CHAPTER 5: CONCLUSION

PART 1: Spatially suspended catalyst

Part 1 (A) Ag-PVA beads

The addition of Ag-PVA beads increased the degree of nitrate elimination and the selectivity towards nitrogen gas generation in both the undivided and divided cells. The concentration of Ag-PVA beads, the cathode material, and the current density all had a significant impact on the end-product selectivity and nitrate elimination. Fe provided the maximum removal of nitrate ions with the best selectivity for nitrogen gas and the least selectivity for nitrite formation among the several cathode materials evaluated. At a dosage of 5 mM Ag-PVA, the catalyst's mass activity (mg NO_3-N removed per g Ag per min) was at its maximum, whereas at a dose of 6.67 mM Ag-PVA, the selectivity for the creation of N_2-N (62.1%) was at its best and that for the formation of NH_3-N (37.7%) was at its lowest. The effect of initial nitrate concentration did not affect ECR of nitrate but had negligible effect on selectivity. The selectivity for nitrogen gas and nitrate removal increased with a rise in current density from 5 to 15 mA/cm^2, whereas the selectivity for NH_3-N production rose with a rise to 20 mA/cm^2. Beads made of Ag-PVA may be recycled eight times without suffering much catalytic activity loss. The ECR of nitrate in a genuine groundwater sample produced a removal rate of 85%, demonstrating the relevance of the current investigation in the field. This work provides the first demonstration of the effectiveness and great reusability of Ag-PVA beads as a catalyst for the removal of nitrate and TN from water.

Part 1 (B) AgMPs catalyst

In both the undivided and divided cells, the addition of AgMPs significantly enhanced the degree of elimination of nitrates and the selectivity for nitrogen gas production. The elimination of nitrate and the selectivity of the end-products were significantly influenced by the concentration of AgMPs, electrode distance, current density, and other experimental factors including the cathode material. Ti had the maximum nitrate removal, the best nitrogen gas selectivity, and the least amount of nitrite formation of all the cathode materials studied. The most mass activity of the catalyst (mg NO_3-N

removed per g Ag per min) was achieved at the maximum AgMPs dosage of 4 mM, while the selectivity of the 8 mM AgMPs was maximum for the synthesis of N_2-N (60%) and lowest for the production of NH_3-N (31%). The rate of NO_3-N elimination reduces as the initial nitrate concentration rises. The selectivity for nitrogen gas as a final product and the removal of nitrate both increased with a boost in current density from 5 to 10 mA/cm^2, however, the selectivity for ammonia generation was improved with an additional increase to 15 mA/cm^2. The catalytic activity of AgMPs may be renewed repeatedly without suffering 10 times. In this study, it is demonstrated for the first time how effectively and repeatedly nitrate and TN may be removed using AgMPs as a catalyst. The ECR of nitrate in a real groundwater sample produced a nitrate removal rate of 59%, demonstrating the relevance of the current investigation in the field.

PART 2: Treatment of metal finishing wastewater containing high nitrate concentration using the ECR process

Ti/Co_3O_4 increased the rate of nitrate removal and the selectivity for nitrogen gas generation in divided cell compared to other immobilised catalysts. 95% nitrate removal was obtained with 750mg/L initial nitrate concentration with 95% selectivity towards N_2-N (72.75%) at 20mA/cm^2 in 180min. Complete nitrate removal was achieved at 30mA/cm^2, however, due to more energy consumption, 20mA/cm^2 current was good enough to remove nitrate with good selectivity towards nitrogen gas. The reusability of coated catalyst Ti/CO_3O_4 was about 12 times. The molar ratio of Mg:NH_4:PO_4 affected the struvite formation for ammonia removal. Among all ratios, 1.5:1:1.5 molar ratio gave maximum ammonia removal giving its concentration in dischargeable limit. The other metals in metal finishing wastewater were successfully removed to be negligible in treated water.