseudomonas fluorescens* are 25-30˚C. The efficiency of *pseudomonas fluorescens* in the bioremediation of rubber processing effluent is already studied. In that study, *pseudomonas fluorescens* is isolated from the rubber processing effluent itself, and is used for the treatment of effluent. This organism is capable of reducing the contamination in the rubber processing effluent by neutralizing the acidic pH and also decreasing BOD, COD and TDS.

EXPERIMENTAL PROCEDURE

Rubber processing effluent for analysis was collected from a rubber processing unit in Thrissur. Characteristics of rubber processing effluent was studied in the college laboratory and the results obtained are as follows,

Table 1. Characteristics of rubber processing effluent.

pH	BOD (mg/l)	COD (mg/l)	TDS (mg/l)	Ammonia (mg/l)	Phosphate (mg/l)
4.7	12601.2	18800	2240	97	48

The experiments were conducted as batch process using digital orbital shaker. 300ml BOD bottles were used, each filled with 100ml rubber processing effluent and pseudomonas fluorescens with varying contact time and varying doses. Sample along with bacterial suspension was kept in digital orbital shaker at a speed of 120 rpm. After every 24 hours, the sample was taken for analysis of the required parameters. The bacterial dosage was varied as 1 ml, 2ml, 3ml etc.. and contact time was varied as 1 day, 2 day and so on.

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RESULTS AND DISCUSSIONS

100ml rubber processing effluent was inoculated with varying dosages of *pseudomonas fluroscens* was kept in a digital orbital shaker at a speed of 120 rpm and the samples were taken at regular intervals and the various parameters were studied.

Effect of varying dosage of pseudomonas fluroscens on effluent parameters.

In this set of experiment the contact time was kept as one day and the revolution speed of the digital orbital shaker as 120rpm. At a dosage of 7ml pH got increased from 4.7 to 7.5 which is in the desirable range of drinking water (6.5 -8.5)

A better BOD removal is obtained at a cell dosage of 7 ml with contact time as 1 day at a revolution speed as 120 rpm. Approximately 71% removal in BOD can be obtained using pseudomonas fluorescens at a dosage of 7ml. As the dosage of *Pseudomonas fluorescens* increase the removal of BOD also increases, but after a dosage of 5ml the reduction in BOD becomes constant. This is due to the increased dead cell mass.

As the dosage increases, the percentage removal in COD increases and after dosage of 6 ml the percentage removal moves to a constant value. Hence 7ml is considered to be the optimum dosage required to attain a better COD removal which gives a BOD of 5025 mg/l. More than 73% removal in COD is obtained at 7ml with 1 day as contact time and 120 as the revolution speed in digital orbital shaker operating at 30^0C.

The effect of dosage of pseudomonas sp on various parameters were obtained as follows

Table 2. Effect of dosage of pseudomonas sp on various parameters

Dosage of pseudomonas Sp in ml	BOD	Percentage removal	COD	Percentage removal	TDS	Percentage removal
1	6653.4	47.2	11229.2	40.27	687.45	69.31
2	5909.96	53.1	10328.7	45.06	604.8	73
3	5279.9	58.1	8787.1	53.26	600.32	73.2
4	4507.4	64.2	6016.0	68	580.16	74.1
5	3632.92	71.2	5027.1	73.26	569.85	74.56
6	3648.04	71.0	5025.0	73.27	577.24	74.23
7	3647.52	71.0	5023.1	73.28	575.45	74.31

Also the removal of TDS was also studied using various dosages of bacterial inoculum with a contact time of 1day and revolution speed of digital orbital shaker as 120 rpm. As the bacterial dosage increases the TDS removal also increases. In the initial stage itself, better removal efficiency is obtained which meets the desirable limit of 500 to 1000ppm. Initial value of TDS was 2240mg/l which got reduced to 575.45mg/l with an efficiency of 74%.

Table 3. Characteristics of rubber processing effluent

Dosage of Pseudomonas fluorescens in ml	Effluent parameters and percentage removal			
	Ammonia (mg/l)	Percentage removal (%)	Phosphate (mg/l))	Percentage removal (%)
1	28.01	67.01	17.04	64.5
2	28.92	70.18	16.8	65
3	26.02	73.17	16.32	66
4	23.28	76	15.79	67.1
5	22.99	76.29	15.65	67.39
6	22.95	76.23	15.264	68.2
7	23.11	76.173	15.266	68.194

At a bacterial dosage of 7 ml, 76% removal of ammonia is obtained i.e. from an initial value of 97mg/l; it is reduced to 22.95mg/l after 24 hours of incubation. An initial removal of 67% was obtained at 1ml dosage (2%) after which the ammonia removal increases as the dosage increases.

Effect of varying Contact time on effluent parameters

Contact time of the experiment was taken as another varying parameter. In this set of experiment the cell dosage and revolution speed of digital orbital shaker were kept constant and the parameters were analyzed after the experiment. The contact time was varied as 1day, 2 day etc... Dosage of Pseudomonas fluorescens was kept as 7ml with a constant revolution speed of 120 rpm.

Table 4. Effect of contact time on various parameters

Contact time Days	Parameters and percentage removal					
	BOD (mg/l)	Percentage removal (%)	COD (mg/l)	Percentage removal (%)	TDS (mg/l)	Percentage removal (%)
1	3574.23	71.63	5069.72	69.31	567.42	74.66
2	3523.83	72	5046.36	71.03	536.06	76.06
3	3525.21	72.02	5044.4	71.2	496.06	77.85

The above table shows the effect of varying contact time in various parameters such as BOD, COD and TDS. From the table, it is clear that contact time has no significance in the case of BOD removal and also in the case of COD removal. That is

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maximum removal of BOD and COD was obtained at a contact time of 24 hrs with dosage of 7 ml *Pseudomonas fluorescens* at a revolution sped of 120 rpm. As the COD and BOD removal and remains constant after 3 days, the treatment was stopped.

Contact time days	Parameters and percentage removal			
	Ammonia mg/l	Percentage removal	Phosphate mg/l	Percentage removal
0	97	0	48	0
1	22.84	76.45	15.34	68.04
2	22	77.31	15.24	68.25
3	21.83	77.43	15.10	68.54

The removal of ammonia and phosphate increases with increase in contact time. But after a period of 3 days the removal remains constant, hence a contact time of 24 hrs was considered optimum with 7ml dosage and 120 rpm as the revolution speed.

CONCLUSIONS

For the giver sample of rubber effluent, 7ml dosage of pseudomonas fluorescens gives better treatment efficiency. It is also observed that varying contact time doesn't show much effect on the treatment efficiency of pseudomonas sp. Increase in dosage of bacterial sp increases the removal efficiency but the removal rate remains constant after a particular dosage here it is 7ml.

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