Introduction

The history of claim substantiation has been an edifying example of an on-going interaction process between consumers, marketing and laboratory personnel in which various aspects of cosmetic attributes of a tissue have been characterized and then defined in terms of properties quantifiable by instrumental measurements. The ability to adapt some of the well established textile methodology has been of a great help in setting the claim support for hair on sound technical basis. One should be reminded, however, that the growing reliance on instrumental methods in no way diminishes the importance of sensory evaluation carried out on live heads in beauty salons or among the consumer panelists. Indeed, such tests have been and remain the cornerstone of the product development process for every hair care product. The discussion of the interplay between the sensory perception, psychophysics and instrumental measurement is, however, beyond the scope of this chapter and the reader is referred to an excellent reviews of this subject by Moskowitz [1] and Bush [2].

The great diversity of hair care products combined with the competitive market pressure to extol products performance in ever changing manner require a variety of tests and approaches to meet such a challenge. In this respect of considerable help have been recent advances in our understanding of the hair structure as well as an explosive growth of analytical techniques in the field of physics and chemistry. Yet, translating sensory perception and cosmetic attributes into a scientifically measured quantities remains demanding task. Occasionally the resolution is straightforward – claims for hair strengths or shine can be relatively simply derived from the tensile properties of hair and its surface reflectance, respectively. On the other hand, the attribute of hair conditioning is much more complex, encompassing hair softness, ease of combing, fly-away, etc. In this case an array of techniques involving both single fiber properties and those of fiber assemblies (hair tresses) are needed to obtain necessary support.

The purpose of this chapter is to provide a concise survey of physico-chemical techniques that are relevant to claim substantiation for hair care products. Much more detailed information on this subject can be found in recent publications by Ishi [3] and Stern et al. [4].
Single Fiber and/or Material Specific Techniques

Physical Properties

Tensile Properties

Ever since Speakman [5] provided the first comprehensive interpretation of the stress-strain behavior of keratin fibers, the measurements of tensile properties have been at the forefront of hair evaluation techniques. The simplicity of the measurement combined with the wealth of information it conveys, contributed greatly to its utilization and success. The load-extension curve (Fig. 1) displays three distinctly different regions; the initial, nearly linear, Hookean region (AB) is followed by the yield region (BC) where the fiber extends with relatively small increase in stress. As extension approaches 30% the fiber stiffens again signalling the onset of the post-yield region which continues until the fiber breaks.

Each of these regions reflects the different character of structural bonding within the fiber which can aid in monitoring the product-induced changes. The stiffness of the Hookean region is attributed to the elastic stability of hydrogen-bonded α-helices which, beyond the yield point, unfold reversibly into extended β configuration. The covalent disulfide cross-links appear, on the other hand, to be controlling factor in the bond network that opposes extension in the post-yield region.

Speakman's [5] observation that the keratin fibers which are extended no further than the yield region have the ability to recover fully their properties when relaxed in water proved of exceptional value in assessing simply and accurately the changes in fiber properties associated with chemical or physical treatment of hair. His technique involves determination of work required to stretch the hair 30% (calibration step) followed by overnight relaxation in water, subjecting the fiber to intended treatment and re-stretching. The change in work (RW30) expressed as the percentage of the calibrated value provides information of changes imparted by the treatment. As each hair is its own control, few tests suffice to generate reliable results and there is no need to account for variation in fiber diameter. This method has been extensively employed [6-9] as a test for hair damage in waving, bleaching, or coloring. By adjusting the pH of the testing solution, insight can be gained as to the coulombic (electrostatic) interaction in hair; testing in solvents other than water yields information on the accessibili-

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