Optimization of Solid state polymerization (SSP) for polymeric encapsulation systems:Effect of capsule size

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ABSTRACT

Micro/nanoencapsulation is a wildely used technique for controlling the release of an active compound from a polymeric carrier, protecting and or improving its physical characteristics. The polymer molecular weight (MW) and thermal properties are associated with the effectiveness of the encapsulation system. Typically the barrier properties of the polymeric shell are changing with the initial polymer, but in a previous work of this research group it was proven that Solid State Polymerization (SSP) can be used as post-encapsulation modification tool on blank poly(lactic acid) microcapsules (PLA MCs)[1]. Following this work, the aim of the current study was to improve the SSP process, study its kinetics and the effect of the MCs size on the SSP rate.

PLA micro/nanocapsules (MCs/NCs) of two MWs (MW_1 50000 g/mol, MW_2 20000 g/mol) were prepared *via* double emulsion solvent evaporation technique and were subjected to SSP in fix bed reactors at 130 ^oC under nitrogen flow for 4 – 24 h after a precrystallization step (110, 100 ^oC for 1 h). The suggested post-encapsulation treatment route was found efficient to keep the spherical morphology of the prepared MCs/NCs and to avoid macroscopic sintering, but microscopic aggregation was noted at some extent. An increase of the MW of the polymeric shell was achieved (up to 70% for the MCs and 20% for the NCs) along with an increase in the crystallinity degree, from 40% to 70% for MCs and from amorphous to 40% in the Ncs. Polycondensation kinetics were studied based on 3rd order Flroy-based models and power-of-time rate equations by measuring and fitting the carboxylic end group concentrations and/or molecular weight values. Comparing MCs and NCs after the SSP it was noted that the increase of the molecular weight and degree of crystallinity was greater in the MCs than in the NCs due to the larger wall thickness.

KEYWORDS: Solid State Polymerization, microencapsulation, nanoencapsulation

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