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Delaminated sodium titanate nanobelts in synergy with cationic polyacrylamide to induce flocculation on kaolin clay

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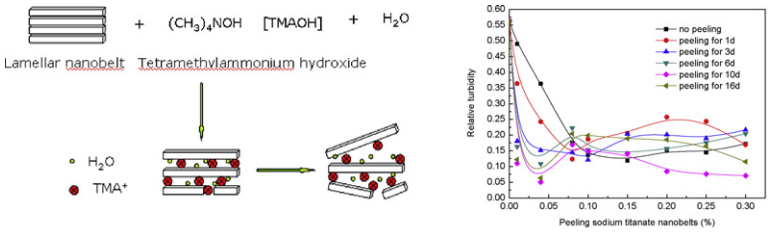
HIGHLIGHTS

- Peeling reduced both the length and the width of sodium titanate nanobelt.
- Peeled nanobelts offered the maximum synergistic flocculating effect with CPAM at a very low dosage.
- CPAM/peeled nanobelt induced larger and denser flocs of kaolin clay than CPAM alone.
- Prolong the peeling time resulted in forming even denser but smaller flocs.

GRAPHICAL ABSTRACT



Peeled nanobelts showed their largest synergistic flocculation effect with CPAM at a very low dosage

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ABSTRACT

Nanoparticle with higher aspect ratio and greater surface area renders higher micro-bridging ability in flocculating paper furnishes adsorbed with cationic polymers. Sodium titanate nanobelt is a typical one-dimensional nano-material with extremely high aspect ratios. In this paper, the nanobelt was synthesized hydrothermally and successfully peeled with tetramethylammonium hydroxide (TMAOH). The peeled nanobelt was characterized by XRD, TEM, BET surface area and surface charge measurement, and employed as a microparticle component partnered with cationic polyacrylamide (CPAM) to constitute a retention system. The flocculation behavior of kaolin clay by CPAM/nanobelt system was investigated using a photometric dispersion analyzer connected with a dynamic drainage jar. The morphology of flocculated kaolin was characterized by TEM and optical microscope. The results showed that the peeling treatment reduced both the length and the width of nanobelt, increased the charge density and sorption capacity to CPAM but did not significantly alter its structure and zeta potential in aqueous dispersion. The peeled nanobelts partnered with CPAM offered the biggest synergistic flocculating effect at a very low dosage, especially the ones that were peeled for 6–10 days. The kaolin flocs induced by CPAM/peeled nanobelt were larger and denser than those induced by CPAM alone, and become even denser but smaller with increased peeling time.

1. Introduction

In papermaking processes, retention aids are often used to improve the retention of fines or filler [1,2]. Microparticle retention systems, also known as nanoparticle retention systems, have been extensively used in high speed paper machine. An anionic

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