Effect of polyelectrolyte structural features on flocculation behaviour: cationic polysaccharides vs synthetic polycations

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Cationic polysaccharides (starch derivatives and chitosan) induce flocculation of kaolin dispersions at the same minimum doses as synthetic flocculants of comparable charge density but in a broader concentration range that was attributed to the difference in conformations of flexible and semi-rigid polymers upon adsorption. The flocculation mechanism for highly substituted cationic starch was suggested to be a combination of bridging and “charge patch” processes, where amylose/amylopectin ratio does not significantly affect the optimum flocculation dose, but determines the width of flocculation window, which tends to decrease with increasing amylose content.

Substantial enhancement of flocculation efficiency in comparison with commercially available starch derivatives is found for highly substituted cationic potato starches, although the dependence of optimum flocculant dose on DS deviates from linear function at DS>0.7 that is explained in terms of increasing mismatch in spacing between polymer cationic groups and oppositely charged surface sites originated from the highly branched amylopectin superstructure. Higher doses of cationic starch and synthetic polycation are required in diluted dispersions to reach complete phase separation, and maximum turbidity reduction by chitosan and commercial cationic starch do not exceed 60% (at pH=8). However, decrease of pH to 5.5 resulted in drastic increase of chitosan efficiency, thus proving domination of electrostatic contributions to its flocculation performance.