Fundamentals of Color and Appearance

Module 11

Fluorescence

Color Science Educational Series

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Fluorescence

Many substances—ranging from minerals and plants to fungi, microbes, and both organic and inorganic chemicals—can absorb ultraviolet radiation. When these materials absorb UV light, the energy excites electrons, pushing them into higher energy states. As the electrons relax back to their original levels, part of the absorbed energy is released as visible light. **This process is known as fluorescence.**

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In industries such as paper, plastics, textiles, detergents, and safety materials, **Fluorescent Whitening Agents** (FLAs) and **Optical Brightening Agents** (OBAs) are commonly used to enhance the apparent whiteness and brightness of products, especially under illumination that contains ultraviolet light.

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These agents work by incorporating fluorescent dyes that absorb ultraviolet (UV) light and re-emit it as visible light, increasing the material's apparent brightness.

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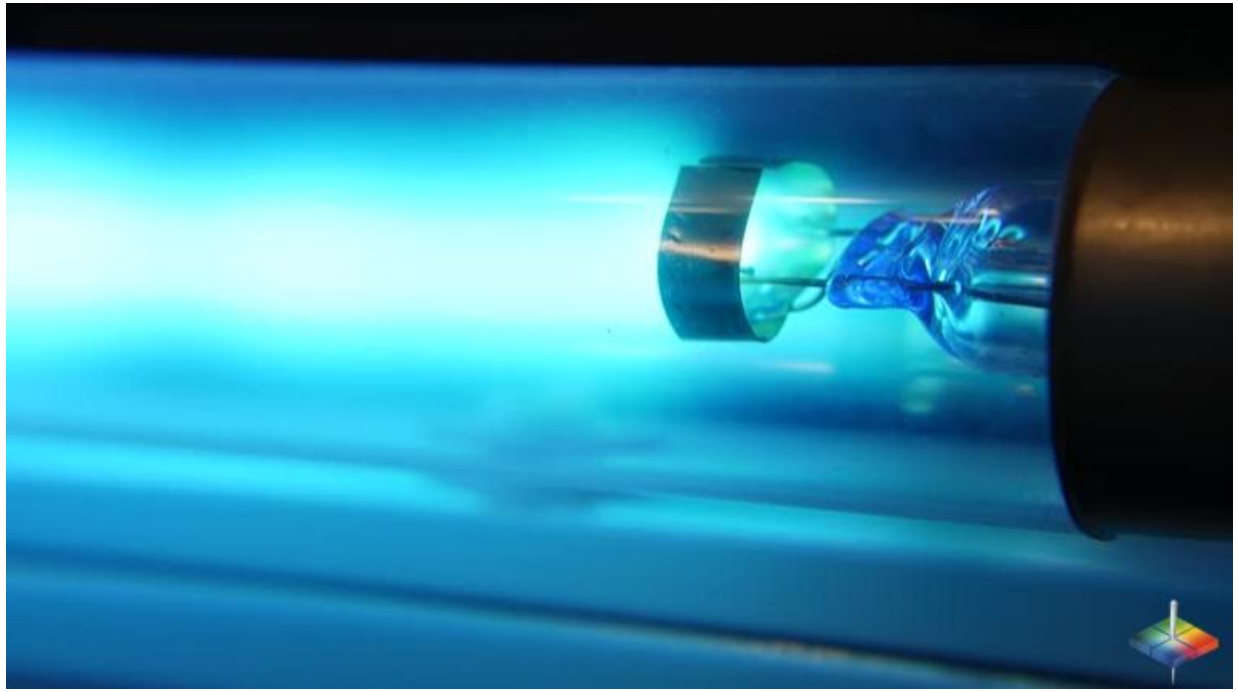
Because these agents respond to **ultraviolet light**, accurate measurement requires more than just visible-range instrumentation. It also requires controlled UV illumination that replicates the UV content present in natural daylight or in standardized daylight-simulating lamps.



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Let's consider a common example - plastics, where fluorescing agents are frequently used - and examine why accurate measurement is so important.

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Plastic resins serve as the raw materials and form the foundation for nearly all plastic products.

