

PERFORMANCE APPRAISAL OF BIOREMEDIATION MATERIALS FOR POLLUTED SURFACE WATER TREATMENT

By

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Problem Statement and Research Gaps



- ✓ Many bio materials are known to be effective as bioremediation agents but only under laboratory conditions and providing the supporting facilities in the field.
- ✓ Most of the bioremediation agents are transient, cost intensive and non viable on upscaling in real world conditions.
- ✓ There is lack of consolidated performance evaluation/audit, optimization & adaptation of the existing bioremediation materials/technologies .
- ✓ There is lack of standalone bioremediation agent/materials which can take care of several pollutants (organic pollutants, nutrients and biological contamination) at a time.

Research Objective

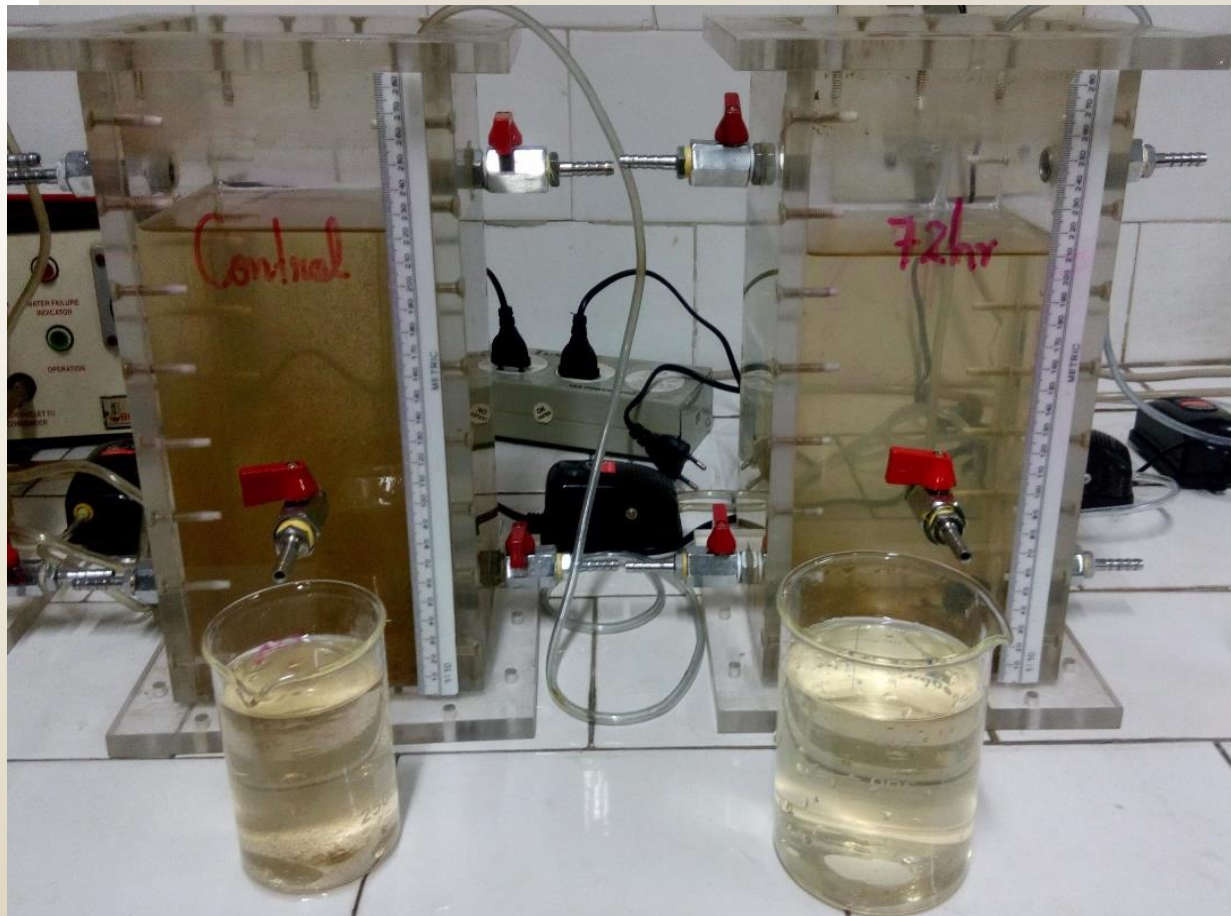
Performance evaluation of selected commercially available bioremediation materials/Technologies

- *Few patented/commercially available biomaterials were selected, procured and bench scale batch studies were performed for the treatment of polluted river water (Tributary (Solani) of River Ganges).*
- *Furthermore field scale assessment studies are to be performed to check efficacy of these biomaterials in real world conditions.*

Materials & Methods

Bench Scale Performance Appraisal of Biomaterials

Sample Collection: The samples were collected from a nearby polluted tributary (Solani) of River Ganges.



