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Review article

A review of electrocoagulation as a promising coagulation process for improved organic and inorganic matters removal by electrophoresis and electroflotation

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ABSTRACT

In drinking water treatment, coagulation is the most common process to remove particles and impurities. It is described as the process whereby particles are destabilised by dosing a chemical additive (coagulant) where charge neutralisation (CN) and sweep coagulation (SC) are the major mechanisms. Due to the encountered difficulties in natural organic matter (NOM) removal, the concept of enhanced coagulation (EnC) was introduced to increase NOM removal where CN is more accentuated. EnC must be well optimised to overcome its practical considerations such as adjusting the pH of the source water and residual metal concentration in the treated water. In the last three decades, there is new tendency to use electric field/electrochemistry in some chemical processes especially chemical coagulation (CC). Indeed, literature has proved that electrocoagulation (EC) is a promising water treatment technology. During EC process, there are two induced phenomena: electrophoresis (EP) and electroflotation (EF); separately, they are well known in electrochemistry's applications and well developed technically and mathematically. How important are these inherent phenomena in EC process efficiency, constitutes the main aim of this review. Moreover, this paper tries to discuss some aspects of coagulation/flocculation, EP, EF, and EC. Since EP depends upon DC electric field, using anode and cathode as for EC for which the anode is sacrificial, it takes place in the EC device and contributes to its performance. Indeed, the first responsible mechanism of EC performance is the migration to an oppositely charged electrode, i.e., EP, and aggregation due to CN. Hence, EP contributes essentially to EC efficiency as EF does with $H_{2(g)}$ bubbles liberation from the cathode. The EF's contribution may be increased when $O_{2(g)}$ is produced from the anode, at the same time with metal ion liberation. However, as EC process is in fact the combination of these three simultaneous processes need more mathematical, technical, and practical studies to quicken its industrial application at a large scale.

Keywords: Colloid; Coagulation; Charge neutralisation; Electrocoagulation; Electrophoresis; Electroflotation

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