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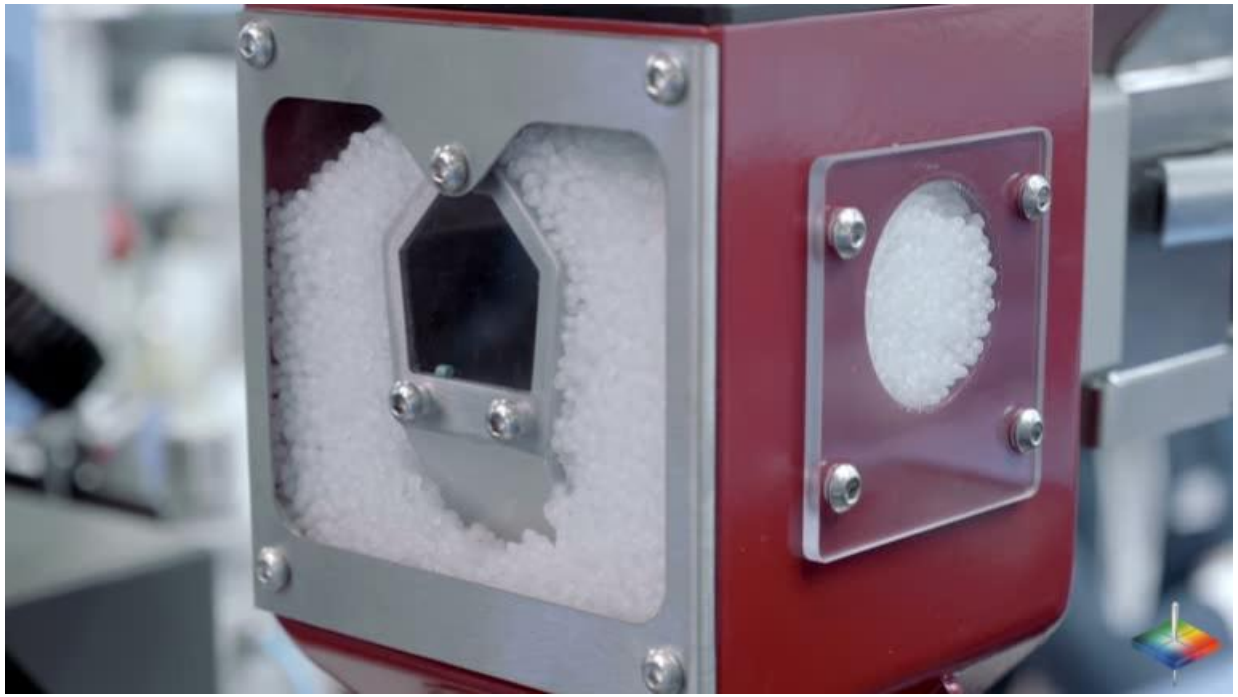
Virgin resins are carefully engineered with a variety of additives to deliver specific performance properties and desired optical characteristics.



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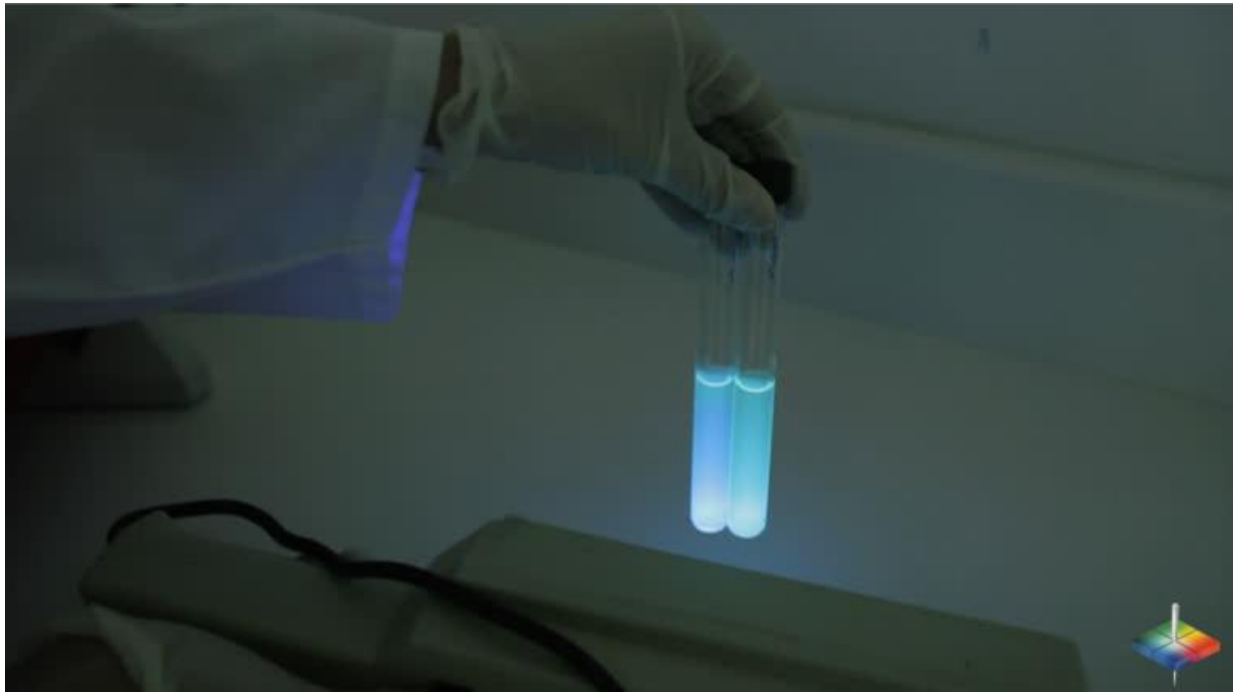
One notable additive is the **Optical Brightening Agent**.