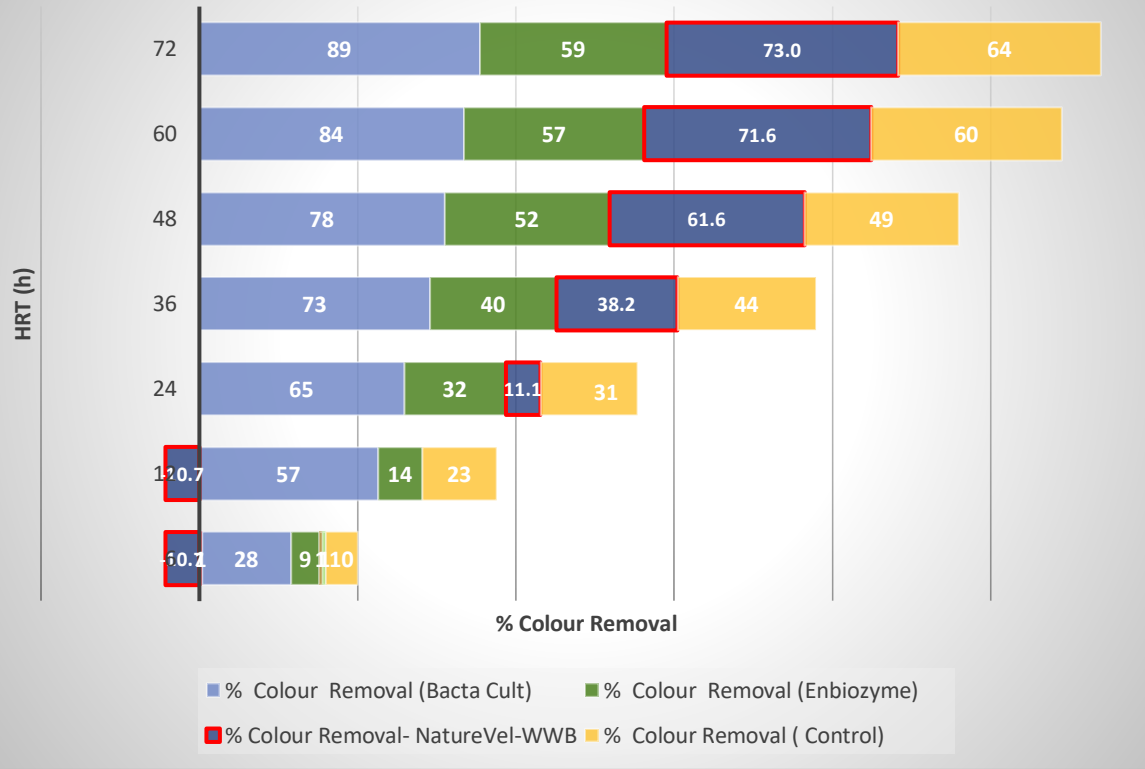
S.No.	Biomaterial	Operating Conditions	Recommended dosage	Parameters of Interest	Running Time	Sampling frequency
1.	Bacta Cult (BC)	1. pH: 6.5-8.5 2. T (°C):20-30 3. DO (ppm): 1-4 4. MLSS (ppm): 2500-3000	150 µl/l	1.Colour, 2. Biochemical oxygen demand (BOD), 3. Chemical Oxygen demand (COD) 5. Total Suspended Solids (TSS) 6.Total Nitrogen (TN) 7. Total Phosphorus (TP) 8.Total Coliform (TC) 9. Faecal Coliform (FC)	6-72 h	12 h
2.	Enbiozyme Aqua-S (EAS)	5. MLVSS (ppm): >60% of MLSS	5 mg/l		6-72 h	12 h
3.	NatureVel-WW (NVWWB)	6. Sample Volume: 4.5 Lit	164 µl/l		6-72 h	12 h
4.	Control (C) (Without addition of Biomaterials)		(Without addition of Biomaterials)		6-72 h	12 h

