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Perfume Microencapsulation by Complex Coacervation

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Abstract. Many techniques are known for the microencapsulation of substances. Complex coacervation is one of them. Generally, gelatin and gum arabic are used to form the capsule wall. Gum arabic may be replaced by other colloidal polymers such as pectin. Most often, pure substances are microencapsulated, but microencapsulation of complex mixtures such as perfumes is also possible. This paper reports on microencapsulation of perfumes using complex coacervation. The influence of the wall material on the microcapsule characteristics is given.

1. Introduction

Microencapsulation of solids and liquids is a convenient method to shield substances from the environment. In general, the purpose is to facilitate the handling or the application of the substance and to protect the substance from the environment. Thus, a bitter drug will be swallowed without repugnance as microencapsulation permits masking of the taste. A sticky substance may be converted into a free flowing powder by microencapsulation techniques. A liquid can be blended with solids when microencapsulated.

Many techniques are available for microencapsulation. Extensive reviews were made by *Sparks* [1] and *Gutcho* [2], and the state of the art was recently summarized [3]. If a substance is to be encapsulated by complex coacervation its solubility in water has to be small.

Usually, gelatin and gum arabic are used to form the capsule wall, although other colloids can also be used. In the review of *Gutcho* [2], pectin is mentioned. *De Leeuw* [4], *Nakagawa et al.* [5], and *Michael* [6] report on microencapsulation of perfumes using complex coacervation and preferentially gum arabic and gelatin to form the capsule wall. This work reports on perfume microencapsulation by complex coacervation using gelatin and pectin as capsule wall materials. The microencapsulated perfume is protected from evaporation and maintains its original composition, as there is no preferential evaporation of its more volatile components. The performance of these microcapsules is compared to microcapsules made from gelatin and gum arabic.

2. Experimental

Perfume was microencapsulated using the technique of complex coacervation with gelatin and pectin as capsule wall forming materials. A 1-l automated laboratory reactor (*Contalab, Mettler-Toledo AG*) was used for the experiments. The process scheme is given by *Fig. 1*. First, 75 g of gelatin and 15 g of pectin were dissolved in 2500 g of H_2O at 50–55°. 460 g of perfume were added and dispersed by stirring. The stirring speed is adjusted to the desired microcapsule size. Then, 2.5 g of AcOH were added to form the complex coacervate, a sticky substance made from gelatin and pectin. The mixture was slowly cooled to 10°. During cooling, the complex coacervate stuck to the perfume droplets, thus form-