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These agents are widely used in plastic resins to make finished products appear brighter, cleaner, and less yellow.

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Today's sustainability mandates require the use of **recycled plastic content** which often varies in materials and additive content, including optical brighteners and other fluorescing agents.

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Under lighting conditions with little or no UV—such as incandescent bulbs, factory floors, warehouses, or retail environments—resins containing optical brighteners can appear duller or even slightly yellow.

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However, under UV-rich illumination—such as natural daylight or standardized daylight-simulating lamps—the same sample appears cleaner, brighter, and noticeably less yellow.

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This cleaner, brighter appearance extends to any finished products made from the resin, such as clear beverage bottles.

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If a color measurement instrument does not include proper UV measurement capabilities, the resulting data will not accurately reflect the sample's real world visual appearance under different lighting conditions.

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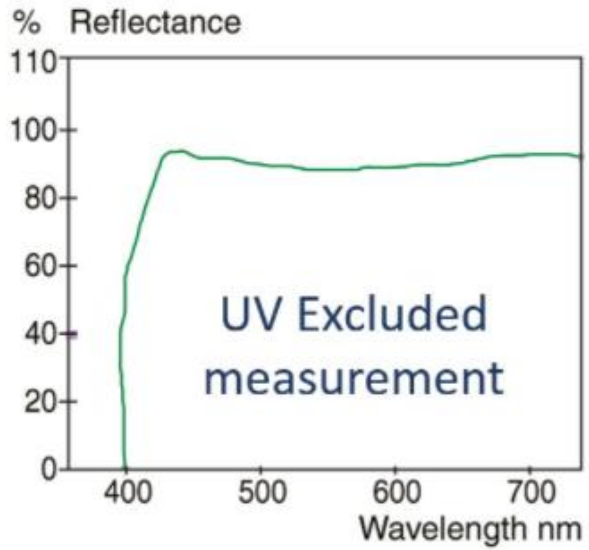
This graph shows the spectral reflectance curve, the green line, of optically brightened pellets measured in UV-excluded mode, where no UV light energy was present during measurement. Without UV activation, the brighteners do not fluoresce, leading to reduced reflectance in the blue region and a correspondingly more yellowish appearance.



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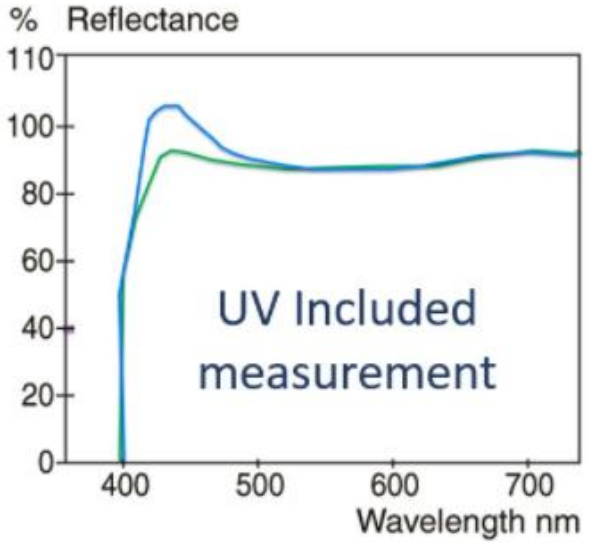
This graph shows the spectral reflectance curve, the blue line, of the same optically brightened pellets measured in UV-included mode. With UV activation, the effect of the optical brightener is evident as a pronounced "blue bump" in reflectance between 400 and 500 nanometers, corresponding to the emission of blue visible light.



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This spectral data directly correlates with the visual appearance of optically brightened resins when viewed under UV-included versus UV-excluded light sources.

