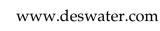
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## Effect of aluminum speciation on silica removal during coagulation of heavy-oil wastewater using polyaluminum chloride

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## **ABSTRACT**

Desiliconization techniques for heavy-oil wastewater are complex and costly. The effect of polyaluminum chloride (PACl) on silica removal during coagulation, however, has not been examined. In this study, the effect of PACl on the removal of soluble silica in heavy-oil wastewater was investigated by analyzing the major species of silica and aluminum during various stages of coagulation. Soluble silica could be divided into three species based on increasing molecular weight: monomer and dimer (Si<sub>a</sub>), oligomer (Si<sub>b</sub>), and polymer (Si<sub>c</sub>). Likewise, aluminum hydrolysates could be divided into the species Al<sub>a</sub>, Al<sub>b</sub>, and Al<sub>c</sub>, which correspond to oligomers of increasing molecular weight. Three PACl samples of specific basicities synthesized in our laboratory, with Ala, Alb, and Alc being dominant in one of the samples, were used. Aluminum salts and preformed collosols of amorphous aluminum hydroxide were employed to explore the effect of Ala and Alc on soluble silica in wastewater. Results show that Al<sub>a</sub> and Al<sub>c</sub> promoted the removal of Si<sub>c</sub> and Si<sub>a</sub>, respectively. The interaction of Sic and Sia with Ala and Alc, respectively, can be described as absorptionmodification, causing the formed admixtures of silica and aluminum to become more insoluble and more susceptible to coagulation. A mechanism involving electrostatic patch coagulation is introduced to explain the reaction of soluble silica and other substances with PAC1.

Keywords: Heavy-oil wastewater; Soluble silica; Aluminum hydrolysates; Absorption-modification; Aluminosilicate sites

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