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Halloysite nanotubes: Controlled access and release by smart gates

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Abstract

© 2017 by the authors. Licensee MDPI, Basel, Switzerland. Hollow halloysite nanotubes have been used as nanocontainers for loading and for the triggered release of calcium hydroxide for paper preservation. A strategy for placing end-stoppers into the tubular nanocontainer is proposed and the sustained release from the cavity is reported. The incorporation of Ca(OH) 2 into the nanotube lumen, as demonstrated using transmission electron microscopy (TEM) imaging and Energy Dispersive X-ray (EDX) mapping, retards the carbonatation, delaying the reaction with CO 2 gas. This effect can be further controlled by placing the end-stoppers. The obtained material is tested for paper deacidification. We prove that adding halloysite filled with Ca(OH) 2 to paper can reduce the impact of acid exposure on both the mechanical performance and pH alteration. The end-stoppers have a double effect: they preserve the calcium hydroxide from carbonation, and they prevent from the formation of highly basic pH and trigger the response to acid exposure minimizing the pH drop-down. These features are promising for a composite nanoadditive in the smart protection of cellulose-based materials.

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Keywords

Cellulose, Controlled release, Halloysite, Nanocomposite

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