

DYNAMIC INDENTOMETRIC ANALYSIS OF HAIR ASSEMBLIES

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Dynamic mechanical analysis is frequently employed to study polymeric materials. It is a convenient method to determine elastic and viscous properties of a tested sample in one experiment. The measurements of solid materials yield parameters such as storage and loss modulae, which are related to elastic deformation and viscous energy dissipation, respectively. Similar principles are used in dynamic rheological measurements of liquids. The fundamental properties of interest in this case are shear modulus and viscosity. Dynamic rheological methods are widely used in cosmetic science to characterize cosmetic formulations, thickeners, surfactant solutions, etc. Dynamic mechanical analysis was also used for characterization of hair (rheovibron) and skin (gas-bearing electrodynamicometry). In the context of hair research, published dynamic studies were limited to longitudinal deformations and the determination of dynamic Young's modulae. There has also been a study of wet hair subjected to bending deformation in water at various pH [1].

In this work we have employed dynamic mechanical analysis to study the behavior of random or organized assemblies of various types of hair such as Caucasian, Chinese, and African. Hair fibers in such systems can assume various positions and orientations, and can shift versus each other during deformation. This contributes to energy dissipation and increases the values of loss modulae. Fiber arrangements were prepared by setting wet hair to impart curling characterized by different geometrical dimensions. Straight-hair assemblies with controlled distribution of orientations as well as fiber assemblies in the form of omega-loops were also investigated. Dynamic mode of operation of a Texture Analyzer (Texture Technologies Corp.) was employed with the deformations ranging from 0.01 mm to 1 mm and frequencies from 1 Hz to 100 Hz. FFT Image Analysis was used to quantify the shape and orientation of fibers.

[1] – J.Jachowicz, Methodologies for evaluating hair-care products, *Cosmetics& Toiletries*, 113 (6), 45 (1998).