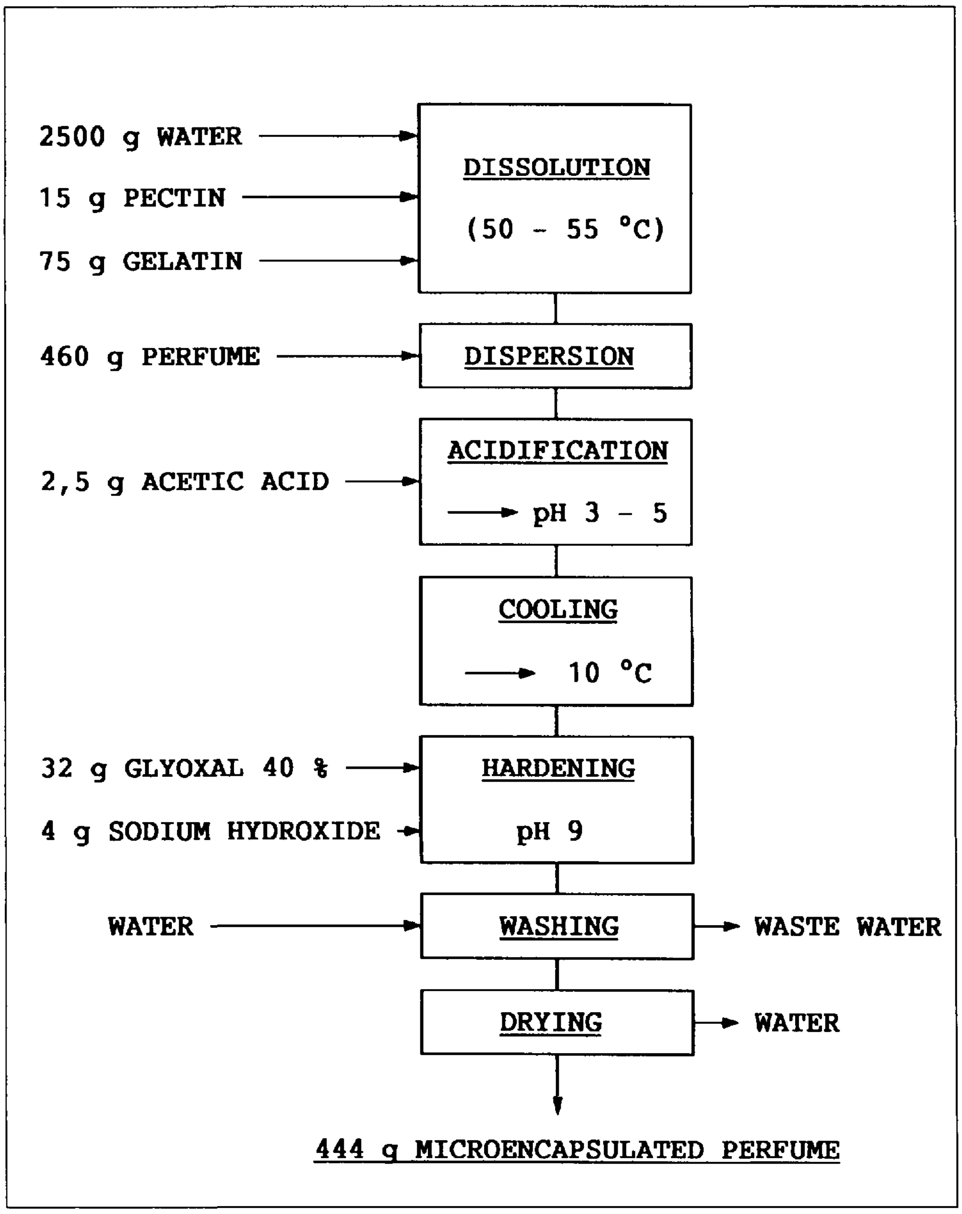

Fig. 1. *Process scheme*

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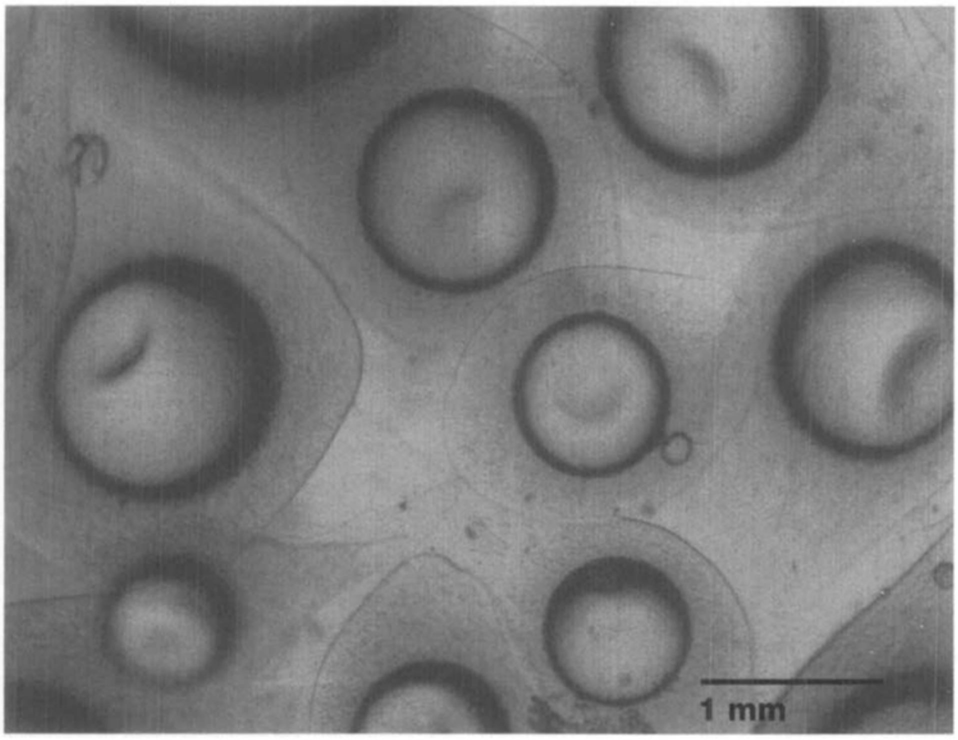

