



A novel approach to synthesize and to fix microparticles on cotton fabric

F. Salaün^{a,b,*}, I. Vroman^c, I. Elmajid^{a,b}

^a Univ Lille Nord de France, F-59000 Lille, France

^b ENSAIT, GEMTEX, F-59100 Roubaix, France

^c Groupe de Recherche En Sciences Pour l'Ingénieur (GRESPI), Laboratoire d'Etudes des Matériaux Polymères d'Emballage (LEMPE), Ecole Supérieure d'Ingénieurs en Emballage et Conditionnement (ESIEC), Esplanade Roland Garros – Pôle Henri Farman, BP 1029, 51686 Reims Cedex 2, France

HIGHLIGHTS

- Microparticles developed from interfacial polymerization.
- Formation in situ of microcapsules into cellulosic substrate.
- Shell structure of microcapsules obtained by monomer diffusion in solution.
- All the particles are linked to each other by covalent bonds due to the reaction of the diamine with TCL.
- High encapsulation yield obtained with cotton fabric.

ARTICLE INFO

Article history:

Received 14 June 2012

Received in revised form 7 September 2012

Accepted 15 September 2012

Available online 5 October 2012

Keywords:

Interfacial polymerization

Microparticles

Polyamide

Cellulosic substrate

ABSTRACT

The preparation process and optimization condition for synthesize polyamide microparticles directly onto cellulosic surface carried out by interfacial polymerization were investigated by a design screening method. The influences of organic solvent choice, the impregnation time, the monomer amount as well as the temperature bath and the reaction time were studied. Based on the encapsulation yield percentage (polymerization yield), the optimum conditions for microparticles preparation were (i) the use of cyclohexane, (ii) impregnation time = 30 min, (iii) released time = 5 min, (iv) terephthaloyl chloride/ethylene diamine mole ration about 1/10, and (v and vi) reaction time = 19 h at 20 °C. The formation of these microparticles was predicted by the analysis of the spreading coefficient in the system; and characterized Fourier transform infrared spectroscopy (FT-IR) and thermogravimetric (TGA) experiments. These analyses revealed the formation of the polyamide microparticles shell and the presence of diamine and water in the core. Based on the experimental results, the process was also applied on a cotton fabric for a potential use for textile purpose with a polymerization yield about 80%.

© 2012 Elsevier B.V. All rights reserved.

1. Introduction

For the last decade, the market and needs for technical or smart textiles has been constantly growing, leading to more technical developments and innovations of advanced textiles for new functionalities. The enhancement of textile performances according to the consumers' demands includes a large range of properties with a higher added value [1]. To achieve it, the formulation and understanding of polymeric surfaces have progressed tremendously allowing to obtain systems well-defined functionality. The use of microencapsulation processes for textile finishing or the incorporation of microparticles is one of the possible ways to manufacture

functional textile products [2]. Thus, many substances are encapsulated for potential textile applications, i.e. phase change materials (PCMs) for thermoregulated textiles improving thermal comfort of the wearer [3], fragrances for aromatherapy or controlled release [4–8], cosmetic formulation for cosmeo-textiles which can impart skin care benefits and promote a feeling of well-being [9], dyes (thermochromic, photochromic, reactive or dispersed) [10–12], insect repellents [13], antimicrobials [14], and fire retardant or intumescent compounds [15–18].

Microencapsulation can be defined as a technique that allows an active substance to be entrapped by a suitable polymer wall on a very small scale typically in the size range of 1–1000 µm in diameter. The functional performance of the microcapsules depends mainly on the morphology, the chemical nature and the shell surface characteristics which are influenced or dictated by the process parameters [19], specially (i) partition coefficient of the aqueous monomer or mass transfer which governs the polymerization rate,

* Corresponding author. Address: ENSAIT, GEMTEX, 2 allée Louise et Victor Champier, BP 30329, 59100 Roubaix, France. Tel.: +33 3 20 25 64 59; fax: +33 3 20 25 25 97.

E-mail address: fabien.salaun@ensait.fr (F. Salaün).