Experimental Setup for Batch Scale bench study

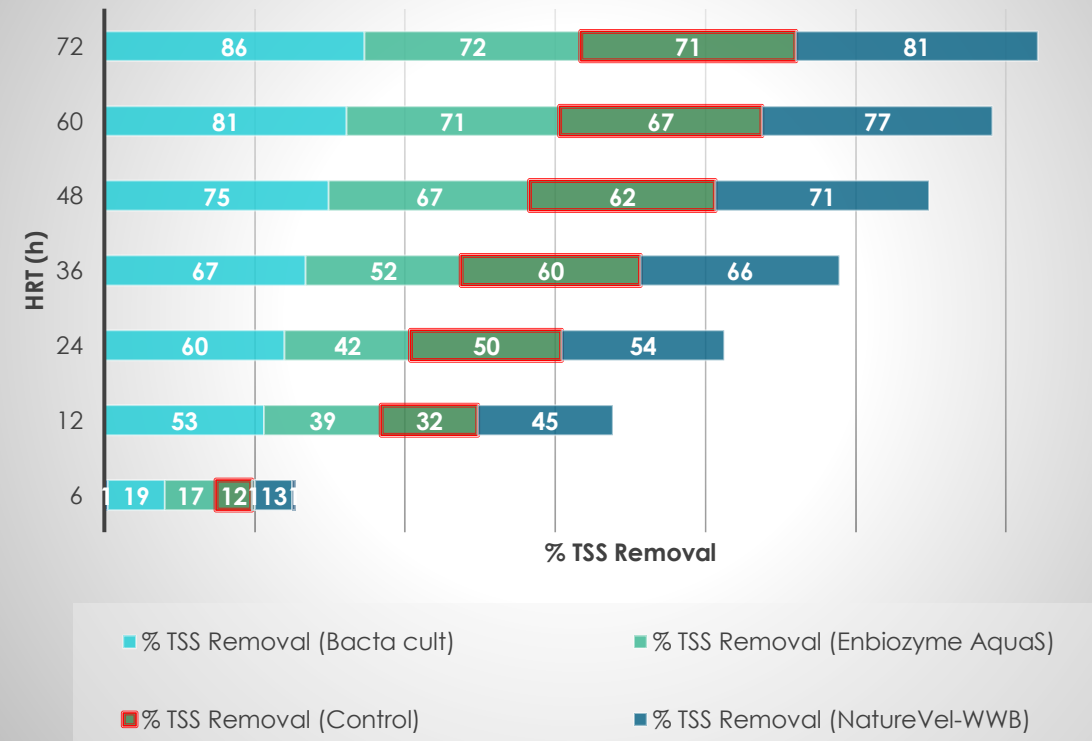
Experimental Conditions

Results & Discussion: Colour & TSS Removal Efficiency of Biomaterials

Colour removal using biomaterials w.r.t HRT



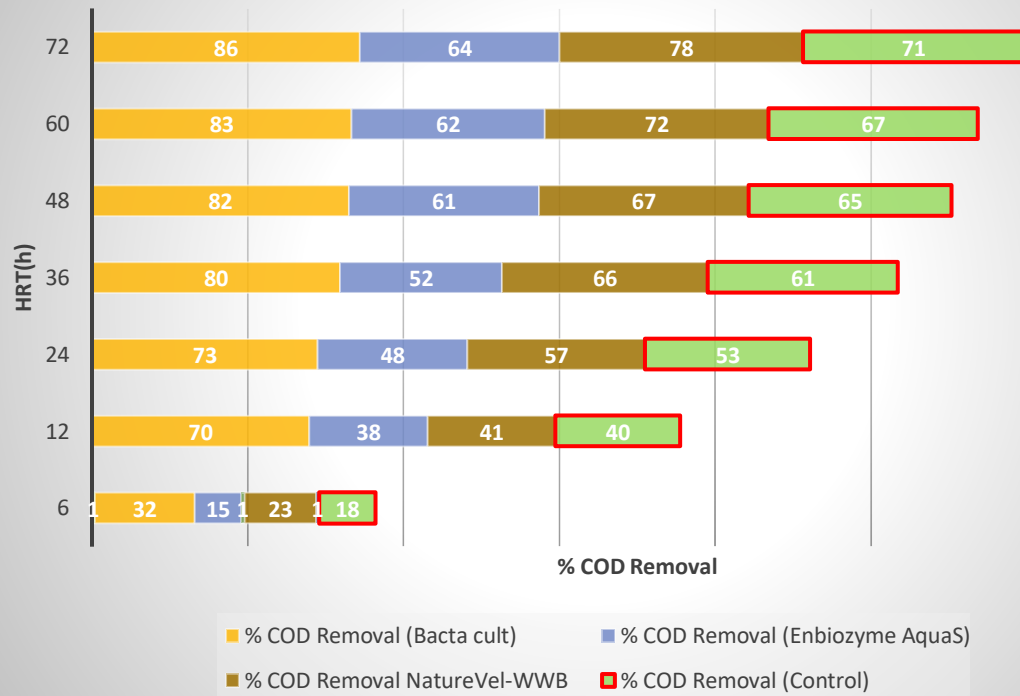
TSS removal using Biomaterials



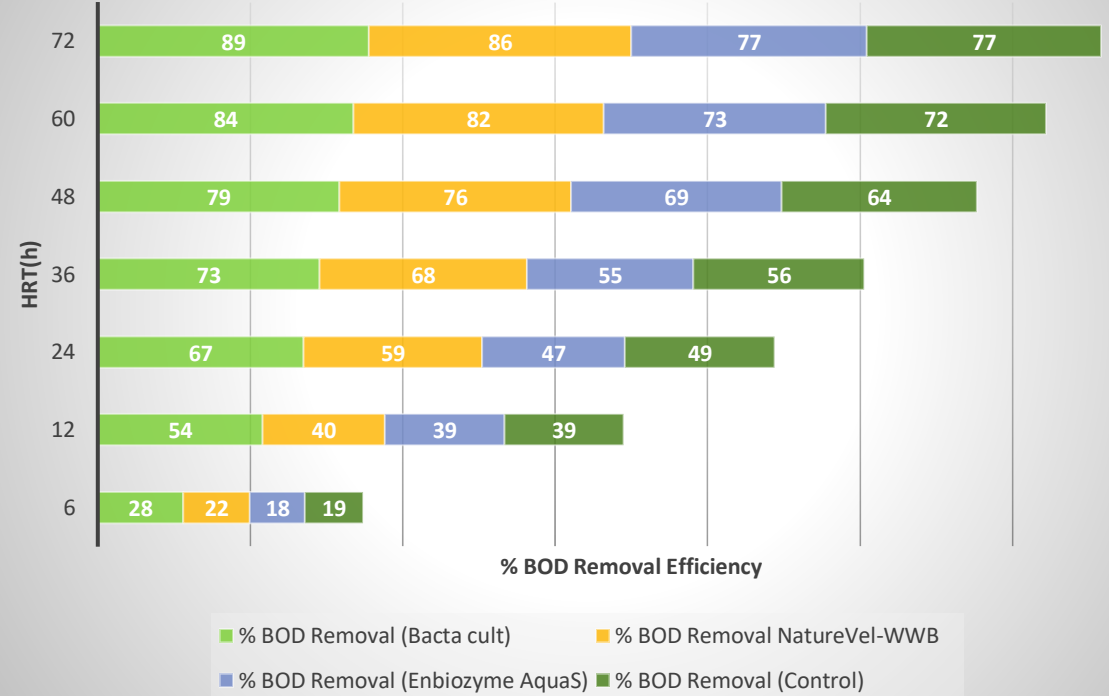
- Bacta Cult showed maximum colour removal efficiency **89%** at 3 days of HRT while actual removal efficiency is appx **24.6%** over control on the other hand EAS showed 5% increase in colour over control at the same HRT.
- NatureVel-WWB revealed negative results up to 12 h or it adds the colour initially after its application.
- Encouraging TSS removal **efficiency of 86%, and 81%** were achieved by using **Bacta Cult, and NatureVel-WWB** respectively at 3 days of HRT. **Although actual removal efficiency is 15% and 10%** respectively over control at the same HRT.

