New Apps For Texture Analysis

By: Chris Freeman - Published: September 6 2011

Texture analysis is an established technique that originated in the 1950s, when manufacturers in the food industry began to require a more objective assessment of the textural (or rheological) properties of a product, such as hardness, elasticity, burst strength, and adhesiveness. The standard texture analyzer utilizes a customshaped probe to make contact with the food item at a defined speed. (See Figure 1.) The resistance to the resulting deformation is measured as a force load in grams versus time and distance of penetration. (See Figures 2a and 2b.) Texture analysis facilitates consistency in production of food products, optimizes this textural attribute, and quantifies consumer perception of a product in terms of properties such as springiness, chewiness, and cohesiveness.

Figure 1. Brookfield CT3 texture analyzer.

Advancements in the science of texture analysis have made possible the development of precise and highly accurate multifunctional and robust instruments that have revolutionized both R&D and quality control, not only in the food industry but also across a wide range of other industries. With consumers better informed, there are now expectations that all industries will produce products that deliver better health and greater economic value. Verifying a product's quality, efficacy, and appeal to gain approval in the market requires a significant investment of manufacturers' time and money in R&D and quality control. With the need for objective, reliable, and cost-effective equipment, texture analysis is becoming the instrument of choice in the pharmaceutical and cosmetics industries to maintain quality standards and provide useful analytical data on multiple products. With a large number of techniques and fixtures available to assess physical properties of materials, texture analysis has emerged not only in the pharmaceutical industry, but also in personal care products, medical devices, and packaging.

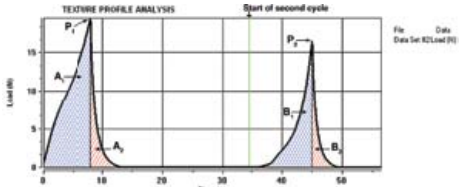

Figure 2a. Texture profile analysis graph measures force vs. time.

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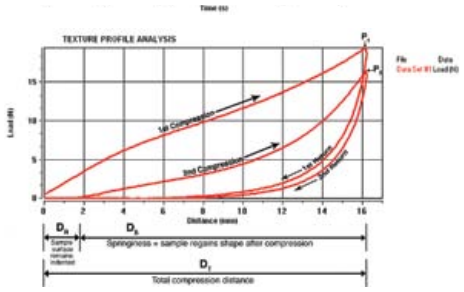

Figure 2b. Texture profile analysis graph measures force vs. distance.

The following examples illustrate how the pharmaceutical and cosmetics industries are embracing texture analysis to improve product quality.

Pharmaceutical applications

Tablet diametric compression

Tablets are the most widely used dosage forms due to manufacturer is to formulate a product strong enough to undergo subsequent processing (when spun in a hopper) and capable of breaking down in the body to deliver the required dose at a controlled rate. Another challenge is to have a tablet strong enough to withstand the stresses of packaging, storage, shipping, and handling by the pharmacist and patient. Assessing the quality of the product throughout processing and distribution is therefore necessary. With the texture analyzer, the force required to cause tablet failure can be determined using a diametric crushing test, the results of which are repeatable for a given tablet type.

Tablet coating

Tablet coating serves to protect the tablet from moisture, improve taste, facilitate swallowing, control release, and ease handling and packaging. The adhesion of a coating to a tablet is influenced by the strength of interfacial bonds between film and tablet surface and the internal stresses within the coating. Poor adhesion results in peeling, markedly reducing film functionality. Loss of adhesion can also compromise the coating's mechanical protection, leading to the accumulation of moisture at the film-tablet interface that can have profound effects on the stability of moisture-labile drugs. Other variables influencing adhesion are tablet composition, tablet compression force, surface roughness, coating formulation, and coating conditions. Performing tests to quantify the adhesive strength of the coating to the tablet surface is necessary in the manufacturing process in order to monitor changes in coating formulations and tablet integrity. The texture analyzer can be used to successfully quantify the coating's adhesion strength at the tablet surface.

Tablet Costing Adhesion Fixture quantifies the adhesive properties of aqueous film coatings, such as enteroroinsoluble or sustained release film, to a tablet surface.

Bilayer tablets

Bilayer tablets contain two or more active pharmaceutical ingredients in a single dosage form, promoting patient convenience, compliance, and marketing. However, production of such tablets has faced great difficulties because the tablets are prone to fracture along the material interface of the adjacent layers (delamination) during compaction, owing to their inherent binding weaknesses. Understanding the mechanical strength of these tablets is commercially significant, since tablet failure as a result of weak mechanical strength can be very costly to the industry. Using a texture analyzer, the probability of tablet failure as a function of layer properties can be determined. The guillotine-like blade exerts a force on the tablet until the two component layers are sheared apart. The force is regarded as a measure of adhesion strength. The lower the force their convenience in administration, compactness, and ease of manufacturing. However, one challenge for the to shear the adjacent compacted layers, the more likely the tablet will fail in the manufacturing process or during packaging, shipping, and consumption.

