

When I was in the sixth grade, one of the most valuable status symbols a person could possess was a Hypercolor shirt. The t-shirts were nothing special in terms of cut or style and, in retrospect, they were quite unattractive. But what made them so alluring and coveted was their thermochromism—the ability to shift color depending on the temperature—which provided endless entertainment for easily impressed 11-year-olds. Along with sprayed bangs and stirrup pants, these were must-have items.

Today, thermochromic inks and dyes go beyond influencing the social lives of pre-teen girls through questionable fashion choices. [Advanced color-changing materials](#) are quickly becoming an integral part of intelligent packaging designs that not only enhance marketability, but improve consumer experiences and offer ingenious health and safety safeguards. The development of packaging with thermochromic elements relies on accurate, objective color measurement to unlock the potential of these innovative materials.

Enhancing Marketability of Foods and Beverages

Thermochromic packaging has made significant inroads within the food and beverage industry. Several years ago, Coors Light launched an ambitious marketing campaign centered around cold-activated packaging that turned the mountains on the label from white to blue when the beer reached optimal drinking temperature.¹

The wild success of the packaging led Coors to expand its range of thermochromic packaging and competitors soon followed suit. Likewise, manufacturers of non-alcoholic beverages such as Coca-Cola and Fanta soon utilized the novelty packaging. Refrigerated items aren't the only products getting the thermochromic treatment; microwavable food manufacturers are increasingly emblazoning their packages with heat-reactive graphics to indicate when the food has reached optimal temperature and takeaway cup companies are producing temperature-sensitive lids to let consumers know how hot their coffee is.

Improving Safety Through Thermochromism

But color-changing packaging isn't just an effective marketing gimmick—thermochromism can be used to monitor temperatures to enhance product safety and preserve consumer health. Temperature often has a significant impact on food quality and contamination vulnerability, making thermochromic package implementation a logical step to indicate freshness and alert customers to compromised products. Irreversible thermochromic packaging can also be used for a broad range of pharmaceutical safety checks, including warm chain and cold chain verification of temperature-sensitive medications to “ensure that products have remained [above or] below the desired temperature threshold at all times during their transit from factory to patient.”² Color-changing dyes are increasingly being [employed as an anti-counterfeiting measure](#), allowing clinicians, pharmacists, and consumers to verify drug authenticity by touching the packaging, their body heat creating a thermochromic reaction. To further enhance safety, both “overtly and covertly designed” thermochromic packaging or labels can be used to produce color changes or reveal hidden messages in the presence of tampering.³

Sources of Change

Thermochromic inks and dyes are formulated using either thermochromatic liquid crystals (TLCs) or leuco dyes. TLCs offer more precise temperature readings, but can be finicky to work with due to their physical qualities, water-based composition, and more strict presentation requirements.⁴ When exact temperature monitoring is not required, manufacturers often turn to the more durable and versatile chemistry of leuco dyes. These dyes may be layered with standard dyes to reveal hidden messages at particular temperatures. Your choice of dye will be determined by functionality and physical properties of your packaging.

Spectrophotometric Precision in Color Measurement

The dynamic nature of thermochromic packaging presents special challenges to their development and production. The advanced color measurement capabilities of spectrophotometers facilitate the creation of these materials to optimize aesthetic impact, functionality, and the creation of meaningful consumer use instructions. Analysis of chromatic changes in response to various temperatures allows you to tailor your

formulation to meet your specifications. Spectrophotometric software gives you the ability to store historical process data to help refine your methodology. Quantifying the relationship between color and temperature is particularly important when thermochromic packaging is designed for critical temperature monitoring and requires the establishment of a predictable, direct color-temperature correlation. Once a formula has been perfected, spectrophotometers can be employed to monitor ongoing production to ensure accuracy and consistency throughout the manufacturing process.

Full article with photos available here:

<https://www.hunterlab.com/blog/color-measurement-2/utilizing-spectrophotometry-to-help-expand-thermochromic-features-beyond-novelty-products/>