Improvement deionization efficiency of CDI system using highly dispersible rGO based electrode

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In recent years, industrialization and urbanization have led to an increase in water use and water pollution, and as climate change occurs, available water resources have gradually declined. As the importance of securing water resources grows, technologies to remove ionic substances from water such as ion exchanger, reverse osmosis, membrane distillation, electrodialysis and capacitive deionization are being applied to secure water resources. Among these various technologies, the capacitive deionization (CDI) is a representative water treatment technology that uses the principle of applying weak current to electrodes in aqueous solution to form an electrical double layer (EDL) on the electrode surface, adsorb ionic substance by electrostatic force, and detach by applying opposite current. Therefore, the electrical and surface properties of an electrode are important factors in determining the ion removal efficiency. A novel nanomaterial, reduced graphene oxide (rGO), has a large surface area compared to mass and high electrical conductivity due to the movement of pi electrons. Thus, many studies have conducted to improve ion removal efficiency by using rGO as an electrode material and applying it to CDI technology. However, general rGO (rGO-H) is manufactured through a chemical reduction method using hydrazine, a representative reducing agent, which is hydrophobic and does not mix homogeneously with the electrode manufacturing materials, resulting in aggregation. Not only is it difficult to manufacture electrode due to its low dispersibility, but there is also a problem that the improvement in ion removal efficiency is not significant. Therefore, the aim of this study is to manufacture highly dispersive rGO to increase the deionization efficiency of the CDI system by homogeneously mixing rGO with electrode manufacturers with high electrical conductivity and large surface area. For this purpose, improved rGO (rGO-D) was fabricated using N,N-Dimethylformamide (DMF) among several chemical reduction methods. A comparative evaluation of the salt removal efficiency of the manufactured CDI system using the prepared electrodes was performed. It was confirmed that the salt removal efficiency of the rGO-D electrode was improved not only when compared to the rGO-H electrode, but also compared to the conventional activated carbon electrode.

Keywords : CDI, rGO, Dispersibility, DMF, Deionization