Table 5: Characteristics of effluent after treatment using Pseudomonas sp.

Time (days)	*pH*	*Total Solids (mg/L)*	*BOD (mg/L)*	*COD (mg/L)*	*Ammonia (mg/L)*
0	4.5	9700	4300	7600	99
3	4.7	9450	4050	7210	74
6	5.5	8700	3800	6500	63
9	6.8	6400	2900	4700	42
12	7.0	4000	1900	2550	30
15	7.7	2600	1600	1950	26

3.2.2 Total solids

The reduction in total solids of rubber effluent after treatment is shown Figure 3. Reduction efficiency of Arthrobacter sp, Pseudomonas sp, Bacillus sp and bacterial consortium were 77.31%, 73.19%, 72.68% and 79.38% respectively. The reduction of TS after treatment might be due to use of suspended organics by microorganisms for their growth and development.

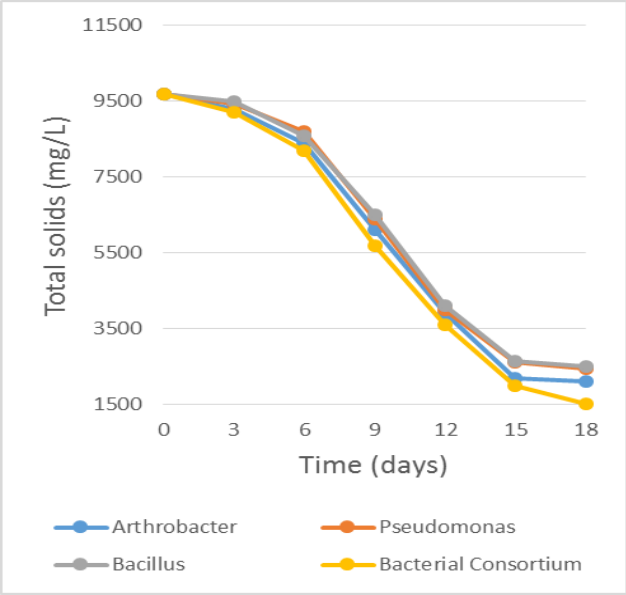

Figure 3: Comparison of total solids after treatment

3.1.3 Biochemical oxygen demand

BOD removal efficiency of Arthrobacter sp, Pseudomonas sp, Bacillus sp and bacterial consortium are 71.16%, 62.79%, 61.62% and 73.25% respectively. The reduction in BOD of rubber effluent after treatment is shown Figure 4.

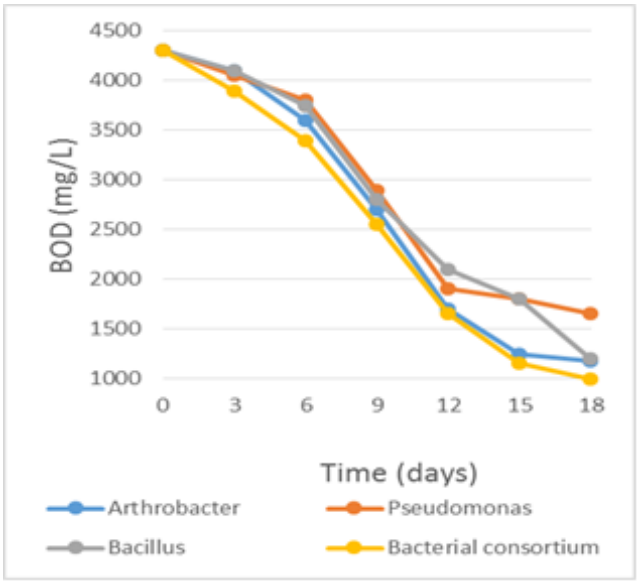

Figure 4: Comparison of BOD after treatment

The significant decrease in BOD values could be associated with consumption of organic material by microbes as a food source. The reduction in BOD can result in simultaneous reduction of coliform population. Though high growth of microbes had consumed the oxygen present in treatment unit, continuous and excess of aeration had provided to be an important reason for reduction in BOD.

Table 6: Characteristics of effluent after treatment using Arthrobacter sp.

Time (days)	*pH*	*Total Solids (mg/L)*	*BOD (mg/L)*	*COD (mg/L)*	*Ammonia (mg/L)*
0	4.5	9700	4300	7600	99
3	4.8	9300	4100	7100	72
6	5.9	8400	3600	6100	60
9	7.0	6100	2700	4500	39
12	7.8	3900	1700	2400	28
15	8.3	2200	1240	1670	21

Table 7: Characteristics of effluent after treatment using Bacillus sp.

