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Streaming current titration for coagulation of high turbidity water

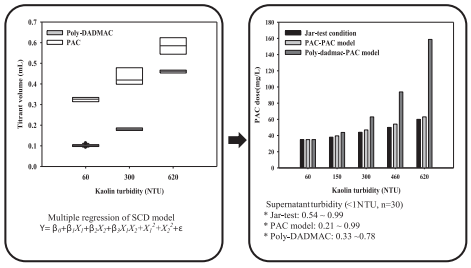
Seung –Woo Nam [a], Byung–Il Jo [a], Moon-Kyung Kim [a], Won-Kyung Kim [b], Kyung-Duk Zoh [a,*]

[a] Department of Environmental Health Graduate School of Public Health Seoul National University 599 Gwanak-ro, Gwanak-gu, Seoul, 157-742, Korea
[b] Sam Bo Scientific Co., Ltd.,418-221, Geahwa-dong, Kangso-Gu, Seoul,157-230, Korea

HIGHLIGHTS

- Streaming current detector (SCD) was used to determine optimal coagulation dosage.
- PAC and poly-DADMAC were added as coagulants.
- High turbidity water samples were lowered to <1 NTU after SCD titration.
- SCD titration model was verified statistically by multiple linear regression.
- SCD accurately determined the coagulation dosage for highly turbid water.

GRAPHICAL ABSTRACT



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ABSTRACT

A jar test is commonly used to determine the chemical coagulation conditions in water treatment plants (WTPs). However, due to the frequent and intermittent turbidity measurements, and time-consuming determination for achieving optimal coagulation conditions, the jar test is not appropriate for the samples which are rapidly changing water turbidities. As an alternative, a streaming current detector (SCD) can be used by achieving electrically neutral conditions. A SCD can quantify the negatively charged particles by measuring the current of water samples. In this study, SCD titration was conducted to rapidly determine the optimal coagulation dosage for highly turbid waters (50 ∽ 600 NTU) prepared with suspensions of kaolin (100 ∽ 1000 mg/L). Polyaluminum chloride (PAC) and poly-diallyldimethylammonium chloride (poly-DADMAC) were added as coagulants. To estimate the optimal dose, a SCD titration-coagulation model was constructed, and its suitability was verified statistically by multiple linear regression analysis. In both homogeneous (PAC-PAC) and heterogeneous (poly-DADMAC-PAC) titration-coagulation models, the residual turbidity of highly turbid kaolin samples was successfully lowered to less than 1 NTU. The homogeneous model and the jar test showed a maximum difference of 3 mg/L for the suggested coagulant dose. Our results suggest that SCD can be applied to rapidly and accurately determine the coagulation dosage for highly turbid waters in water treatment plant even during rainy season.

1. Introduction

Determining the coagulant concentrations needed to clarify water is important during water treatment processes. An overestimated coagulant dose is wasteful, and chemical residue such as Al^{3+} can have negative health effects, such as promoting Alzheimer's disease [1,2]. Typically, a jar test is used to determine coagulant dosages by dosing with different amounts of coagulant using a lab-scale test. However, because sample measurements are performed intermittently during the test, this method is time-consuming and does not respond well to rapidly changing water turbidity [3–5].

As climate change becomes a more serious global issue, the intensive rainfall can affect the quality of water influent to water treatment plants, and increase turbidity of the influent in some

* Corresponding author. Tel.: +82 2 880 2737; fax: +82 2 762 2888.
E-mail address: zohkd@snu.ac.kr (K.-D. Zoh).

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