COD and BOD removal Efficiency of Biomaterials

COD removal efficiency of biomaterials w.r.t time



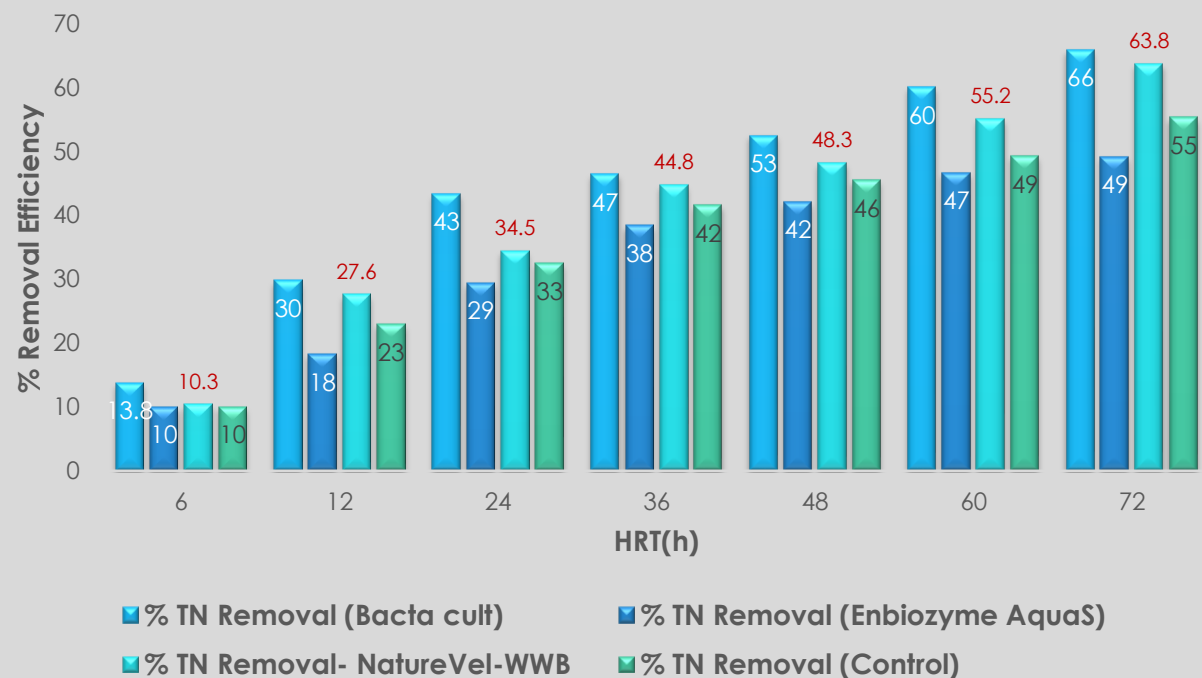
% BOD Removal using various biomaterials



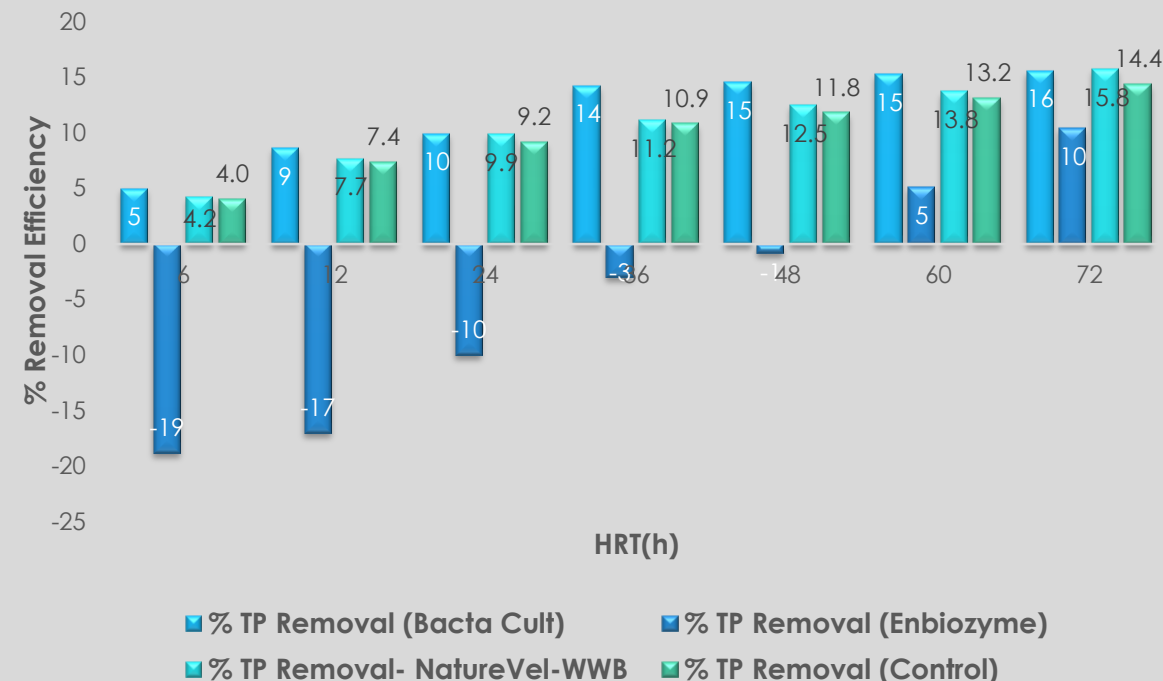
- BC exhibited **86%** COD removal efficiency and although actual removal efficiency was only **15% over the control** at 3 days of HRT while EAS showed **negative COD removal (7% less)** than control at the same HRT.
- **BC and NVWWB** revealed remarkable BOD removal efficiency i.e upto **89%** while actual removal efficiency was only upto **12% over control** at 3 days of HRT.
- **EAS** showed same BOD removal efficiency as control thus EAS does not have any role in BOD removal.

