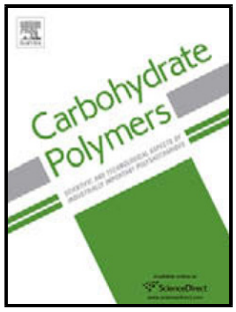

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Chitosan nanoparticles via high pressure homogenization-assisted miniemulsion crosslinking for mixed-matrix membrane adsorber

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Highlights

- Straightforward synthesis and reproducible preparation of chitosan nanoparticles.
- Rapid adsorption rate and high adsorption capacity for Diclofenac on nanoparticles.
- Adsorption capacity of membranes is enhanced when nanoparticles are incorporated.

1 Abstract

Glutaraldehyde-crosslinked chitosan nanoparticles (Chi-NPs) were prepared reproducibly via miniemulsion crosslinking for effective adsorption of the active pharmaceutical ingredient (API) Diclofenac (DCL). Three different molecular weights (MWs) of highly deacetylated (> 90%) chitosans (low, medium and high MW) were used to vary the disperse phase viscosity. Particle formation was evaluated ranging from one to seven homogenization cycles at 40 MPa. Particles were prepared successfully with the low and medium MW chitosan in the range of 125 nm - 250 nm (z-average). In HPLC assisted, static adsorption experiments, all particles showed a rapid sorption rate (<2 min) with an adsorption capacity of up to 256.2 mg g^{-1} DCL. Modelling of adsorption isotherms resulted in a q_{max} 358.3 mg g^{-1} for Langmuir and 502.5 mg g^{-1} for Sips, respectively. Membrane adsorbers were prepared by processing Chi-NPs into porous polyether sulfone microfiltration membranes via a casting and phase inversion process, resulting in an adsorption capacity of up to 3.6 mg m^{-2} DCL in dynamic adsorption experiments.

Keywords: chitosan nanoparticles; adsorption; active pharmaceutical ingredients (API); water purification; membrane adsorbers

2 Introduction

An increasing contamination of the aquatic environment with substances from industrial sources is expected to become one of the major challenges for the next decades. Especially, the appearance of active pharmaceutical