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Catalytic reduction of nitrate in water with catalysts made of palladium-indium on aluminum-pillared montmorillonite

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Human activities occasionally increase the inflow of nitrate to the aquatic ecosystem. The inflow of nitrate not only deteriorates the quality of the ecosystem by promoting eutrophication of water but also often restricts its use as drinking water. Various methods have been studied to find the most promising technology with simple facilities and fast processing time for the removal of nitrate contained in fresh water by comparison. Recently, the development of catalysts using clay minerals as supporting materials are getting attention along with the verification of their efficiency. In this study, palladium (5% wt.) and indium (0.1-2.5% wt.) are added to montmorillonite each as a catalyst and promoter for nitrate removal. In addition, aluminum and cerium are pillared to montmorillonite to increase the activity of catalysts. The nitrate removal efficiency of this catalyst was evaluated with a batch system. Hydrogen and carbon dioxide were used as a reducing agent and pH controller, respectively. The concentration of nitrate and nitrite were analyzed by HPLC after filtration. Ammonia was analyzed as a byproduct by the salicylate method. In the case of the palladium-indium added to montmorillonite (MPI), the nitrate degradation constant k=0.20 min^{-1} g-pd was shown. When the montmorillonite was pillared with Al and had Pd-In added after AMPI, the decomposition constant increased to k=0.53 min^{-1} g-pd. In contrast, adding Ce to AMPI showed no significant effect. In the decomposition process, the production of ammonia increased along with the efficiency of the catalyst, which was up to about 50% of initial nitrate concentration for AMPI. However, production of nitrite by nitrate decomposition was not significant. Furthermore, we will investigate the structural characteristics of the fresh and used catalysts for nitrate reduction by using XRD, FTIR, BET SSA, SEM and XPS to improve the nitrate decomposition efficiency and to suppress ammonia generation. Nitrate degradation properties and structural characteristics of catalysts will be discussed.

Biography

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