Time (days)	*pH*	*Total Solids (mg/L)*	*BOD (mg/L)*	*COD (mg/L)*	*Ammonia (mg/L)*
0	4.5	9700	4300	7600	99
3	4.8	9500	4100	7300	75
6	5.7	8600	3750	6250	65
9	6.9	6500	2800	4800	46
12	7.7	4100	2100	2800	32
15	8.1	2650	1650	1950	29

Table 8: Characteristics of effluent after treatment using bacterial consortium

Time (days)	*pH*	*Total Solids (mg/L)*	*BOD (mg/L)*	*COD (mg/L)*	*Ammonia (mg/L)*
0	4.5	9700	4300	7600	99
3	4.9	9200	3900	7000	70
6	6.1	8200	3400	5900	58
9	7.4	5700	2550	4200	35
12	8.1	3600	1650	2350	27
15	8.5	2000	1150	1500	24

3.1.4 Chemical Oxygen Demand

COD reduction using Arthrobacter sp., Pseudomonas sp., Bacillus sp. and bacterial consortium were 78.02%, 76.34%,

74.34% and 80.26% respectively. The reduction in COD values might be due to more amounts of nutrients present in the form of dissolved and organic nature, which cultures could have used for growth. The comparison of reduction in COD after treatment is as shown in Figure 5.

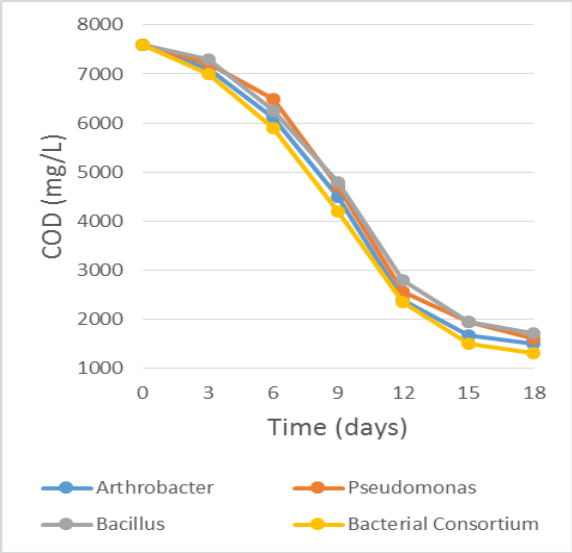

Figure 5: Comparison of COD after treatment

3.1.5 Ammonia

In comparison to initial levels, substantial reduction in ammonia was observed after treatment signifying the degradation of toxic solid components in the effluent by bacteria. Bacterial consortium showed the highest removal efficiency of 80% followed by Arthrobacter sp (78.78%), Pseudomonas sp (73.73%) and Bacillus sp (70.70%) respectively. Reduction in ammonia level indicates that bacteria degrade organic and inorganic constituents. The reduction in ammonia after treatment is as shown in Figure 6.

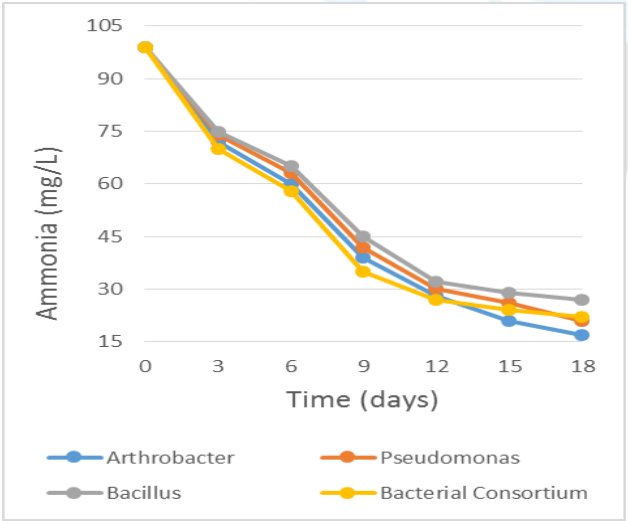

Figure 6: Comparison of ammonia after treatment

4. Conclusion

Any treatment system should be able to reduce or eliminate pollutant level in the effluent. In the present study, it was observed that the bioremediation of effluents with bacteria reduced physico-chemical characteristics significantly in a retention period of 15 days. Bacterial consortium was most effective in reduction of these factors and Bacillus sp was found to be least effective. Reduction in the physico-chemical properties of the effluent such as total solids (79.38%), BOD (73.25%), COD (80.26%), ammonia (80%) was observed after incubation with bacterial consortium. It is more economical and beneficial than a single culture. Further studies should be conducted to determine exact mechanism of bioremediation and reduction of waste quality parameters. This is necessary to improve the efficiency of wastewater treatment system.

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