Blister pack compression

The increasing use of blister packs for unit-dose packaging of tablets, capsules, and lozenges in the pharmaceutical industry has demanded high-quality packaging. Blister packs should provide some degree of tamper resistance, thereby avoiding accidental opening during transportation or by children, but still be easily opened by weaker patients

and the elderly. A quality blister pack should be consistent in the force required to extract the tablet. The degree of stiffness of a blister pack determines its effectiveness. Measuring the required force to push the tablet through a blister pack is therefore necessary. The texture analyzer utilizes a hemispherical probe that simulates the force applied by the fingers to extract a tablet from a blister pack.

Blister Pack Support accessory imitates the action of a human finger pressing on blister packs to ensure product integrity when extracted from packaging.

Metered dose inhalers (MDIs)

MDIs come in the form of nasal or oral inhalers and are much appreciated by patients who depend on them for their treatment. They are designed to deliver precise, accurate, and reproducible doses of the drug to the lungs or nose. Two crucial components of the MDI are the metering valve and the formulation. A change in formulation, such as a new propellant, will ultimately necessitate the redesign of the valve system for successful drug delivery. The texture analyzer, using a hemispherical probe, can simulate the downward movement of a finger exerting force on the metering valve in order to assess its performance.

Cosmetic applications

Eye pencils

The hardness of an eye pencil tip is very important. Its texture should be such that upon application, it glides along effortlessly, enabling ultimate control and flexibility. It is the consistency and soft texture of the product that will influence its performance. For instance, a tip that is quite dry may cause discomfort to the user during application by pulling or tugging at delicate eye tissue. Using an eye pencil fixture, the texture analyzer can quantify the hardness of the eye pencil tip.

Eye Pencil Fixtures simulates the human force required to apply cosmetic eye pencil as well as the break strength needed to withstand normal applications and packaging/transportation hazards.

Lipstick

Users of lipstick generally prefer a product that does not bend, crumble, crack, or break during application. Because of this, base ingredients are of paramount importance in formulating a product with resilience and physical strength capable of withstanding firm lipstick application by the user. The texture analyzer uses an imitative test with a hemispherical-edged probe that simulates the bending action caused during application to measure product firmness.

The texture analyzer can also be used to objectively measure the quality and properties of the major components in the lipstick formulation, such as wax and oils. The quality and composition of the wax will determine the quality of the final product. The test can also be used to monitor change in the hardness of the lipstick over a range of temperatures to which the product may be subjected during transportation and storage.

Toothpastes

Toothpastes that meet consumer expectations will have no lumps, graininess, or air bubbles. These qualities are

influenced by the selection of raw materials, manufacturing procedure, and quality control. Toothpastes should have a good thickness (viscosity) and a low thixotropy so that when they are squeezed out of a tube, a clean break-off is achieved when the desired amount has been extruded. The toothpaste should also be firm enough so that it stands up well on the brush and does not sink in between the bristles.

The texture analyzer can perform an imitative test for the ease of extrusion of toothpaste to evaluate the effects of product formulation or extrusion temperature.

Toothpaste Extrusion Fixture simulates the human force required to test squeezing material out of a tube that comes from the toothpaste industry.

Facial powder

The most popular form of facial powder today is the compressed tablet form. The texture, shade, and perfume are the three key characteristics that are most important to a manufacturer, and certainly the most obvious features to a customer.

The texture of the facial powder needs to be consistent from purchase to purchase. The selection of ingredients and their respective quantities is therefore important and will affect powder hardness and the ease with which the powder packs together (caking). The texture analyzer can measure the hardness or “cake strength” of the compressed powder using a cylindrical probe attached to the instrument.

Conclusion

Texture analysis is a cost-effective, objective, and highly accurate technique providing fast evaluation of results that are reproducible. It provides a scientific means of quantifying products’ physical properties that can be correlated to sensory perception.

With a large number of techniques and fixtures available to assess physical properties of a variety of products, texture analysis can be applied to other pharmaceutical and cosmetic materials such as gelatin, hydrocolloids, gel capsules, suppositories, transdermal delivery patches, pharmaceutical release films, sachets, alginate rafts, mucoadhesion tablets, and syringes. In the cosmetics industry, texture analysis can be applied to products such as shampoo, hair gel, moisturizing creams, and petroleum jelly, among others.

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