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Flocculation by cationic amphiphilic polyelectrolyte: Relating efficiency with the association of polyelectrolyte in the initial solution

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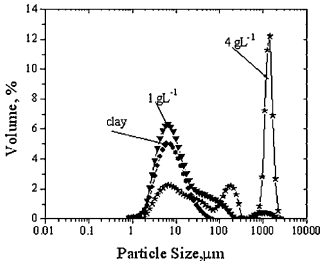
HIGHLIGHTS

- Amphiphilic polymer based on non-toxic polysaccharide is studied as a new flocculant.
- Flocculation efficiency was studied as function of the polymer initial solution concentration, c_i.
- Flocculation window width and floc size significantly increased when c_i was above cac.
- Flocculation mechanisms depended on the electrostatic and hydrophobic forces competition.
- We show for the first time the importance of the polymer association state in the initial solution for flocculation efficacy.

GRAPHICAL ABSTRACT

Particle size distribution.



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ABSTRACT

Flocculation ability of an amphiphilic cationic polysaccharide with N-octyl-N,N-dimethyl-N-(2-hydroxypropyl)ammonium chloride groups attached to a dextran backbone, was evaluated in clay dispersions with respect to polycation dose and initial solution concentration and, consequently, its association state. According to turbidimetric results, the concentration of initial solution of polymer influenced, mainly, the width of the flocculation window (the polycation dose range where the minimum of the residual turbidity was obtained) since this flocculation characteristic increased with increasing this parameter. A significant change in flocculation performances was noticed when polymer concentration was above its critical aggregation concentration. Possible reasons for this dependence are discussed. The negative value of the zeta potential in the whole flocculation window and the floc size distribution point to contributions from both patch/charge neutralization and bridging mechanisms for the flocculation process.

1. Introduction

Interactions between small particles and polymers represent a subject of great interest in the industries in which flocculation process plays a key role, for instance in papermaking, mining, sludge dewatering, domestic/wastewater treatment. Polymeric flocculants are available in uncharged or charged (cationic, anionic) forms and may be synthetic and natural [1,2].

For effective flocculation, polymers need to be adsorbed on particles by electrostatic and/or hydrophobic attractions, hydrogen bonding and ion binding [1]. These interactions lead to various conformations of the adsorbed chains, such as trains, loops, tails and hence, to different flocculation mechanisms: chain bridging, charge neutralization and charge patch [2]. Quite often, more

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