Colour communication & control

There are few things as hard to test as the colour of cosmetics – and probably fewer as personal to the end user. Lucie Matuskova explains how colour determination using modern instrumental methods is key to improving quality control and workflow in just about every step of the product life cycle

While components of a car or appliance all have to match seamlessly, women generally give cosmetics an even more critical eye when it comes to how well a nail varnish or lipstick matches their clothing and accessories. After all, one goal of cosmetics is to attract attention, so long as it is positive.

On top of that, women are exceptionally keen at discriminating between colours. Studies show that nearly one in every 12males has some form of colour vision defect, but only one in every 255 females has deficient colour vision. Cosmetic manufacturers face additional challenges, in addition to serving demanding customers. Many cosmetics now contain micronised minerals such as mica and titanium dioxide that are particularly hard to match with colour standards due to the way they disperse light. And many cosmetics in liquid or paste form are sophisticated recipes that must not directly touch the viewing ports of colour measuring devices or they will foul the sensitive instruments for the next reading.

But just as demands on manufacturers have grown, so have the number of tools they can use to ensure that their cosmetics are consistent from production batch to batch, as well as harmonising perfectly colour-wise with new lines of clothing and accessories.

Cosmetic manufacturers are employing new methods to improve quality and workflow in just about every step of the product life cycle, from inspiration to quality control of formulations. Colours of cosmetics can be forecast months or years in advance thanks to new colour communication standards and systems used worldwide. For instance, Pantone LLC publishes its Pantone View Colour Planner based on the Pantone Fashion + Home Color System that predicts as far as two years in advance what colours will be popular for men's and women's apparel, cosmetics and beauty, and other industries. Pantone started out as a manufacturer of cosmetic colour cards before it began to branch out as a colour matching system to other industries in 1962, and the company was purchased in 2007 by X-Rite Inc, the world's largest designer and manufacturer of workflow solutions for measurement and communication of colour.

After designers have decided on the colour of a new cosmetic product, laboratory technicians and production personnel need to identify the colour and make sure it can be communicated properly throughout the supply chain. To accomplish this, technicians and production personnel need three elements to determine colour: a person or instrument, an object or sample, and a source of light.

PEOPLE & INSTRUMENTS

Addressing the first element, Schwan-Stabilo Cosmetics GmbH & Co, the Weissenburg, Germany-based manufacturer of cosmetic pencils, uses the Farnsworth-Munsell 100-Hue Test to help make sure individuals who are responsible for quality control can distinguish between colours adequately for their jobs.

Used for more than 60 years to distinguish between individuals who have poor, normal or exceptional colour vision, the FM 100-Hue Test helps Schwan-Stabilo produce accurate and consistent colours for over 10,000 shades and over 200 textures that cover every possible cosmetic use. Incidentally, the FM 100 Hue test is also used to detect medical conditions such as ocular disease, diabetes and Parkinson's disease.

When it comes to instruments, cosmetic manufacturers now have a number of affordable and sophisticated devices that take the guesswork out of colour matching - even in hard-to-measure situations such as the colour of iridescent eyeshadows and nondrying, oil-based products like foundations and lip glosses.

The cost of purchasing accurate spectrophotometers and computer systems for colour measurement has plummeted over the past few years. The result: relatively inexpensive, quick and easy ways to accurately measure hues of subtle colours, shimmer and sparkle of 21st century cosmetics.

Some companies in the cosmetic industry now use relatively elaborate tests to measure colours of foundations, lip glosses and other non-drying products. Because the tests are simple, these companies use them frequently to catch non-specification batches early in the production process.

Over the past five years, Joko Cosmetics E.i G.Kosyl s.j has been using an X-Rite SP62 portable sphere spectrophotometer to maintain good manufacturing practices in its production process, according to the company's research and development manager Piotr Borsukiewicz. Based in Wolomin, Poland, Joko Cosmetics has been manufacturing a wide range of pressed powder products, eyeshadows, nail varnishes, lipstick and mascara for over 20 years.

