DEVELOPMENT OF AN ELECTROCHEMICAL TECHNOLOGY TO REMOVE NITRATE FROM CONTAMINATED GROUNDWATER

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The use of synthetic fertilizers is a common practice in agricultural countries like Sri Lanka. The increased use of nitrogen – based fertilizers has been reported to lead the elevated amount of nitrate in groundwater. Nitrate is a known culprit behind methamoglobinemia and it can be carcinogenic. In accordance with the World Health organization (WHO), the maximum limit of 50 mg/dm^{-3} NO_3^- (Short term exposure as NO_3^-) in drinking water is permitted.

Among other denitrification technologies, such as physiochemical and biological methods, electrochemical denitrification is an attractive technology since it is easy to operate and maintain. In addition, by careful development of material, electrochemical denitrificaion can offer high efficiencies at lower energy cost. However, most of the reported studies are based on commercially available electrode materials. A little attention is paid on the development of electrode materials to electrochemical denitrification.

In this study, the attention is paid on the development of novel electrode materials considering the electrode properties pertaining to a higher degree of nitrate removal in chloride free environment. Cathode material is developed using copper as the main coating material. Iridium dioxide (IrO_2) coated on titanium substrate was used as the anode material. Optimization of the electrode materials was done by statistical based experimental design using Minitab 16 software. Three independent parameters, namely, current density, plating duration and Cu^{2+} concentration were used in order to optimize the cathode material. Anodic charge which represents the electro-active surface area of the electrodes and nitrate conversion efficiency for each fabricated electrode were measured in order to evaluate the optimum conditions for the development of cathode material. The optimization of Ti/IrO_2 anode was conducted by varying two parameters namely, calcination time and calcination temperature simultaneously. Anodic charge, nitrate conversion efficiency was measured to find optimum conditions. Apart from that the stability of anode material was analysed by means of open circuit potential.

After, development of electrode materials, electrochemical reactor cell was created and the technology was applied for actual ground water samples. Finally, safety analysis was carried out to ensure the safety of treated effluent.