World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:12, No:10, 2018

The Influence of Mechanical and Physicochemical Characteristics of Perfume Microcapsules on Their Rupture Behaviour and How This Relates to Performance in Consumer Products

Authors : Andrew Gray, Zhibing Zhang

Abstract : The ability for consumer products to deliver a sustained perfume response can be a key driver for a variety of applications. Many compounds in perfume oils are highly volatile, meaning they readily evaporate once the product is applied, and the longevity of the scent is poor. Perfume capsules have been introduced as a means of abating this evaporation once the product has been delivered. The impermeable capsules are aimed to be stable within the formulation, and remain intact during delivery to the desired substrate, only rupturing to release the core perfume oil through application of mechanical force applied by the consumer. This opens up the possibility of obtaining an olfactive response hours, weeks or even months after delivery, depending on the nature of the desired application. Tailoring the properties of the polymeric capsules to better address the needs of the application is not a trivial challenge and currently design of capsules is largely done by trial and error. The aim of this work is to have more predictive methods for capsule design depending on the consumer application. This means refining formulations such that they rupture at the right time for the specific consumer application, not too early, not too late. Finding the right balance between these extremes is essential if a benefit is sought with respect to neat addition of perfume to formulations. It is important to understand the forces that influence capsule rupture, first, by quantifying the magnitude of these different forces, and then by assessing bulk rupture in real-world applications to understand how capsules actually respond. Samples were provided by an industrial partner and the mechanical properties of individual capsules within the samples were characterized via a micromanipulation technique, developed by Professor Zhang at the University of Birmingham. The capsules were synthesized such as to change one particular physicochemical property at a time, such as core: wall material ratio, and the average size of capsules. Analysis of shell thickness via Transmission Electron Microscopy, size distribution via the use of a Mastersizer, as well as a variety of other techniques confirmed that only one particular physicochemical property was altered for each sample. The mechanical analysis was subsequently undertaken, showing the effect that changing certain capsule properties had on the response under compression. It was, however, important to link this fundamental mechanical response to capsule performance in real-world applications. As such, the capsule samples were introduced to a formulation and exposed to full scale stresses. GC-MS headspace analysis of the perfume oil released from broken capsules enabled quantification of what the relative strengths of capsules truly means for product performance. Correlations have been found between the mechanical strength of capsule samples and performance in terms of perfume release in consumer applications. Having a better understanding of the key parameters that drive performance benefits the design of future formulations by offering better guidelines on the parameters that can be adjusted without worrying about the performance effects, and singles out those parameters that are essential in finding the sweet spot for capsule performance.

Keywords : consumer products, mechanical and physicochemical properties, perfume capsules, rupture behaviour
Conference Title : ICMEP 2018 : International Conference on Microcapsules and Engineered Particles
Conference Location : New York, United States
Conference Dates : October 08-09, 2018