Modeling study of a promising electrocoagulation system for water treatment

Abstract

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Arsenic (As) is one of heavy metals found in local water wells in Illinois, affecting human health seriously when it is consumed in excess amount. But it has been challenge for low income and rural areas to control and maintain the As content in the water below standard of 10 parts per billion defined by Environmental Protection Agency, requiring a new water treatment system which is low-cost, easy-to use, and environmental friendly.

In this study, a promising water treatment system called electrocoagulation (EC) was investigated through a physics-based mathematical modeling to define key parameters dominating the treatment performance. EC is a modern and effective technique for treating water to remove pollutants by utilizing coagulants generated by electricity, and thus the contaminated water can be easily treated on demand without requiring expensive chemical additives in the conventional system. However, this promising EC has not been fully applied due to issues such as inefficiency and difficulty in scaling up the system. In order to resolve those issues, we have conducted research to understand the physics underling the EC process and to define key control parameters.

A two-dimensional unsteady mathematical model was developed by considering mass transfer of ionic species in a porous media, and optimizing the effects of applied current, current efficiency, porosity, water velocity, and electrode cell gap. It was found that As removal rate increases with applied current and current efficiency, while the removal rate decreases as water velocity and cell gap are increased. It was also found significant effect of porosity of the porous media on the removal rate. Detailed results and analyses will be discussed in the presentation.