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EDITORIAL

RHEOLOGY: A FEASIBLE TOOL TO ASSESS THE VISCOELASTIC BEHAVIOR OF NATURAL INGREDIENTS

LA REOLOGÍA: UNA HERRAMIENTA FACTIBLE PARA EVALUAR EL COMPORTAMIENTO VISCOELÁSTICO DE LOS INGREDIENTES NATURALES

Rheology studies the flow and deformation of materials. Thus, the knowledge of the rheological and mechanical properties is important for product design, production, quality control, and for predicting shelf storage stability. Rheology studies can assist scientists in formulating optimal products (1). Conventionally, a single-point viscosity tests are widely used, but they not adequate in characterizing the full rheological profile of these materials, and thus, it is better to generate the full viscosity curves to capture a wide range of material responses (2). There are several tests conducted to characterize a material. The first one implies plotting viscosity as a function of a stress ramp at constant temperature and within a specific time interval. Usually, at low stresses viscosity might remain constant, and then a critical stress point is reached were viscosity decreases abruptly. The magnitude of the resulting slope confirms the shear sensitivity of the material (3). Another highly used plot involves the viscosity versus shear rate. Usually, at low shear rates viscosity remains constant and then it decreases steadily. Further, from the stress ramp test the minimum shear stress required to initiate flow (Yield stress) is determined. The higher the yield value, the more readily a dispersion will maintain particles in suspension with minimal sedimentation. However, a low yield stress might be useful for a product to improve the sensorial properties such as the ease of spreading onto a surface forming a short-term thin layer (4).

On the other hand the dynamic oscillatory tests are even more powerful to reveal the microstructure of a viscoelastic material and provide information about its structure and elasticity. The main test involves the storage modulus (G') that measures the extent of the elastic component (caused by aggregation, crosslinking, entanglement, etc) of the system, and measurement of the loss modulus (G''), which is proportional to the extent of the viscous component of the system. The ratio of these two values corresponds to the damping factor $\tan \delta = G''/G'$. Thus, phase transitions due to cross-linking, curing or crystallization could also be detected by measuring both modules against time or temperature (5). Moreover, the strain sweep is conducted by plotting a strain as a function of the modules (G' and G") and the maximum strain at which G' remains constant is called the critical strain and indicates the minimum energy needed to disrupt the polymer structure (6). Further, from the plot of G' versus stress the dynamic yield stress and the film formation of material applied onto a surface is assessed. Another test involves a frequency sweep made by plotting frequency versus G' at an amplitude lower than the maximum critical limit. The frequency dependence of G' is related to temperature, particle size distribution, and concentration of the material (7). Thus, a minimum variation in G' results in a larger susceptibility towards frequency. Further, in a temperature ramp experiment a less elastic product will exhibit a lower phase angle requiring more force to be applied onto the skin but stay softer (2).

The rheological characterization of natural ingredients provides essential information for scientists to improve and optimize their products and manufacturing processes. Nowadays, most researchers are relying on the rheological measurements to develop competitive customized products in the marketplace.

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