One of the three basic types of spectrophotometers, the SP62 measures colour and gloss through the use of a hollow sphere made of highly reflective material designed to perform in a rigorous production environment.
Borrowing from industries such as automotive and paint manufacturing, cosmetic companies also regularly use 0/45° spectrophotometers that 'see' colour like the human eye because they replicate how a person tries to exclude the specular component (gloss) when judging colour. But a number of styles of these instruments have to touch test surfaces to take their readings, which can cause measurement errors.

OBJECTS & SAMPLES

Cosmetics manufacturers that need to precisely determine the colours of wet, powdered and paste samples should consider measuring those products from a distance. That technique more closely represents the way the human eye perceives colour and ultimately how the consumer will view the finished product when it is demonstrated by sales associates in stores or used by a consumer.
Tests currently performed by many cosmetics manufacturers don't accurately replicate what the eye sees because samples are placed on cuvettes or slides for measurements. When a transparent barrier is inserted between the sample and instrument, it immediately imparts errors such as depth of field issues and ambient light piped in from the surroundings.
To eliminate those errors, the VS450 non-contact spectrophotometers were developed to take precise colour measurements from a distance of approximately 38mm. The VS450 can accurately measure the colour of nondrying, oil-based products including foundations and lip glosses – products that would normally foul the port of a conventional benchtop spectrophotometer.
Cosmetic companies also need to address how they measure the latest shimmery foundations or sparkling eyeshadows that are so popular with consumers – formulations that can confuse lab technicians and 0/45° spectrophotometers. Quality control personnel on a cosmetic production line may observe that two batches don't match properly, but some spectrophotometers may not give readings to help explain why the mismatch was occurring. Consequently companies can spend an inordinate amount of time and resources trying to determine the root cause of problems through trial and error methods.
To address that problem, a family of MA94, MA96 and MA98 multi-angle spectrophotometers to measure colours at various angles at the same time were developed. A typical multi-angle spectrophotometer may measure light at aspecular angles at 25°, 45°, 75° and/or 110°, with a 15° angle used as necessary. An aspecular angle is defined as the difference angle to the direction of the specular reflection of the incident beam.
European cosmetic manufacturers have begun to use the most sophisticated multiangle spectrophotometers such as the MA98 to measure the colours of their shimmery products because the instruments provide the most complete and accurate data.
Better data analysed properly with advanced software can yield some powerful results for cosmetic manufacturers. For instance, the X-Color QC makes it possible for companies to link objective numerical data (eg degree of hue, chroma and saturation of a particular cosmetic sample) with shop floor variables during the manufacturing process, such as recipe of a particular formula, temperature or mixing time.

LIGHT SOURCES

Finally, cosmetic companies need to manage the third element of good colour measurement: the source of light. When measuring colour, it is critical to consider the source of light due to metamerism, an optical phenomenon where colours appear different when viewed under various illuminants. Two colour samples may appear identical when viewed under incandescent illumination, but appear very different under daylight. In general terms, customers choose a standard illuminant that best represents the source that will light their products where they are sold.
In 1931, an international organization standardised colour order systems by specifying the light source, the observer and the methodology used to derive values for describing colour.
The Commission Internationale de l'Eclariage (CIE), an international organisation that standardised methods for describing colour, has defined some standard illuminants as:

- **A** – incandescent illumination, yellow orange in colour
- **C** – tungsten illumination that simulates average daylight, bluish in colour
- **D** – daylight
- **D65** – the most commonly used daylight illuminant
- **F2** – cool white variety of fluorescent bulbs
- **F11** – represents a narrow band white fluorescent source

Cosmetic companies can evaluate how the colours of their products appear under different light sources through the use of light booths, enclosures that provide extremely accurate simulations of natural light, incandescent, and even invisible ultraviolet light. Macbeth Lighting and other companies manufacture light booths that provide a range of illuminations to view cosmetic samples against standards.

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