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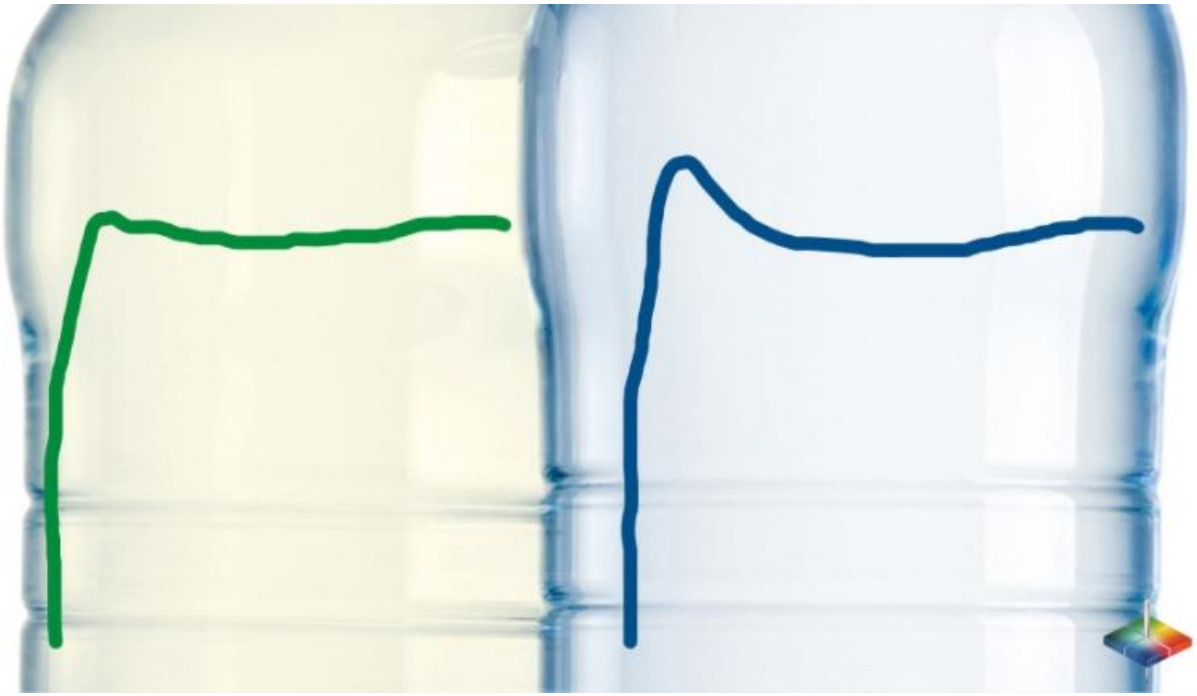
And extends to any final products made from this optically brightened resin, such as these water bottles.



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This underscores the critical importance of using UV-capable color measurement instruments when evaluating products that contain optical brighteners or other fluorescing agents.

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The world's true measure of color

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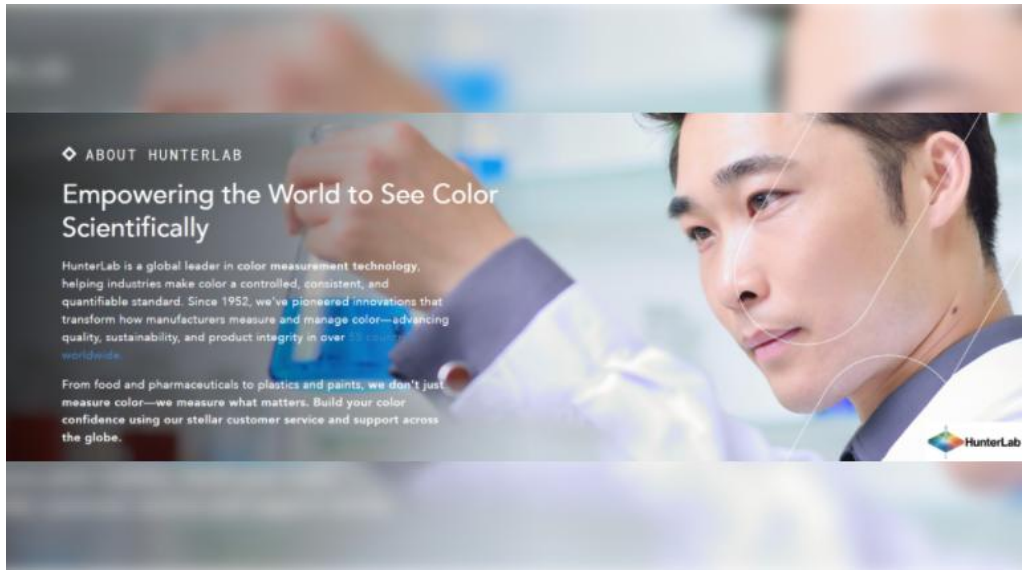
This concludes the first 11 modules of this Fundamentals of Color and Appearance educational series.

Thank you for joining us on this journey through the science of color. From the very first step in the production process, HunterLab is proud to deliver precision color measurement solutions that ensure quality, consistency, and confidence.

Be sure to visit **hunterlab.com** to learn more about how our solutions can help you achieve color confidence, every time, or to schedule a consultation with one of our color experts.



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