Nutrient removal efficiency of biomaterials

TN removal efficiency of biomaterials



TP removal efficiency of Biomaterials



- Remarkable TN removal efficiency (66%) exhibited by Bacta cult although actual removal efficiency is only 10% over control at 72 h of HRT whereas actual removal efficiency using NVWWB was upto 8.8% over control.
- In case of EAS although optimum TN removal is upto 49 % if we represent individually ,while it demonstrated negative result (-6.0) over control.
- Bacta cult has maximum TP removal efficiency that is **16% although actual removal efficiency is only 2% over control** at 3 days of retention time on the contrary using EAS there is **19 % increase in TP just after its application it gradually decreases to -1 in 48 hr** thereafter removal started from 48 hr and reached upto 10% in 72 hr.
- Incase of NVWWB **<2.0%** of TP removal observed over control at optimum retention time.

Total & Faecal (TC & FC) Coliform Removal Efficiency of Biomaterials



Non of these biomaterials are able to kill TC & FC. Thus these materials could not be recommended for the removal pathogenic microbes.

Key Findings

- Among the mentioned biomaterials, the **Bacta Cult (BC)** was examined to be **efficient** as compared to rest two biomaterials. The optimum pollutant removal efficiency reached with BC at 3 days HRT were BOD-89%, COD-86%, TSS-86%, Colour-89 %, TN-66%,TP-16%TC-0% and FC-0%, while in Control BOD-77%, COD-71%, TSS-71%, Colour- 64 %,TC-0%, FC-0% TN-55% and TP-14.4%.
- **Actual maximum removal efficiency using BC, increased with a percentage of 12% for BOD, 15% for COD, 15 for TSS, 25% for Colour, 21% for TC, 12% for FC, 10% for TN and 1% for TP.**
- The study concludes that the Bacta Cult (BC) is efficient in removing the maximum pollutants except TC and FC under optimum conditions. Moreover, the performance of NVWWB was found to be fairly good, whereas, the efficiency of EAS was insignificant under the same controlled conditions.
- It was observed that **TP removal efficiency is not significant using these biomaterials**. Results achieved for TP were **almost similar to control samples**. It means there is absence of phosphate accumulating microorganism in these biomaterials.
- On the basis of overall performance of these biomaterials decreasing order of efficiency is as below
BC>NVWWB>EAS

Recommendation & Future Prospect

- **Bacta Cult can be recommended for the removal of organic pollutants and Total Nitrogen because it showed encouraging results. Additionally, it can also be used for the Total phosphate removal if alternative remedy is not available.**
- **Its (BC) efficiency in terms of TP, TC and FC can be improved by incorporating phosphate accumulating micro-organism and formulating disinfectant as product additive.**
- **Furthermore field scale investigation needs to be performed to check efficacy of these biomaterials in real world conditions.**
- **The present investigation will help in selective utilization of bioremediation materials for their application in real world and synthesis of robust and frugal bioremediation material. It will also lead to addition to the existing knowledge base on bioremediation will enable and promote further research in this area at various levels.**

Limitations



- **Surface water treatment using these biomaterials could not be a stable and standalone method as biological methods are susceptible to change in environmental conditions.**
- **Real-world application of these biological agents for heavily polluted water might require external aeration supply and more retention time which could be cost-intensive and non-viable.**

THANK YOU