ABSTRACT

Perchlorate is one of the highly toxic inorganic compound present in the environment as natural deposits and as a man-made source. Significant methods of treating perchlorate compounds are physical, chemical and biological. The physical and chemical methods are mere removal methods which have a higher reaction rate, however the biological method on the other hand is a very slow process in which perchlorate ions are degraded into less toxic substances such as oxygen and chloride. This work focusses on combining physical and biological methods in order to effectively degrade perchlorate from water.

Perchlorate degrading microorganisms are found in various environmental conditions. One of such microorganism was isolated from the contaminated sites from southern part of Tamilnadu and identified as *Dechlorosoma Sp.* The degradation process of perchlorate using *Dechlorosoma Sp* was influenced by various factors such as pH, initial perchlorate concentration, concentration of acetate and temperature. The microorganism degrades perchlorate faster in low concentrations and found that the optimum pH was found to be 7.0. The modified Gaussian peak equation was used to incorporate the effect of pH and it was found that the optimum concentration ratio of perchlorate to acetate was 1:2 and 1:3. A Simple Monod model described the degradation rate and it was found that the
maximum growth rate and half saturation constant for *Dechlorosoma sp* were 0.309/h and 18.27 mg/L respectively.

In order to investigate GAC support media for packed bed reactor, tests were conducted in a batch reactor. From this study, it was observed that the optimum pH for perchlorate removal using GAC was 6 and Langmuir model fits well within the studied temperature of and concentration of 50 to 500 mg/L range. The kinetic data revealed that the adsorption of perchlorate on to the activated carbon followed pseudo-second order reaction and the process of adsorption was influenced by intra particle diffusion. Thermodynamic studies indicated that the adsorption of perchlorate on to the activated carbon was favorable and the exothermic process was spontaneous.

The performance of upflow packed bed reactor using GAC as support media for perchlorate biodegradation with *Dechlorosoma* was evaluated and the reactor showed significant degradation rate during the startup. It was observed that the hydraulic loading rate of 0.835 ml/cm².min was optimum for the reactor. Upon spontaneous removal of acetate from the reactor affects the performance of perchlorate degradation significantly after a day. A removal efficiency of 95 % achieved keeping 1:3 ratio of perchlorate to acetate with concentration of 50 and 100 µg/L. The numerical model correlates with the experimental data well with the regression coefficient of 0.947 ($R^2$). This study demonstrates that perchlorate can be removed effectively with the aid of GAC as a packed bed media using *Dechlorosoma Sp*. 