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# The removal efficiency and reaction mechanism of aluminum coagulant on organic functional groups-carboxyl and hydroxyl

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## HIGHLIGHTS

- ▶ SOM with the carboxyl functional group could be coagulated effectively.
- ▶ SOM with the hydroxyl functional group could not be coagulated.
- ▶ Pre-hydroxide degree of coagulant has an important effect on SOM of MW = 3000.
- ▶ Pre-hydroxide degree of coagulant has no effect on SOM of MW higher than 450000.

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## ABSTRACT

In order to remove the synthetic organic matter in drinking water and wastewater efficiently, aluminium chloride ($AlCl_3$) and polyaluminum chloride (PAC) with different $B$ values ($B$ = 0.5, 1.5, 2.3) were used to coagulated polyacrylic acids (PAAs) and polyvinyl alcohols (PAs) in this study. The effect of molecular weight and functional groups on the coagulation behavior was investigated by the experiments of the removal efficiency, floc size and fourier transform infrared spectrometer (FTIR) analysis of the formed flocs. The results indicated that aluminum salt coagulants had a fairly high removal efficiency for the carboxyl containing organic matter water but almost no removal efficiency for hydroxyl containing organic matter water. When organic matter interacts with aluminum salt coagulants, the molecular weight (MW) of organic matter affects the coagulation performance. For MW = 450000 of PAA, the dissolved organic carbon (DOC) removal efficiency can reach 94% at the dose of 8 mg/L. However, for MW = 1800, no DOC removal occurred for all tested coagulants. FTIR analysis indicated that during the coagulation process of PAA, the COOH existed in PAA molecule was transformed into $COO^-$.



## 1. Introduction

Water pollution, as a global environmental problem, has drawing increasing attention throughout the world. With the high-speed development of modern industry especially petrochemical, pesticides and pharmaceutical industries, the amount and type of organic compounds in water environment have increased dramatically. In addition, the direct discharge of different kinds of produced industrial wastewater and sewage into original water bodies has induced the quality deterioration of raw water and water distribution system [1]. So far, more than two thousand kinds of organic chemical pollutants have been detected in water/wastewater all around the world. As indicated by other researchers, 765 species have been detected in drinking water, among which, 20 species have been identified as carcinogens, 23 species were suspected carcinogens, 18 species were promote cancer materials and 56 species were mutagen materials [2]. As a consequence, more attention should also be given to the deterioration of water quality caused by synthetic organic matter (SOM) in recent years. Subsequently, the removal of organic matter (OM) has become an increasingly important issue in water treatment due to the formation of disinfection by-products (DBPs) caused by the incompletely removed OM. Effective treatment process is needed to remove OM from water/wastewater and to reduce the toxicity of effluents.

Coagulation/flocculation has been widely used process in water and wastewater treatment processes, in which, coagulants play an important role for removing suspended particles and organic materials [3,4]. Different with biological treatments, no toxic intermediate were produced during the flocculation process. Moreover, relatively high cost to effectiveness ratio was achieved during the large scale flocculation operation [5–7]. Enhanced coagulation was used by Liu et al. [8] to remove natural organic matter and to control the formation of disinfection by-products in Luwen drinking water treatment plant which was a typical experiment with conventional processes employed to treat source water

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