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REVIEW

Microcapsules application in graphic arts industry: a review on the state-of-the-art

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Abstract The process of oil-containing microcapsules production by complex coacervation of gelatine and gum arabic was patented in 1957. Microencapsulation technology gained importance in production of carbonless copy paper as one of the most important commercial products. Development of this technology in later years led to the emergence of different types of microcapsules and the production procedures for various application fields. Nowadays, they are mainly used in medicine, pharmacy, agriculture, construction industry, chemical industry, food industry, biotechnology, cosmetic industry, photography, electronics, textiles and printing industry. This review paper highlights the major types of microcapsules and their applications in production techniques in graphic arts and printing industry, various processing parameters that affect their important characteristics and methods for microcapsules characterization. This paper discusses the applications of microcapsules within printing industry, and feasible printing technologies related to the desired substrate materials. The analysis of these subjects offers a deeper insight into the mechanisms of microcapsule transfer processes, their behavior, and working conditions leading to the final products. It reveals the advantages and the drawbacks of certain printing technologies for microcapsules transfer, which enables the determination of favorable transfer procedure for specific microcapsule type and substrate materials. This paper also provides valuable recommendations and potential solutions on how to overcome the obstacles created by certain printing technologies.

Keywords Microcapsules · Printing technology · Graphic arts industry · Microencapsulation technologies · Microcapsule characterization

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Introduction

Microcapsules are small spheres that usually consist of two parts: the core (inner part) and the shell (outer part). The core represents an active ingredient in the form of either solid, liquid or gas, while the shell protects the core material and is usually made of natural or synthetic polymers [1]. The main goal of the microencapsulation technology is to entrap the active reagent, the core behind a barrier—the shell, which ensures that the encapsulated material reaches the area of action without affected by the environment through which it passes [2–4]. Depending on the application, a wide variety of the core materials can be encapsulated, including pigments, dyes, monomers, catalysts, curing agents, flame retardants, plasticisers, and nanoparticles. The shells can be permeable (prolonged release of active components in the environment), semi-permeable (absorb substances from the environment and release them when brought into another medium), or impermeable (e.g., separation of reactive component, protection of sensitive substances against environmental effects, taste, and odor masking, etc.) [1]. Microcapsules can be classified as mononuclear, polynuclear or matrix type (Fig. 1), while the shells may have regular or irregular shape [4].

One of the most significant properties of microcapsules is their microscopic size, thus it involves a substantially lower quantity of core active agent compared to