

Development of a Solar Energy Based Prototype, CyanoClean, for Arsenic Removal from Water with the Use of a Cyanobacterial Consortium in Field Conditions of India

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Abstract : Cyanobacteria are known for rapid growth rates, high biomass, and the ability to accumulate potentially toxic elements and contaminants. The present work was planned to develop a low-cost, feasible prototype, CyanoClean, for the growth of a cyanobacterial consortium for the removal of arsenic (As) from water. The cyanobacterial consortium consisting of Oscillatoria, Phormidium and Gloeotrichia was used, and the conditions for optimal growth of the consortium were standardized. A pH of 7.6, initial cyanobacterial biomass of 10 g/L, and arsenite [As(III)] and arsenate [As(V)] concentration of 400 µM and 600 µM, respectively, were found to be suitable. The CyanoClean prototype was designed with acrylic sheet and had arrangements for optimal cyanobacterial growth in natural sunlight and also in artificial light. The As removal experiments in concentration- and duration-dependent manner demonstrated removal of up to 39-69% and 9-33% As respectively from As(III) and As(V)-contaminated water. In field testing of CyanoClean, natural As-contaminated groundwater was used, and As reduction was monitored when a flow rate of 3 L/h was maintained. In a field experiment, As concentration in groundwater was found to reduce from 102.43 µg L⁻¹ to <10 µg L⁻¹ after 6 h in natural sunlight. However, in shaded conditions under artificial light, the same result was achieved after 9 h. The CyanoClean prototype is of simple design and can be easily up-scaled for application at a small- to medium-size land and shall be affordable even for a low- to middle-income group farmer.

Keywords : cyanoclean, gloeotrichia, oscillatoria, phormidium, phycoremediation

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