Fig. 2. *View of microcapsules*

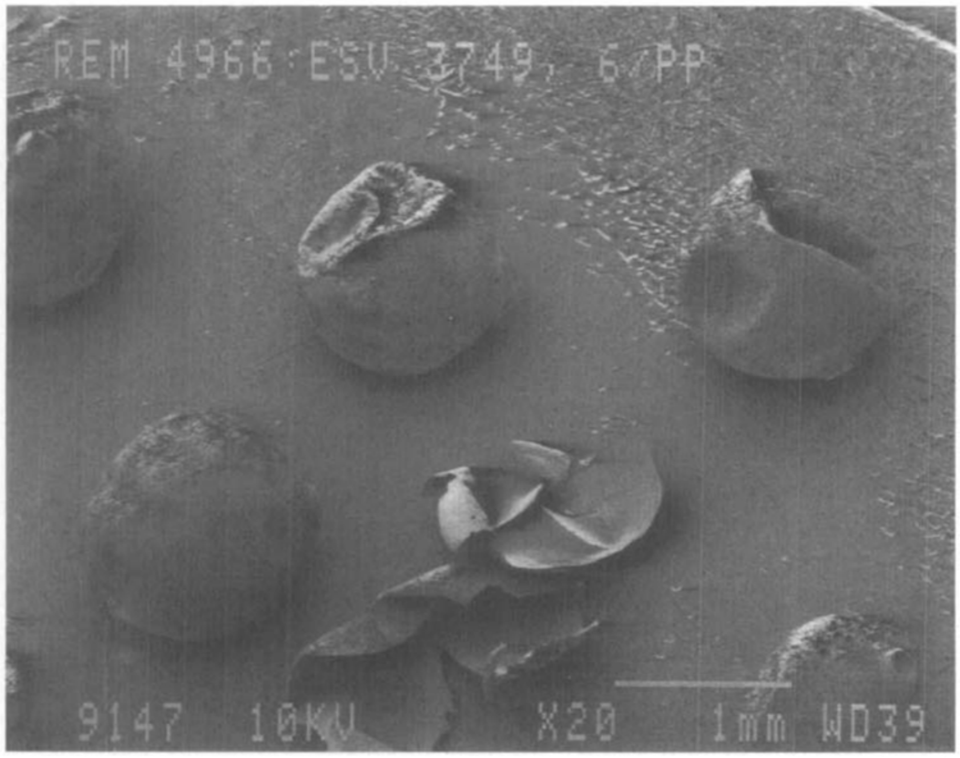

Fig. 3. *View of microcapsules taken by a scanning electron microscope*

ing microcapsules. The microcapsules were hardened with 32 g of 40% glyoxal under alkaline conditions. After washing and drying, the originally liquid perfume was obtained as free flowing granules. 460 g of perfume yielded 444 g of microcapsules having a size from 0.5 to 1.0 mm.

3. Results

Fig. 2 shows a view of the microcapsule suspension. A microscope from *Olympus*, model *BH-2*, was used to take the *Polaroid* picture. One can clearly distinguish the spherical perfume droplets and the lemon-shaped capsule walls. The capsule walls contain a lot of water, and their thickness is comparable to the perfume droplet radius. During the drying stage, the water is removed from the capsule wall and the wall shrinks a lot. After drying the capsule size is determined by the size of the perfume droplet. *Fig. 3* gives a view of dried microcapsules taken by a scanning electron microscope (*Jeol-JSM 840*). One capsule was voluntarily injured (top, right), one broken (bottom, middle) to demonstrate the capsule character of the particles obtained.

Although such a thin shell is sufficient to change a liquid perfume to free flowing granules the wall is not completely impermeable and some perfume is lost over the years. Evaporation is faster at higher temperatures. At 60°, 5% of the encapsulated perfume was lost during one month. This compares favorably with microcapsule walls made from gelatin and gum arabic where the loss was 55% for one month at the same temperature.

4. Discussion

Complex coacervation is a suitable technique for encapsulating materials with small solubility in water. Even complex mixtures such as perfumes are easily encapsulated. The same wall materials known to be capable of forming a complex coacervate with gelatin may be used. Always, a liquid perfume is converted to a free flowing powder. However, as far as the performance of the microcapsules is concerned, the wall material has a big influence. For the same wall material-to-perfume weight ratio, much tighter microcapsules are obtained when gelatin is used in combination with pectin instead of gum arabic as was shown in this paper.

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